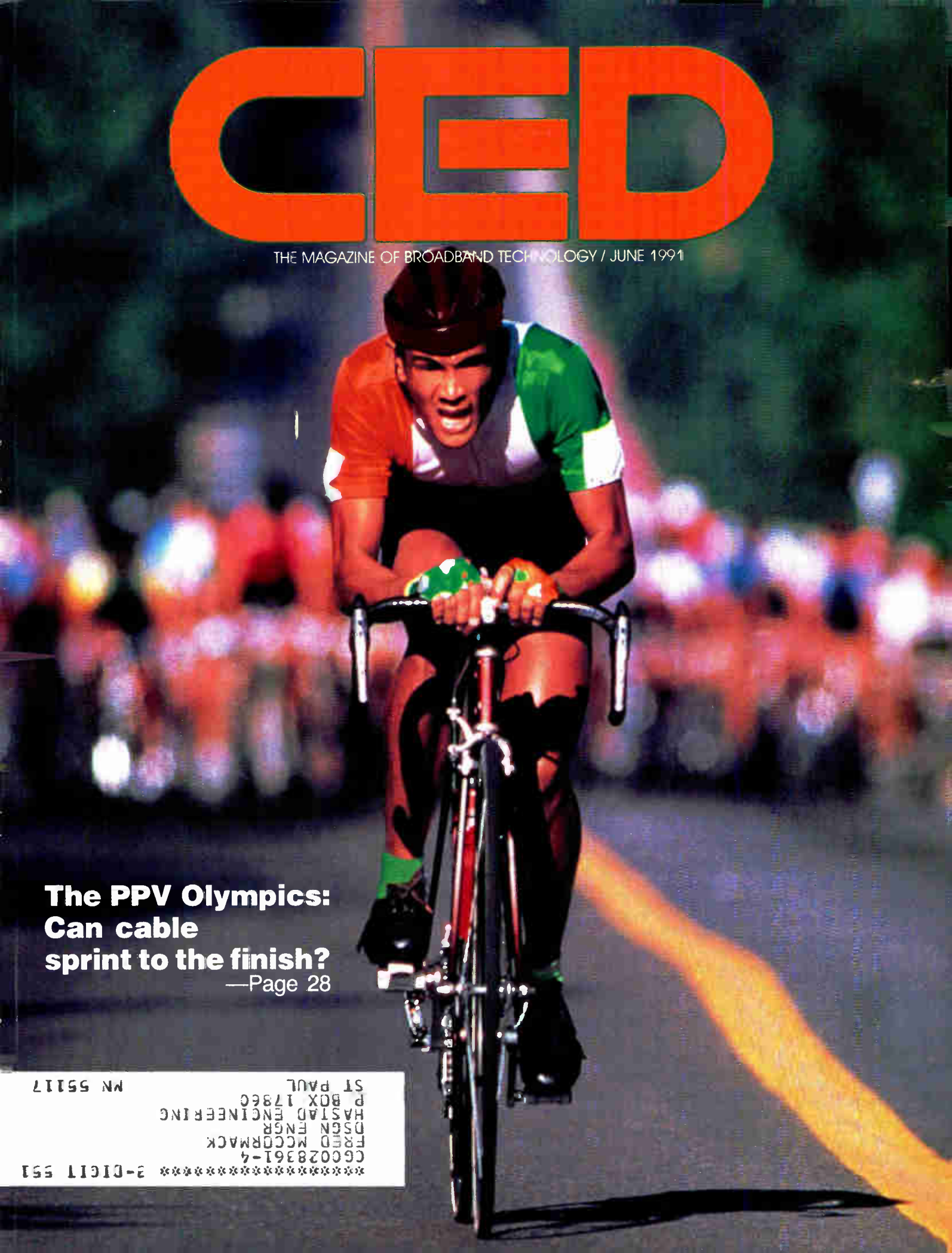
# CED

THE MAGAZINE OF BROADBAND TECHNOLOGY / JUNE 1991



**The PPV Olympics: Can cable sprint to the finish?**
—Page 28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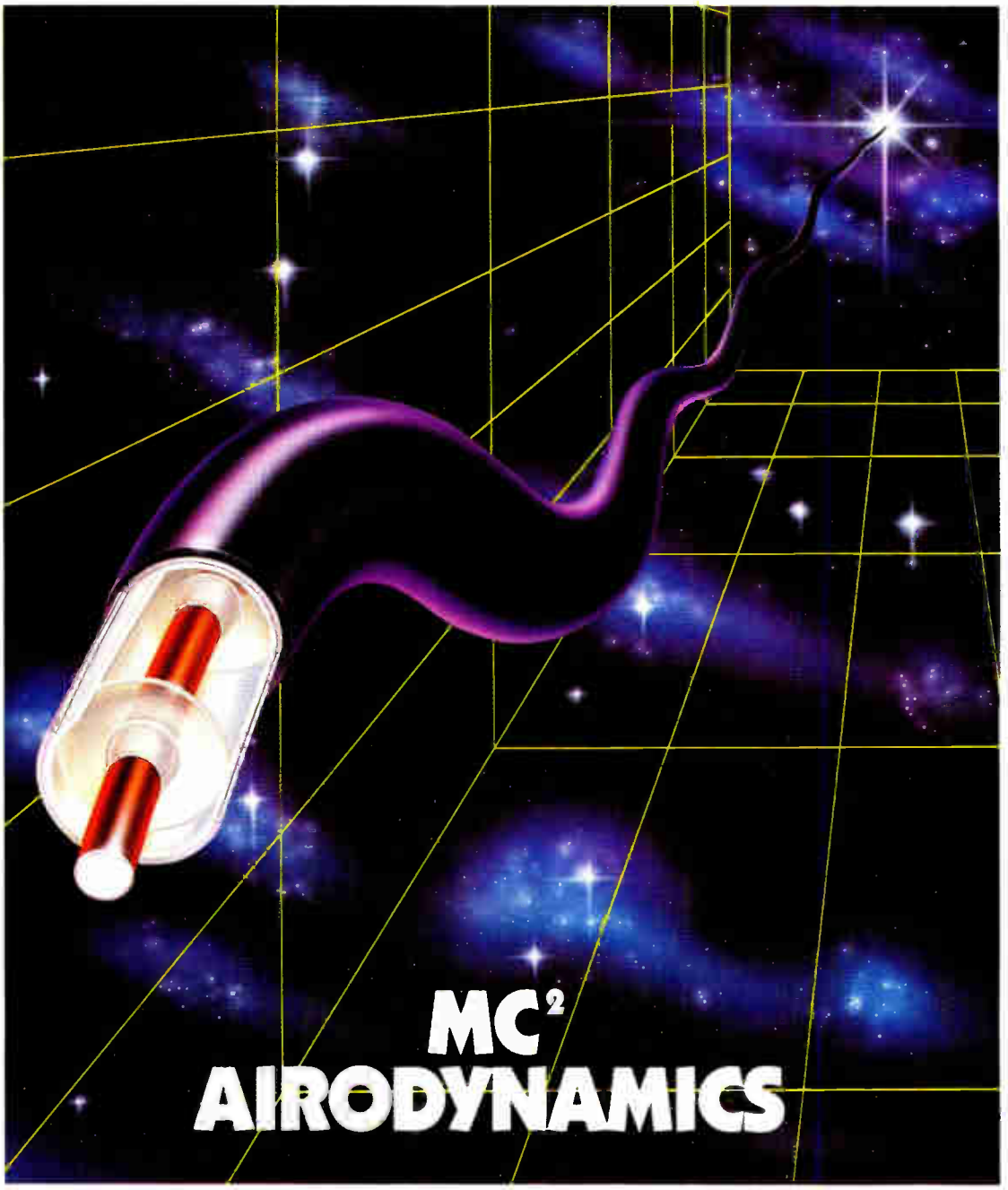


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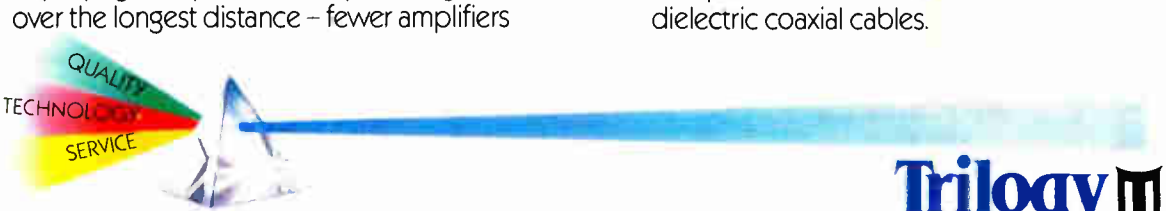


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June 1991 CED Volume 17, Number 7




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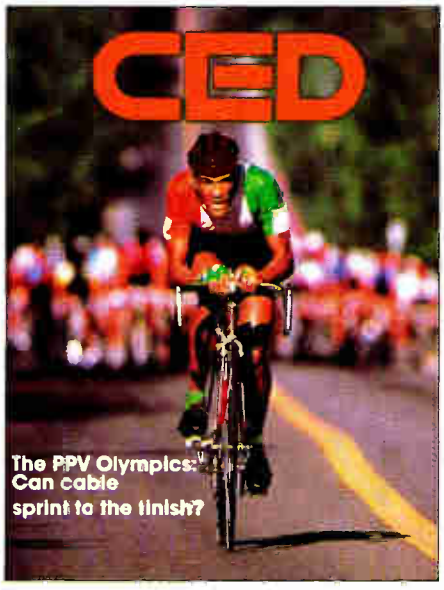


**About the Cover:**
*The PPV Olympics: Will it be an uphill climb for cable? Photo: Tony Stone, Worldwide*

DEPARTMENTS

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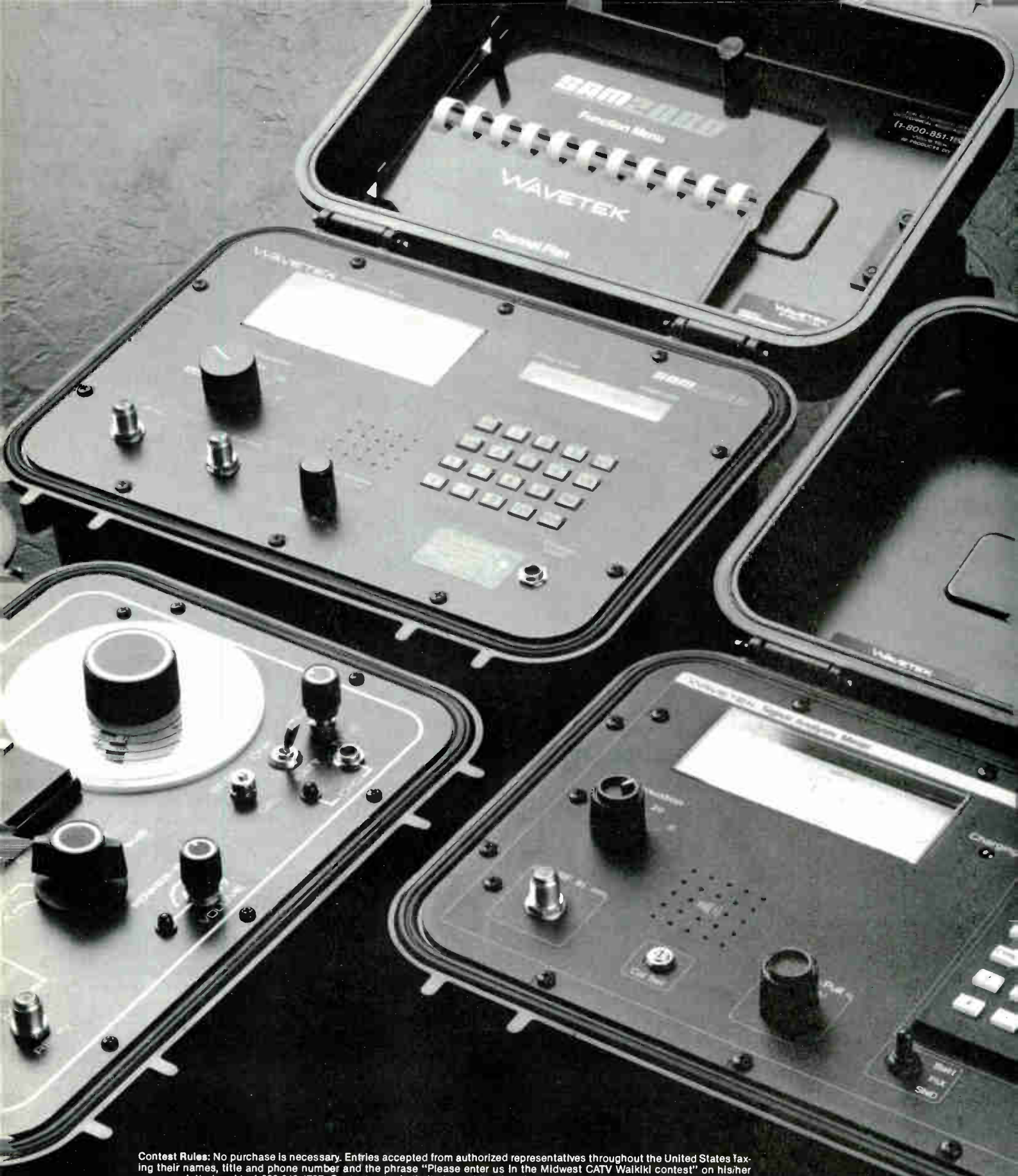


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# Win a Free Trip to Waikiki courtesy of Midwest CATV and Wavetek.

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The second way to enter the contest is for you, the company's authorized representative, to send us on company letterhead, via fax machine, your name, title, telephone number, and the phrase "Please enter me in the Midwest CATV Waikiki Contest," and your company is entered.

Only one prize will be awarded. The prize includes roundtrip airfare from anywhere in the U.S., three nights stay at The Outrigger Hobron and roundtrip transfers from hotel to airport. The winning company will be selected by July 20, 1991. So hurry and enter.

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Reader Service Number 4

# A few changes in the wind

One year ago, I told you about numerous happenings within the *CED* organization that were coinciding with the SCTE Cable-Tec Expo '90. Well, this year is no different.

First of all, *CED* is proud to have once again published the SCTE's Annual Membership Directory and Yearbook. The yearbook is a tribute to the SCTE organization and all of the 8,600-plus members that are working to better our industry. I'd like to thank all of you who supported this year's edition and encourage you to use the directory to contact your fellow engineering professionals. If you're an SCTE member but haven't received a copy yet, contact the SCTE in Exton, Pa. or stop by our booth (#709) at the Expo. If you're not an SCTE member, why not become one?

If you're attending this year's show in Reno, we hope the show planner, included with this issue, will come in handy as you plan your time. If you need an extra pen to fill in your schedule—or maybe some extra "goodies"—be sure to look inside the canvas bag that will be outside your door at the Bally's Reno Hotel on Friday morning. Some great reading and give-aways await you, courtesy of numerous vendors.

As usual, the *CED* staff will be in force at the Expo and you can count on a solid post-show issue written and compiled by our editorial staff.

Speaking of staff, I'm pleased to announce the promotion of Cathy Wilson to advertising/marketing director for *CED*. Cathy is well-known for her marketing savvy and has been national sales manager for the past seven years.

And in a final note, after two years of serving as associate publisher, I am stepping into the publisher's shoes as of this issue. Given the current challenges that face our industry and the competitive publishing market, it is a move that will be, to say the least, challenging. I look forward to helping *CED* continue its leadership position and I'm grateful for the support so many of you have given myself and the *CED* staff.

See you in Reno,

Rob Stuehrk
Publisher

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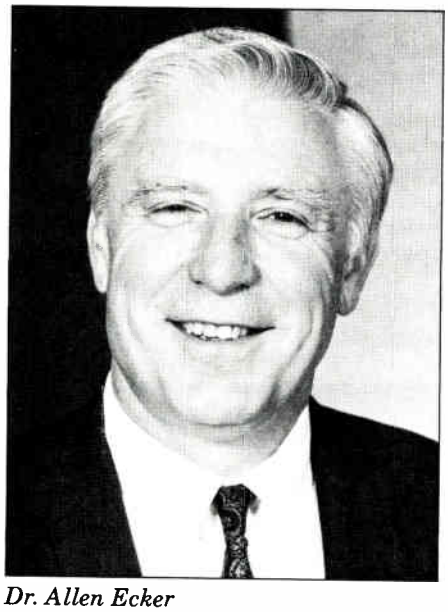


*Dr. Allen Ecker*

# Ecker: S-A's quarterback

Listen up, sports fans—here's a quick quiz. In the mid-1950s, what cable television industry engineer took to the gridiron as both a guard and a linebacker for Georgia Tech—and even wound up as an All-American athlete?

Answer: Dr. Allen Ecker, currently senior vice president and chief technical officer of Scientific-Atlanta. Indeed, Ecker—the man who leads Scientific-Atlanta's technical activities from all angles—is decidedly well-rounded, both personally and professionally.

### Well-rounded

Think about this: Ecker played on both sides of the ball in college. And, he's applied his engineering prowess on three major fronts: The academic side, in government areas and in private industry. Further, his management approach is admittedly well-rounded, tackling problems by "isolating the issues and weighing them against the success factors."

Running a close second to Ecker's inherently balanced style is his athletic background—which plays a larger role in his day-to-day business approach than he may care to admit. Ecker's speech, for example, is peppered with words like "win," "team" and "motivation." Clearly, Ecker sees many positive attributes that bridge over from sports to business.

"I've found in my experience that people don't get discouraged by working hard. They get discouraged by not winning," Ecker says, explaining his approach to motivating Scientific-Atlanta's technical team. "The real key to motivation, then, is to show clearly how they can win, both individually and as a team. And then the company can win."

### Long list of laurels

Don't the wrong impression: Ecker doesn't even remotely resemble the stereotypical football personality (big and dumb). His list of credentials is long and respectable: bachelor's and masters degrees in electrical engineering from Georgia Tech and a Ph.D. from Ohio State, for starters. And as if that wasn't enough, the Ecker name holds its own in *American Men of Science*, *Who's Who in Engineering*, and *Who's Who in America*.

All the glitz hasn't gone to Ecker's head, however. On a person-to-person basis, this born and bred Georgian is warm, polite and clear-minded—decidedly a gentleman. "I guess there are two characteristics that describe me," Ecker says, "One is 'focused.' I try to focus on the critical issues and address those. The second is 'persistent.' I think many people would describe me that way. Just keeping after the issues until they're resolved."

Dr. Ecker has resolved many "issues" in his long engineering career, having worked with the U.S. Air Force, Georgia Tech and Scientific-Atlanta in the communications area. "I've touched on it all, in a way," Ecker recalls.

### Engineering background

"Before I was at Georgia Tech (as a staffer heading up a research lab and doing graduate school teaching in the school of electrical engineering), I worked with the Air Force in research and development activities.

"Then, at Georgia Tech, I thought it would be an exciting challenge to apply technology to the real world to see things working; to solve some problems," Ecker explains.

So, to complete the circle, Ecker joined Scientific-Atlanta in 1977. "I started out as director of research and development," Ecker says. "Then I moved over to become general manager of government divisions. After that, I had a group that included all of our satellite communications and government businesses.

"In 1982, I moved over to corporate as a member of the corporate team," Ecker continues. And that's where he is now, as the kingpin responsible for all new business activities and development, including digital compression, addressable interdiction and fiber optics. Ecker tackles these on-going challenges with an almost paradoxical scope of vision: far-sighted, near-sighted and peripheral.

"Technology for technology's sake is really not an adequate way to address technology," Ecker continues. "You really have to look at what the market requires, and what you can do, both from the point of view of performance as well as cost. *Then* come up definitions for products and systems."

### Challenges ahead

Despite his diverse engineering background, Ecker foresees the next decade as the one presenting the most challenge. "With the rapidly changing technology in the cable industry—things such as moving the whole system architecture from what was coax-based to a hybrid fiber-coax—add on the emergence of digital video compression, which will see us migrate from analog to a hybrid system of analog and digital—I think these are some of the biggest challenges ahead," Ecker muses.

"We have to make sure we use these technologies wisely," Ecker continues, "so we can continue to take advantage of our real position, which is the fact that we have the broadband height into the home. That height gives the cable industry a significant lead in the delivery of entertainment and services into the home."

For his own entertainment, Ecker is (not surprisingly) sports-oriented, with tennis and skiing topping the list. In fact, Ecker and his family of five (two sons and a daughter; all college-age or older) try to hit the Rocky Mountain slopes at least twice a year.

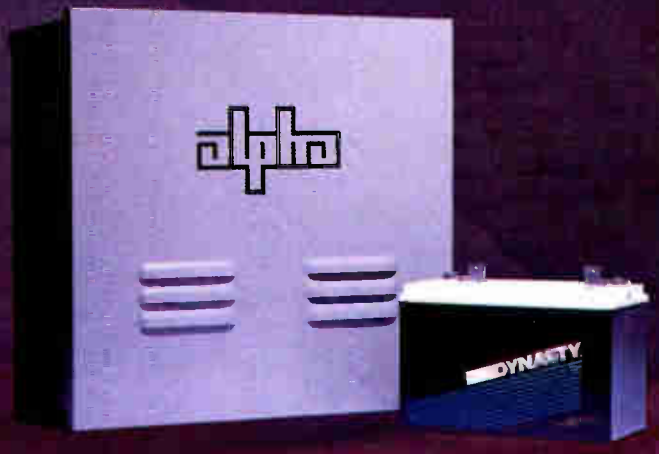
### Bright future ahead

Ecker sees a bright future for cable television, citing cable's architecture as the inherent factor. "The fundamentals we have are great," Ecker says.

"The nineties will be the decade of the consumer, in that consumers are getting much more sophisticated. They (consumers) want higher quality service and reliability. Clearly, cable is the industry that can provide." ■

*—Leslie Ellis*

# BUILT TO STAND THE TEST OF TIME.

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# Coping with disaster

On Saturday, February 23, 1991, the Comcast corporate offices outside of Philadelphia were severely damaged by fire in the building. While the floors that housed the Comcast offices were outfitted with a working sprinkler system, the rest of the building was not. Thus, the effect of the fire on the entire building, including Comcast headquarters, was severe—so severe that even today no one has been allowed back into the building to retrieve anything remaining in the facility.

I'm sure by now most of you know the story of the miraculous effort by Comcast corporate to get back in business. By Wednesday of that week, most corporate departments were back on-line, working with regions and divisions of the company from temporary facilities scattered around in the friendly offices of lawyers and accountants and the odd building or two that had space available.

Before two weeks had gone by, Comcast was in permanent quarters and was, for the most part, up and running as a corporation. If you talk to the Comcast people, there are several lessons they learned in this whole incident. One thing they've learned is that while a wealth of paperwork and documentation deemed critical to their jobs is no longer available to them, the critical part of the company's assets in an operating sense were not located at corporate headquarters and thus were not affected.

For instance, Comcast's mainframe computer system was located in Miami, Fla. So, what it took to get back on-line with that database was telephone lines and modems. They've also learned they can actually live without some of the paperwork and documentation they thought was vital to their daily managerial functions.

*By Wendell Bailey, Vice President Science & Technology, NCTA*

### It couldn't happen to you?

But I only raise the issue of the Comcast situation to enter into a discussion that could become of increasing importance to the cable industry: Emergency preparedness. In my previous life in the long distance telephone industry, the possibility that some segment of our long-haul route would be damaged or destroyed was a possibility that was planned for in advance. Yes, it was just a "possibility"—but still, a very real possibility, and sometimes expensive.

All repeater and junction sites were backed up with emergency power; all city building locations were backed up with emergency power; spare antennas and towers were scattered at strategic locations around the country and were stored on and in trailers, so that they could be trucked to a site. Frequently, these assets were deployed in such a way that they could be retrieved and set up in 24 hours, and a whole host of other plans and activities were put in place to deal with the possibility that some part of a route could be knocked out by a natural or man-made disaster.

Indeed, in my 15 years in that side of the business, rarely did a year go by in which some facility somewhere *wasn't* affected in a rather serious way. I saw first-hand how the application of preplanned responses help get the network back on-line quickly and without panic.

### Plan now for disaster

As cable television operators and systems become more important to the daily life of our customers—particularly in the areas of news, information and weather situations—the possibility that our customer could be disadvantaged by disasters could exacerbate the general confusion that typically comes with a natural disaster.

You might think that if a natural disaster occurs, it will probably knock the cables down and the power out, so by the time that side of the business gets its act together, it would be entirely possible to get back on-line. But there are actually disasters that produce situations where the entire plant isn't down, only *portions* of it. And the power is restored relatively quickly. Then the only issue is whether or not the cable headend can be put back on-line or repairs made to the part of the system that is down.

Thinking in advance about a limited scenario like this would, in all likelihood, produce plans that would be useful and helpful in coping with such a situation. You'd be surprised at the number of very simple things that just aren't thought about when preparing for emergency activities in general.

If you have computer systems at the headend with sensitive accounting or customer information, what provisions have you made to back up the database? Almost nothing can cause more problems in the immediate future than the possibility of losing access to that information through some violent or disastrous event. Backing up the information and keeping it in the same building doesn't sound to me like a very reasonable thing to do, if you think about the possibility of damage to the facility.

Also, backing up every six months might not be good enough, if you don't have a backup plan that considers backing up all of your current data on a very regular basis. Something like weekly or bi-weekly—or at best, daily—must be considered.

### Computer back-up

Imagine this: What would happen if you lost access to all the information that's in your computer right now? What would you do to recover it? The point of all this, of course, is that there are myriad things to consider if you want to prepare yourself for the possibility that you'll be overtaken by disastrous events.

In addition to merely providing ongoing service to our customers, there is the issue of whether you can continue to bring your business back on-line in a timely manner. As cable plants evolve into broadband conduits carrying entertainment, information and communications, our customers will rely on our availability more and more.

We should all begin giving these matters serious thought, so that we will be worthy of the trust our customers place in us for the future. ■

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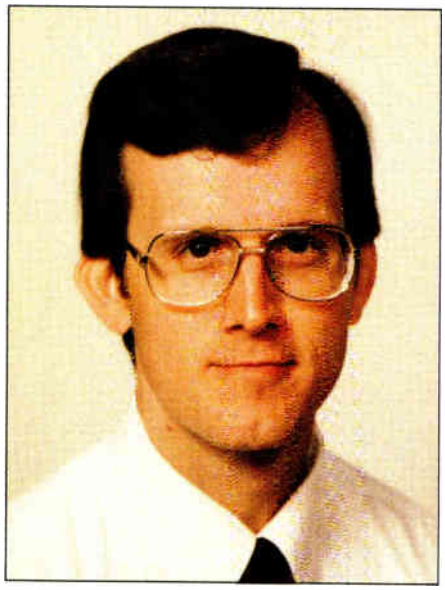

# Quadrature modulation

In the world of digital modulation, bits-per-hertz is the name of the game. How many bits per second of digital data can I cram into a hertz of bandwidth? The answer is...it depends. And it depends on a number of different factors—mostly having to do with the type of digital modulation employed, the data rate and the characteristics of the transmission media.

Previously, I briefly introduced some of the terminology related to digital video transmission, but we really haven't scratched the surface. Let's dig a little deeper into one particular modulation technique, called quadrature modulation.

### Not a new technology

Quadrature modulation is a technique that has been around for many years. Probably one of the most familiar signals using the technique is the NTSC color subcarrier at 3.58 MHz that uses a modulation technique called QAM.

In quadrature modulation, shown in block diagram form in Figure 1a, there are actually two RF carriers, both occupying the same RF spectrum, but transmitted 90 degrees out of phase (in quadrature) with each other. This is typically accomplished by creating two double-sideband suppressed-carrier modulators, operating in parallel, with each being driven from quadrature components of a single local oscillator.

*By Chris Bowick, Vice President Engineering for Headend Equipment, Scientific-Atlanta, Inc.*

The output from the LO is split into two paths—an "in-phase" and a "quadrature" path. The quadrature LO is an exact replica of the original LO source but 90 degrees out of phase. The in-phase LO is applied to one of the modulators creating a double-sideband suppressed carrier signal commonly called the I channel. Similarly, the quadrature LO is applied to another double-sideband suppressed carrier modulator creating the Q channel. These two channels are then simply summed together and filtered to create the transmitted signal.

The creation of such a signal seems simple enough, but it isn't obvious how the two quadrature components can actually occupy the same bandwidth and yet be recovered without any crosstalk or interference between the two quadrature channels. In reality, the generation of such a signal on the transmit end does cost something on the receive end in the way of complexity of the demodulator.

In the demodulator, no longer are we able to use the familiar and simple technique of envelope detection. Instead, since the two quadrature carriers have been suppressed, a technique called synchronous detection, sometimes called coherent detection, must be used to recreate and reinsert the original in-phase and quadrature RF carriers, and ultimately to recreate the two demodulated quadrature baseband channels. This technique is shown in Figure 1b.

Here, the original carrier must first be recovered—typically by using phase-locked loop techniques. An in-phase and a quadrature component of the recreated carrier are then applied to their respective demodulators. Theory says that when we reinsert the in-phase carrier during the detection process, the output from that detector will be only the I-channel information. The Q-channel information, since it is 90 degrees out of phase with the reinserted carrier, will not be detected.

Mathematically this can be proven through trigonometry. In fact, as Taylor[1] points out, the amplitude of the recovered signal in either the I or the Q channels decreases with the cosine of the angle between the modulating carrier's phase and the demodulating carrier's phase. If the phase angle between the two is zero degrees, then the amplitude of the recovered signal is perfectly reconstructed (COS (0) = 1). If the phase angle between the modulating carrier and the demodulating carrier is 90 degrees, on the other hand, then the recovered signal is perfectly eliminated (COS (90) = 0).

The recreated carriers to be used in the synchronous detection process must be identical in both frequency and phase to the original LOs used in the transmitter, or the recovered signal's amplitude and phase characteristics will not match those of the original. An error in the re-inserted carrier's phase will cause the detector to demodulate a portion of the unwanted quadrature channel causing crosstalk or interference between the in-phase and quadrature channels. Two degrees of phase error, for example, will create crosstalk between the I and Q channels with the undesired signal only 29.1 dB down (20 log (COS (90-2))).

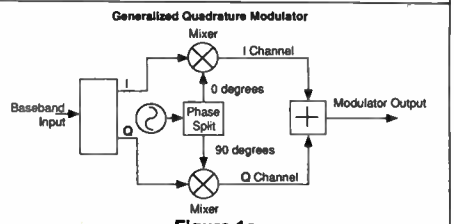


Figure 1a

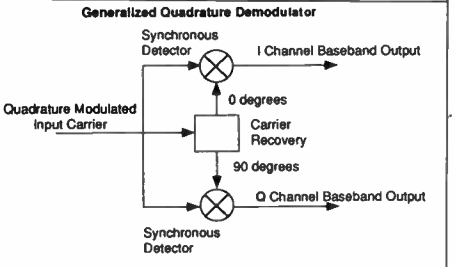


Figure 1b

This basic technique of quadrature modulation is used in many different variants such as QPSK and 16-QAM to cram as many bits per hertz as possible by putting two RF carriers, in phase quadrature, in the spectrum normally occupied by one. Future columns will further explore these various digital modulation techniques. ■

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3. Pratt, Timothy, and Bostian, Charles, *Satellite Communications*, John Wiley and Sons, New York, 1986.

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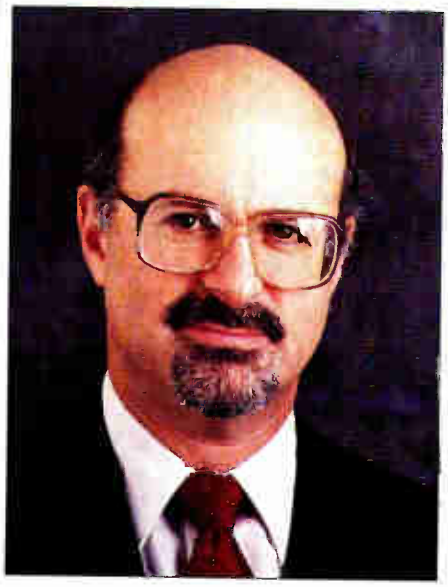

# Digital audio broadcasting

Just about a year ago, my column reviewed the activity in digital cable radio and digital radio broadcasting from satellites. I noted that the terrestrial radio broadcasters did not seem to be interested. Things have changed so much in a year! Digital audio broadcasting (DAB) was one of the hot topics at the recent National Association of Broadcasters (NAB) show in Las Vegas.

The FCC has begun an inquiry on DAB. This inquiry will eventually lead to a new U.S. standard for DAB, after the FCC decides what spectrum to use, who should be eligible for licenses, and which system design is best for U.S. consumers. It is hard to say when the FCC might be expected to make a decision on these issues, but 1994 is as good a guess as any.

In recent months, a number of new proposals for DAB have surfaced. In fact, DAB has become a very controversial topic among radio broadcasters. This column provides a status review.

### Satellite vs. terrestrial vs. hybrid

While the readers of this column may favor cable as the delivery medium for DAB, we should not forget that the radio spectrum offers several other alternatives. For example, Radio Satellite Corporation proposes to provide a DAB service that uses satellite transmission only. Satellite CD Radio has proposed a satellite-based DAB service that also uses terrestrial transmitters. The NAB supports a terrestrial-only approach that would foreclose satellite use. There are at least two other terrestrial approaches, one led by Gannett, a major radio broadcaster. These alternatives use different modulation and coding methods, and have differing implications for spectrum requirements.

*By Jeffrey Krauss, Independent Telecommunications Policy Consultant and President of Telecommunications and Technology Policy of Rockville, Md.*

### In-band vs. additional spectrum

Some of the DAB proposals can operate within the existing radio broadcasting frequencies, while other approaches will require the allocation of new spectrum for the service.

The FM service operates in the 88 MHz to 108 MHz band. The "in-band" proposals would create new digital radio stations within the 88 MHz to 108 MHz FM band. On the other hand, both Satellite CD Radio and the NAB have proposed to use spectrum around 1500 MHz for a new DAB service.

Gannett proposes to operate within the 88 MHz to 108 MHz band. The Gannett system uses a digital signal transmitted at the same frequency as the analog FM signal, but at a power level more than 25 dB down from the peak analog FM carrier.

Mercury Digital Communications has another in-band system. Mercury uses an approach called MultiFrequency Modulation (MFM) and operates on the first adjacent channel to an FM station, 16 dB down in power from FM power levels to achieve identical coverage.

Yet another company, KinTel Technologies, has proposed an in-band approach called Power Multiplexing. Power Multiplexing allows multiple RF carriers to share the same frequency at the same time without disruption to existing FM stations. The receiver detects the "dominant" carrier and subtracts it from the total signal, thereby making it possible to detect and receive the DAB signal that is 25 dB down from the FM signal.

There is some doubt that these approaches will work, but the FCC may decide to allocate additional frequencies for DAB, even if these in-band systems are shown to work without causing interference to existing FM radio stations. Several studies and proposals have suggested that spectrum around 1500 MHz would be suitable for DAB.

The 1435 MHz to 1530 MHz band i not heavily used. It is used for aero tical telemetry—the transmi data from aircraft and mis they are being tested. Th Force claims that this en needed for that purpose. A at actual usage patte shows that the band occasionally, and only a around the country. Mo few channels, typically MHz wide, are actually time, and they are widely avoid interference. More ceiver technology could rejec ence, even if the channels we spaced.

Another possibility for a new trum allocation for DAB is the 2360 MHz to 2410 MHz band, but this is less suitable because it would require much higher power levels, particularly to support indoor reception, and the top 10 MHz (2400 MHz to 2410 MHz) is occupied by microwave ovens and other industrial and medical devices.

### Advances in sound coding

One major challenge for DAB is to compress the digital signal to fit into a narrow radio channel. An FM radio station has a channel that is 200 kHz wide, which is not wide enough for a stereo CD-quality digital radio signal. Using traditional pulse code modulation, and the CD sampling rate of 44.1 kHz and 16 bits per sample, gives a data rate of about 700 kilobits per second; double this for stereo. There is no way to fit a 1.4 Mb/s data stream into 200 kHz.

However, there is no need to use pulse code modulation. In the same way that there have been recent ad vances in digital video compressio there have also been advances digital audio compression. The Dc Adaptive Delta Modulation coding tem, for example, which is being u by Digital Cable Radio, can comp CD-quality sound into 256 kb/s for e channel, or 512 kb/s for a stereo pai

We have recently seen the deve ment of several digital audio cod techniques that achieve even gre compression. They make use of "au masking" techniques that elimin the need to transmit sounds that t ear is unable to hear.

The two leading contenders are t Dolby AC-2 system, which uses a approach known as adaptive transfor




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coding, and the European Musicam system which uses subband coding. Both of these approaches can achieve CD-quality sound at 128 kb/s for each channel, or 256 kb/s for a stereo pair. AC-2 has been chosen by Satellite CD Radio for its satellite DAB system, and by General Instrument Corp. for its DigiCipher HDTV format. Musicam is part of the Eureka 147 DAB system, and has also been chosen as part of the Gannett in-band DAB design. There are several others that claim to achieve about the same level of compression.

There have never been any comparative tests of these new digital sound coding algorithms. It seems almost certain that the FCC will require comparative tests before choosing one as a U.S. standard for DAB, in the same way the HDTV formats are being tested.

### Advances in channel coding

The major challenge in a channel coding design or transmission link format is to defeat multipath problems. For a radio receiver in a moving car, multipath shows up as "picket fencing" or fast deep fades that sound like momentary loss of the signal.

Most of the proponents of DAB systems have come up with approaches that use many simultaneous narrowband radio channels, on frequencies that are slightly offset from one another. Because a multipath fade is frequency-dependent, some part of the total signal is likely to get through unfaded. This multichannel concept has only become practical with the availability of high speed digital signal processing chips.

### Conflicts among broadcasters

The broadcasting industry is far from unified on DAB. The NAB has abandoned its traditional role as a spokesman for the industry, and instead has come out as a proponent for a terrestrial-only version of the Eureka 147 system, operating at 1500 MHz. Other broadcasters, including Gannett and Group W Broadcasting, support an in-band approach, because they believe this assures that only existing broadcasters will be able to offer DAB service.

At the recent NAB Show, a group called the Committee for Digital Radio Broadcasting hosted a panel discussion that disclosed a wide divergence of viewpoints. This Committee is an ad hoc group, not part of the NAB, and it is dedicated to an open discussion of alternative DAB approaches. In retaliation, the NAB refused to allow the Committee to meet at the Las Vegas Convention Center.

Radio broadcasters believe they should have the right to become the first DAB broadcasters. But there is a dispute among broadcasters over whether only FM broadcasters should be allowed to convert to DAB, or whether AM broadcasters should have the opportunity as well.

Even among the FM broadcasters, there is a dispute about coverage areas. Today, Class C FM stations have the highest power levels, and greatest coverage areas, while Class A stations have the least. Depending upon which DAB technical approach is adopted, this coverage difference may evaporate. The Class C owners, who paid much higher prices for their radio stations than the Class A owners, don't like that idea one bit.

Once again, new technology seems to have created controversy, created opportunities for some and risks for others, and upset the established industry. ■

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# Imagining the future

Fifty years ago, I told the chief engineer of the radio station where I worked that I did not believe television would fly. I simply could not see myself watching movies night after night. I still don't; but millions of people do, fortunately for broadcasting, cable TV, and TV set manufacturers, dealers, and service shops.

### Things that came true

In 1953, no one but DX hobbyists could watch television in Kalispell, Montana, unless they were connected to the CATV system my associates and I had built. Surely, we thought, a TV station would open up in Kalispell within a few years. Would anyone then pay us to watch TV when they could watch the new station for free? We even tried to anticipate this disaster by applying for our own TV station to put our own cable out of business!

Who would have believed, before London was blitzed by the V-2 rockets of World War II, that within a few decades the expression "flying to the moon" would no longer be a metaphor for the impossible?

The world cheered when Lindbergh flew the *Spirit of St. Louis* from Newfoundland to Paris in 33⅓ hours. But only daft dreamers could have imagined flying from Paris to New York in three hours on the *Concorde*. In fact, Pan-Am initiated sleeper service for its early transoceanic flights, in the belief that they would take a couple of days.

The Empire State Building was designed in 1931 to be strong enough to withstand the stresses of mooring a fleet of 800-foot long airships that would soon be used for rapid transatlantic passages on a regular schedule. Airships would provide deluxe accommodations, comparable to an ocean liner, and surely would be safer than earthbound airplanes.

Then, in 1937, on its first trip from Germany, the airship *Hindenburg* exploded and burned when a static electric discharge ignited the hydrogen which kept it aloft. That was the end of the airship mode of transportation, before even the first mooring on the Empire State Building could take place. Although TV was non-existent in 1931, the 1,200-foot skyscraper in the center of Manhattan became a serendipitous mounting for television transmitting antennas.

### HDTV skepticism

Many experts and otherwise are skeptical about HDTV. Does anyone really want it? Others point out that for viewing on large screens, HDTV is almost a necessity. Will the public buy large screens? It depends on price, size of room, and individual taste.

Some believe interactive TV would be great. Others suggest that its appeal will be transient.

Twenty years ago, an imaginative entrepreneur invested heavily (with the help of some banks) to develop the Aquacar. This was a vehicle, not unlike the VW Cabriolet in appearance, but with a propeller and rudder in back that could be engaged to the transmission for propulsion and steering in water. Unfortunately, it was neither a good car, nor a good boat and the idea came to a well deserved end, accompanied by a certain amount of financial distress.

### Things that failed

Then there was the much advertised Bensen Autogyro (that looked more like an airborne Moped than an aircraft), the Piper Skycycle, the Fulton Airphibian, the Taylor Aerocar (no kin), the Waterman Arrowbile and many others. Flying cars, intended to beat traffic congestion on the highways by overflying, appeared on television and in James Bond movies, but they have yet to play any kind of role in real life.

### My forecast

With such a depressing record of failures in prognostication, I am loath to make predictions without the statistical cover so cleverly devised by meteorologists for weather forecasts.

All things considered, therefore, I predict there is a 60 percent chance that all-digital HDTV sets and VCRs, with large flat panel "picture-on-the-wall" displays, will be offered at retail by 1996. However, the probability is less than 10 percent that the price will be under $2,500.

Although I am sure many will take issue with my judgment, I am quite confident these predictions cannot be proven wrong.

Think about it! ■

*By Archer S. Taylor, Senior Vice President, Engineering, Malarkey-Taylor Associates, Inc.*

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# Some changes in Boulder

## Two people who help vendors do it right

A quiet event is underway at Cable Television Laboratories in Boulder, Colo. Most of us who follow these pages are aware of the significant start our industry center for progress and innovation has made in its brief existence so far. The major initiatives in cable operations, fiber optics, personal communications networks and high definition television started by CableLabs have received interest and acclaim far out of expectations for such a small staff.

### Faces are changing

It's no wonder then, that many might not notice that faces are changing at CableLabs, while the mission remains the same. New positions are being created and talent is coming from the industry to fill these demanding and pioneering jobs. Some other positions are seeing new talent also, and it's appropriate, I believe, to comment on the event.

Vendors depend on the pioneers among operators to sort their priorities. There is no shortage of interesting ideas for new services and products in CATV. But no one wants useless products, and a few hard experiences can take the edge off one's creativity. Alternatively, new products (even great ones) can overlook details, such as installation necessities, compatibility with other products, and "fit" with cable operator's strategic needs. That's where the operator pioneers come in—that's why they're so vital to the health of the industry. Two individuals have played a significant role here, and both have assumed major responsibilities at CableLabs.

Many of us have been fortunate to work with Tom Elliot, the first VP of Science and Technology at CableLabs, through his key role at TCI and through his involvements in industry professional organizations, such as the NCTA and the SCTE.

My purpose is not to recount the many programs he has started at CableLabs; though the diversity is amazing. Our industry will be learning the results of these programs for years to come. In a couple of short years, projects have been begun (and some finished already) in key areas such as subjective picture quality, headend organization, future architectures and component corrosion. It is significant that CableLabs chose Tom first, a person who has had profound influence in the vendor community.

First, Tom Elliot would never allow technical solutions to problems best served by better engineering or management discipline. Likewise, he would never lay off onto management or installers problems that were really caused by product deficiencies. A spade is, simply, a spade. Tom understands the delicate relationship between information flow, technical capability and operator priorities and limitations. He understands how change comes about.

Second, Tom Elliot has assisted vendors (sometimes *reluctant* vendors) to make their products work together better with those of other vendors and in the hands of the craftsmen. Splendid products can be and are engineered for the nominal tolerances of the equipment they adjoin, but tolerance stacks may not be known—except to the fellow in the field. With technology moving rapidly in CATV, not enough time would otherwise be given by vendors to "working out the bugs" before marching forward to the next product.

The consequences of ignoring these needs is to be termed "nonresponsive." Tom has taught us all to heed these needs by working together at the design stage where vendors can save real time and development cost.

Tom Jokerst, the new VP of science and technology, is much the same, but brings some new qualities to the job as well. Continental has generously made Tom available to serve the NCTA as its Engineering Committee Chairman, a role in which he continues. Tom has demonstrated a fairness and diplomacy that makes his stewardship particularly enjoyable.

He also has his technical ducks in a row, as well as a full appreciation of the challenges the industry faces. Now that he is part of CableLabs, he will be almost entirely at the service of the industry in a joint role that has never been performed before. This is no small change, but one that his soft-spoken, diplomatic bearing will serve well.

Tom Jokerst has helped vendors too. An example can help make the point here. Several years ago, drop connector companies developed premium connectors to reduce corrosion and aid in quality, consistent installations. But the elimination of moisture leakage into connectors posed a new problem: What does one do during a service disconnect?

The earlier practice of cutting off connectors at the tap (permitting moisture to readily enter the cable while disconnected) was not only more wasteful for premium connectors, but defeated attempts to reduce cable deterioration. By working with industry engineers, Tom was able to show a necessary augmentation of these products in the form of temporary seals for disconnected cables.

### The vendor/operator relationship

The point here is that the vendor community depends in many ways on the assistance of these leaders who are more than figureheads. They are pioneers and co-workers with us, who realize that vendors are an extension of their own organizations. ■

**Editor's Note:** *The opinions expressed above do not necessarily reflect the views of the staff or management of* CED *magazine. Persons wishing to respond to this article are encouraged to write a letter to the editor of the magazine.*

*Joe Lemaire is the manager of CATV marketing and application engineering for Raychem Corporation. He works on SCTE and NCTA engineering subcommittees and periodically writes on issues affecting cable plant maintenance and reliability. His technical field is materials science and mechanical engineering, in which he holds several degrees.*

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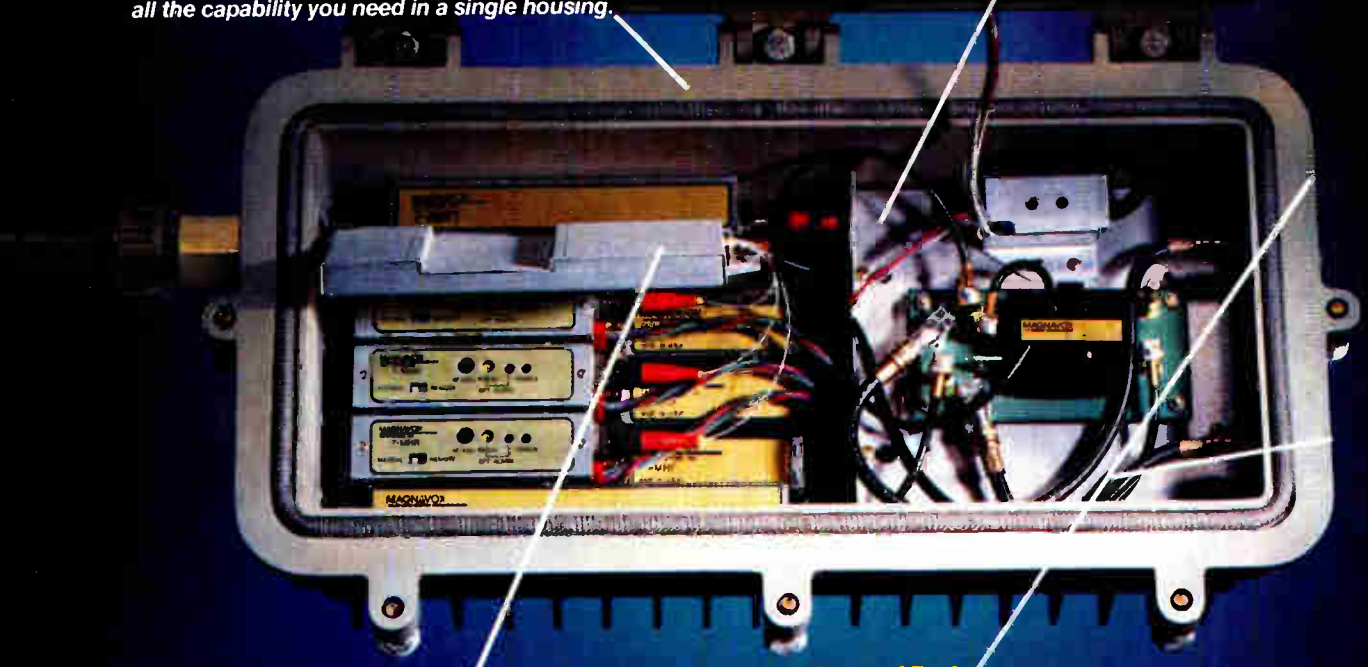

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Reader Service Number 16

# Olympics 1992:

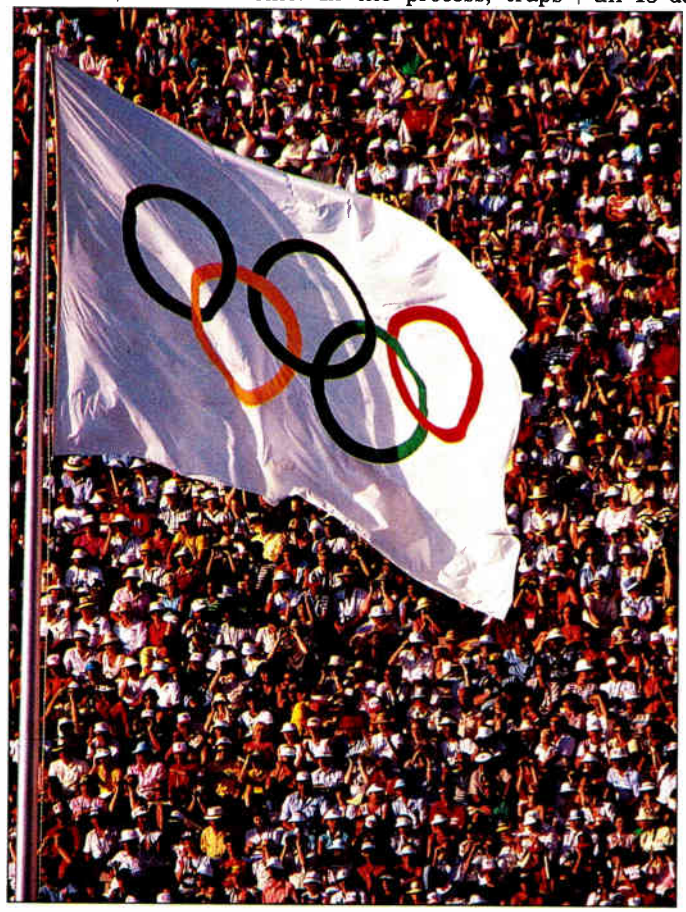
## Can cable hurdle the issues?

When it comes to the 1992 Summer Olympics, track-and-field athletes won't be the only ones who'll have to work hard to clear the hurdles—cable operators will be right there with them.

With 13 months and counting until NBC/Cablevision's pay-per-view Olympic Triplecast, scheduled for broadcast from Barcelona, Spain next July and August, cable operators will have to spend long hours planning their strategies if they want to end up winners. Because, from the looks of NBC/Cablevision's promotional lineup—with Olympics advertisements blitzing cable and broadcast television in an unprecedented magnitude—this pay-per-view event isn't something to start thinking about next April.

In fact, just about everything about the NBC/Cablevision Olympics Triplecast (so named because three live channels will be dedicated to the event) is unprecedented. This, in turn, has created a tangled web of issues, both technical and marketing, that remain a conundrum.

NBC/Cablevision's goal is to gain "universal distribution" of the 15-day, 540-hour event. That's shaping up to be a tough goal, considering cable's mix of addressable, non-addressable and "addressable-capable" (those systems that have addressable capabilities, but haven't yet "hooked" subscribers into taking them) subscribers.



### Non-addressable systems murky

Most of the murk lies within the non-addressable universe, representing at least 14.5 million subscribers (according to recent Paul Kagan and Associates research data).

For starters, non-addressable systems have limited security measures, and will rely on positive-trap technology to secure the event. Putting it mildly, using traps for an event as intricate as the Triplecast is like pruning a rosebush with a steak knife: It'll work, but in a rather limited way.

Basic positive trap design dictates that an interfering carrier is injected into the signal to be secured at the headend, then removed at the subscriber's home. In the process, traps "eat" bandwidth and correspondingly degrade picture quality. This alone puts cable in a dangerous position, from a customer service point of view, because Olympics-hungry subscribers will be sinking an unprecedented chunk of change into the event, and will undoubtedly be watching closely to ensure the dollar-for-dollar value.

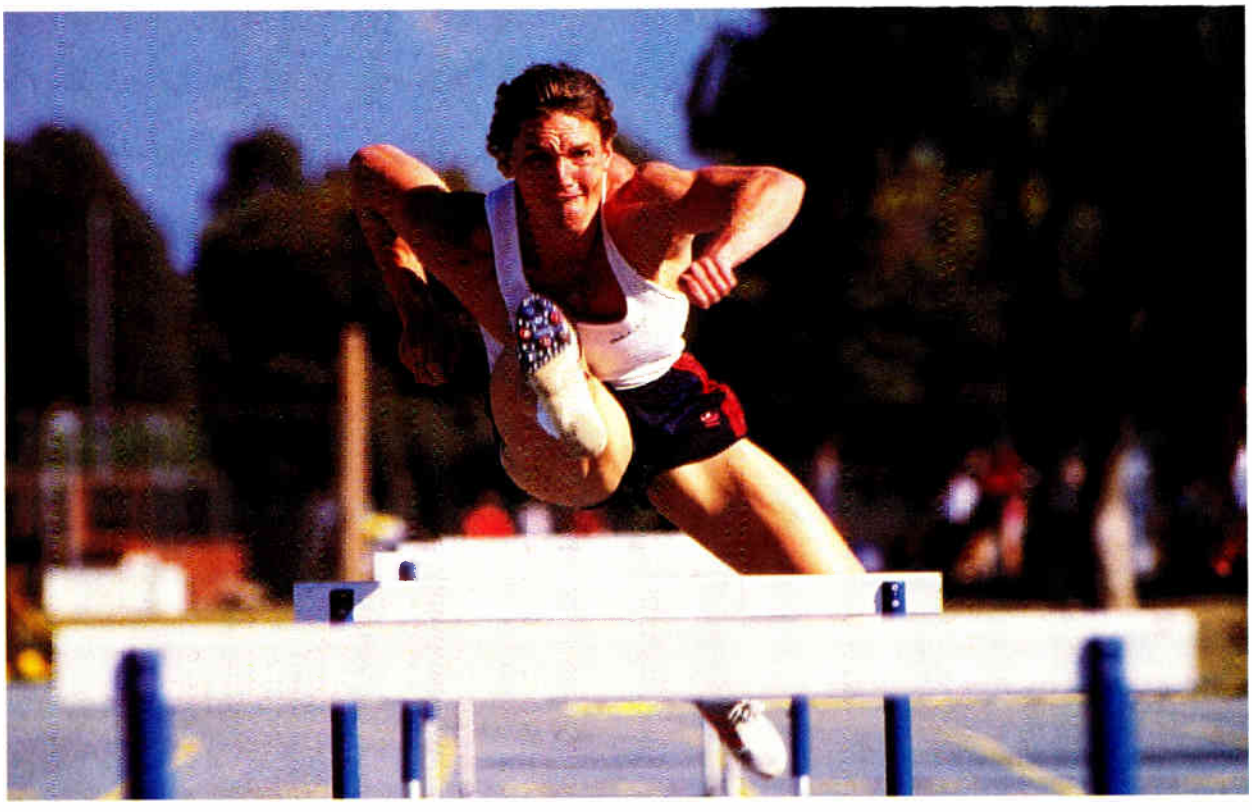
What makes the trapping even more tricky is the Triplecast's wrappings. Subscribers wanting the event have no shortage of purchase options. All Triplecast options offer three channels of service; price levels vary by the amount of coverage purchased. The top-of-the-line "Gold" package, which ensures full 15-day coverage and a "loot bag" of Olympic memorabilia, costs $195. Or, for $135, subscribers can buy the "Silver" package, covering all 15 days, minus the "goodies." And lastly, two $95 flavors of "Bronze" programming are available.

And it's those two bronze packages that may get messy for non-addressable systems, because they're time-specific—a feature that stymies trap applications. Subscribers opting for the cheapest package have a choice: Either they buy the first seven full days of the Triplecast, or the first seven weekend days of the event.

### Bronze head-scratcher

Non-addressable systems that offer both bronze packages have a dilemma: Deployment and retrieval of the $15 three-channel trap bundle. If a subscriber buys the first seven days of the event, what happens on the eighth day? And for the weekend buyer, what happens Monday through Friday—do installation staffers make repeated trips to protect the extra $100 worth of Olympics? Many suggest that's highly unlikely.

In answer to that question, NBC/Cablevision officials have suggested that non-addressable operators offer only the Silver and Gold packages. "It's largely up to the cable system's resources," comments Bruce Babcock, VP of network services for the NBC/Cablevision cooperative. "We're making the three channels available and trying to unblock as many impasses as we can. In this situation, we have to leave it up to the operator."



# Jerrold and the '92 Olympics get you over the hurdle to addressability.

Another challenge presented by positive trap design is frequency allocation. Positive traps historically operate best between channels 2 and 13—although both Eagle Comtronics Inc. and Arrow Communications (Arcom) have introduced new positive trap designs, both unique, that offer "limitless" frequency range (reaching as high as channel 60), "enhanced" picture quality and affordability. The three-trap bundle, packaged in a tube-type enclosure, will cost operators roughly $15 per bundle.

Arcom's Gaussian trap, originally designed to provide sensitive European PAL-version technology with a less offensive method of securing sub-titled programming (without chewing up the subtitle), relates to "a uniform curve which follows a particular mathematical equation," says Peter Warburton, VP of sales and marketing for Arcom. "It's a way of delivering high grade picture quality, which is exactly what you don't get with a positive trap.

"Positive traps, by the way they operate, remove parts of the bandwidth. By removing part of the bandwidth, you remove part of the picture quality," Warburton continues. "It's a bit like an oil painting with very vivid colors, but now it becomes like a

# Who's carrying the Olympics?

## The list grows daily

At press time, nearly one quarter of cable television's top 100 multiple system operators and a handful of small (less than 43,000 subscribers) MSOs had signed affiliation agreements with NBC/Cablevision to carry the two-week global sporting event.

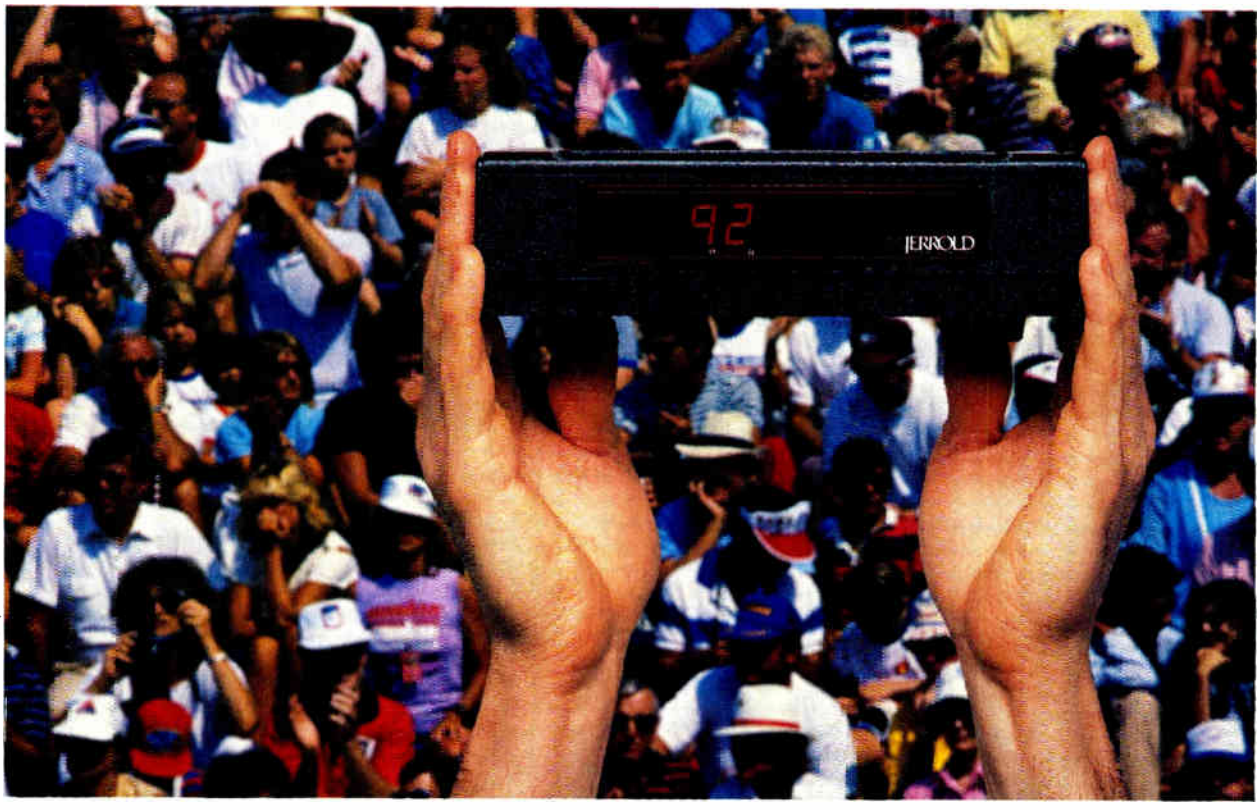
The participants include:

Adelphia Cable Communications
Armstrong Utilities, Inc.
Buckeye Cablevision
Cencom Cable
Callais Cable
Coaxial Communications
Colony Communications
Columbia International
Insight Communications
InterMedia Partners
King Broadcasting Co.
Masada Corp.
MultiVision Cable TV Corp.
National Cable Ltd.
Omega Communications
Palmer Communications
Prestige Cable
Prime Cable
Post-Newsweek
Rifkin and Associates Inc.
Rock Associates
Scripps-Howard
Sonic Communications
Summit Communications
Tele-Communications Inc.
Triax Communications
United Video Cablevision
Western Cablesystems Inc.
Western Communications
Wometco Cable Corp.

The combined number of subscribers reached by the listed cable systems is roughly 14.4 million—which represents about 26 percent of the United State's 55 million cable subscribers. ■

*—Leslie Ellis*

# Introducing the Olympian Addressable Unconverters.*



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watercolor, because the colors are all washed out. That presents some problems, as far as the Olympics are concerned. If somebody is paying $100 or more for the event, and the picture quality of using a positive trap for these three channels is not as good as watching regular NBC broadcast—which is free—then there's a problem.

"The Gaussian technology is different (than traditional trap design). It's passive and can go internal or external to the home. And the recovered picture quality is as good as when it started before it was scrambled. That's the first advantage," Warburton explains. "The second advantage is that it essentially doesn't have a frequency limitation. And, they're just plain cheap, particularly compared to a decoder. There's a big difference between $5 (for one trap) and $100 for an addressable decoder."

Eagle's "SIS" (for Sideband Interdiction System) offers essentially the same advantages as the Gaussian technique—but Marketing and Sales Vice President Joseph Ostuni is more concerned with availability than the bells and whistles associated with making the new product work.

"We're talking about 6 million traps," Ostuni says. "Even with both companies (Eagle and Arcom) operating at full capacity, we would have to start production in the fall of this year. That's just not feasible, since NBC/Cablevision recently informed us that we will be taking orders directly from operators.

"I wish I could say this (to operators) in bold, red ink: Plan now. Buy now. Because there's no way we can make that many traps come next April," Ostuni emphasizes.

### Where will all the traps go?

Opinion is also mixed regarding the ultimate fate of the 6 million traps slated for usage by next July. Sources close to the project admit that some operators may try to strike a "return" deal with the trap manufacturers, but "that's a Murphy's Law situation for us," Warburton explains. "Each trap (in the bundle) will be frequency-specific for that cable system. That makes them largely non-reusable."

Some systems, notably Metrovision of Prince George's County, have successfully utilized a deposit structure to guarantee trap returns. "We did an experiment with pay-per-view last fall, in which we charged a $5 deposit on 4,200 traps deployed," explains Ray Miller, regional engineer for Metrovision of Prince George's County. "We got somewhere near 3,700 traps back—and made a *ton* of money." Ironically, the success of the pay-per-view event has since prompted Metrovision to convert to addressability, because regardless of the company's 88 percent return rate on the trap experiment, addressability is "more manageable," Miller says.

Or, operators can simply take a laissez-faire approach, and expect never to see the traps again. "I think they should probably count on losing 60 to 70 percent of the traps," says NCTA VP of Science and Technology Wendell Bailey.

### Receivers and descramblers

Another very real issue is what to do for non-addressable systems that don't have headend reception and descrambling equipment to handle the incoming three channels of programming. To date, NBC/Cablevision deals are pending the final ink from Cable Video Store, Request TV and Viewer's Choice—but non-addressable systems that have no reason to receive those three channels must invest in new receivers/descramblers or find back-ups and press them into service.

Some say most operators will be equipped with three "on-shelf spare" satellite receivers and VideoCipher descramblers. Manufacturers think otherwise. "No way," says Warren Davis, technical manager, Standard Communications. "They (operators) may have a spare (receiver), but it's only for a certain polarity. I feel confident in saying that maybe 20 percent of the systems out there may have something around that could put one channel back on the air. That includes a receiver and a descrambler.

"Most of these guys don't usually even have one (receiver) on the shelf. And if they do, it's broken. I see guys all the time paying the overnight and return-overnight shipping to have a receiver back on-the-air the next day. These poor guys are in constant critical service situations. They can't afford to have $5,000 worth of equipment lying around," Davis continues.

### Addressable wanna-bes

For a few more dollars, operators that have been contemplating addressability but waiting to take the plunge have a few new options. Jerrold Com-

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*SIS SYSTEM PATENT PENDING

Reader Service Number 25

munications, for example, recently introduced its Olympian 2000 converter—"which we call the addressable *un*converter," explains John Burke, product manager for Jerrold's addressable terminals.

Priced at $75, the Olympian 2000 is an RF device with no consumer features (no remote, parental control or accessory outlet) that aims to entice typically addressable-resistant operators by offering addressability only when the unit is turned on.

"When the subscriber wants to use a pay-per-view service, he or she orders the event in the traditional one-way addressable fashion," Burke explains. "Then the subscriber turns on the converter. At that point it acts like a converter. The subscriber does not have to use this device to view normal cable television.

"This helps operators overcome their concerns with the 'consumer unfriendliness' of a converter, while still providing them a way in which to participate in pay-per-view events," Burke continues.

Jerrold hopes the consumer-friendly aspect of the new converter will spur operators into addressability. "This enables systems that either don't want a large converter investment or are resistant to all the other consumer features associated with reliability to offer the security of the technology," said Jerrold President Hal Krisbergh in a press statement. "The converter will pay for itself based on (Olympic and other) pay-per-view revenues."

Zenith has also brought an offering to the Olympic table. Its PayMaster decoder, priced as low as $35 (in bulk) is an add-on decoder that upgrades most non-volume control converters to addressable status. Zenith submits that the pocket-sized device can be installed by the subscriber and is based on the company's existing phase modulation (PM) scrambling system, currently used in more than 50 U.S. cable systems.

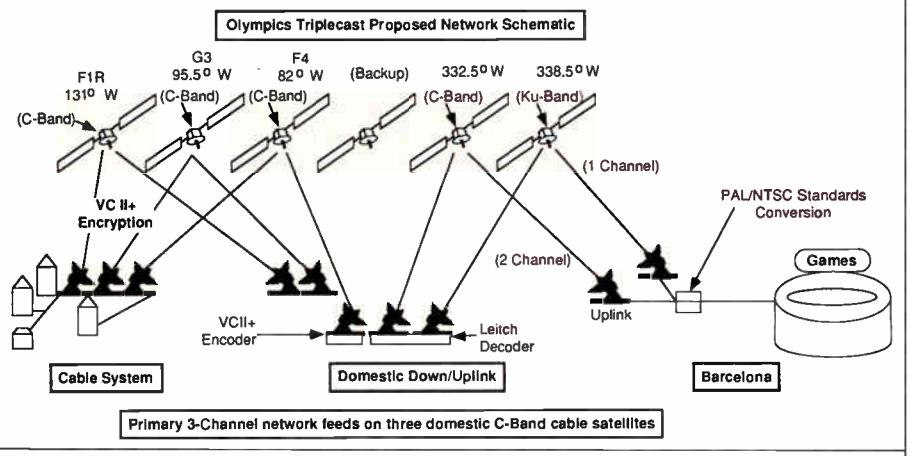
On the encoding end, Zenith's "Event Center" mini-headend houses the necessary three encoders and is priced at roughly $5,000—which is "approximately one-third the cost of a conventional system controller plus encoders," said Vito Brugliera, VP of marketing and product planning for Zenith's Cable Products Division in a press statement.

Reportedly, Scientific-Atlanta, Pioneer Communications and Oak Communications also have decoder models in the works. Of the contenders, Jerrold and Scientific-Atlanta are expected to be the most likely manufacturers to serve Tele-communications Inc.'s more than 8 million subscribers (at press time, the TCI Olympic-carriage plan was close to a conclusion), most of whom are non-addressable. This is because TCI will control the event via its national satellite-directed administration center, currently operated with both Jerrold and Scientific-Atlanta addressable software.

### Addressable: Home free

Cable's addressable subscribers essentially sit in the winner's circle, technologically. The Triplecast represents little more than a long live event for this group; the only real issue is equipment availability for the millions of subscribers who reside within an addressable system but don't currently view any scrambled channels.

"To say a system is addressable is accurate. To say the whole subscriber world within that system is addressable is inaccurate. Because for everybody (who is currently addressable-capable) who buys the event, we're going to have to find a converter for




them and spent around $130. Or, spend $15 for a set of traps," says Charles Cerino, director of technical operations for Comcast Cablevision.

### Bandwidth blues

All three system configurations—addressable, non-addressable and addressable-capable—still have to grapple with the search for three channels to carry the Triplecast. In fact, a random survey of 30 small (under 5,000 subscribers), medium (5,000 to 10,000 subscribers) and large (over 10,000 subscribers) systems revealed that 80 percent are concerned with "finding" three available channels to dedicate to the Olympics for two weeks.

NCTA's Bailey doesn't put much stock in system-level operator's bandwidth woes, however. "That's a knee-jerk reaction by (system level) operators, because (management) knows the channels are there. The bottom line here is, the MSOs who have decided to do it will tell their people, 'Okay, find me three channels.' And coming from the boss, the statement 'I don't have three channels' simply doesn't work. They know there are a couple of bulletin boards which you can drop off for a while; a couple of access channels which you can probably go to the city and get permission to drop for a few weeks."

However, NBC/Cablevision has reportedly asked the "top MSOs" whether they should make it "financially appealing" for some as-yet unnamed basic cable channels to go dark for the two-week stint. At press time, MSO reaction to the NBC/Cablevision proposal wasn't in.

### Extraordinary efforts

Indeed, NBC/Cablevision's efforts to make the Triplecast a success can be deemed nothing less than extraordinary. "Deals," financial and otherwise, seem to hit the streets on a near-daily basis as Triplecast officials work toward the Olympic finish-line.

"We're trying to create as many unusual and problem-solving kinds of programs as possible," says Babcock. One such "problem" recently solved by Triplecast ink is advertisement carriage on cable channels. In a highly unusual move, NBC/Cablevision has signed a contract with Utah-based Ad Systems that essentially trades cross-channel promotion equipment for Olympic spot air-time.

The "non-exclusive" deal is clearly a plum for operators and ad insertion vendors (although unconfirmed by Triplecast officials, Channelmatic foresees a similar deal between it and the cooperative). Operators who place orders for Ad System's equipment by December 1990 will be allowed to use the equipment—free—until after the Triplecast, at which time they pay for it. In return, participating operators must dedicate 50 percent of advertising traffic to Olympics commercials.

### Everybody wins

Clearly, operators and commercial vendors stand to gain from the deal. Sources close to the project say NBC/Cablevision will reportedly use its ties with G.E. Capital to finance the equipment as a long-term lease. In doing so, operators get to use the equipment at no charge for as long as three quarters of a year and vendors nudge products through doors that were previously closed to them.

Yet another financial Triplecast carrot entices smaller operators (those with fewer than 1,500 subscribers) to carry the event by allowing them to keep the first $1,500 earned from the event. Called the "small system incen-

tive plan," the deal intends to offset some of the capital costs involved with Olympic carriage.

"What we're trying to do is recognize the cost of entry of getting into this 'universal distribution' Olympic Triplecast," Babcock offers. "This is a way for everybody to play, especially the little guy. This way, we say 'Keep the first $1,500, and then we'll split the rest.' "

And aside from the financial incentives, NBC/Cablevision is planning a multi-faceted, far-reaching advertising campaign that will essentially make it difficult to turn on the tube without seeing an Olympic spot. In fact, NBC/Cablevision president Marty Lafferty likens the Triplecasts eight month (starting in November, 1991) ad campaign to "the introduction of the Lexus automobile, or typical of what a McDonald's or Burger King does in a month." One question that comes to mind when considering such a media blitz is the non-cabled universe, representing some 40 million households.

Will the flurry of Olympic ads spur "Christmas gift" and "Father's Day gift" purchases by non-cabled and cabled homes? NBC/Cablevision sure hopes so. But are operators equipped to handle such an influx of consumer demand? And for that matter, how will payment be handled?

To that end, Triplecast officials recently unveiled a three-way purchase plan devised to accommodate consumer purchases of the four Olympic packages. In the first option, consumers can phone the "Olympic Pay-per-view Phone Center" (officials are undecided whether an 800 or 900 number will be used) with a credit card in hand to make the buy. Or, they can contact their local cable system "for details."

And in yet another unprecedented move, NBC/Cablevision has struck a deal with Ticketmaster, wherein subscribers can order Olympics services there. How will a subscriber know whether his system is addressable, non-addressable or otherwise? According to NBC/Cablevision's Babcock, Ticketmaster will have a "ZIP code database that provides about 80 percent of the relevant information about a caller's cable capabilities. If a Ticketmaster order taker is uncertain, the remaining 20 percent of the information block is solved when the caller discloses which cable system he is on."

Sound confusing? NBC/Cablevision thought it might, and as such has formed a handful of "advisory teams" to handle cable-specific questions. For example, an "operations advisory team" consists of experts from Request TV, Viewer's Choice and Cable Video Store. Similarly, a hotline consisting of contact names and phone numbers for Jerrold, Panasonic, Scientific-Atlanta, Pioneer and Zenith personnel has been established. Eagle and Arcom representatives make up the trap-side hotline.

### Triplecast cash cow

All issues aside, there is an up-side to Olympics Triplecast participation. Indeed, the good news that keeps the Triplecast burning is the potential purse. Even if a mere two percent of cable's 50 million households took the middle-of-the-road silver package, the gross proceeds would stand at $135 million. Split in a 30 percent worst-case scenario with NBC/Cablevision, the industry still stands to gain roughly $39 million.

NBC/Cablevision president Marty Lafferty's potential revenue predictions are even more optimistic. "Our goal is to reach 40 million addressable and non-addressable homes," Lafferty says. "We did a 900-number survey recently, in which we asked people whether they would purchase the event for $125 if it was to be aired, hypothetically, 'next week.' Ten percent of the respondents responded positively.

"Based on that ten percent rate of 40 million subscribers, priced at $125 and with a 40 percent pocketable amount, I see cable potentially making $200 million," Lafferty continues.

And beyond the potential payoff, the Triplecast could well represent the largest pay-per-view event in cable's history. "Really, the Triplecast is a catalyst that will further launch cable television into the pay-per-view business," Babcock predicts. "The whole sports industry is going through the roof. The experience operators gain in preparing for the Olympics—equipment purchase and deployment, channel clearing—will clear the way for future pay-per-view business."

But just as clearly, the Triplecast could well represent the biggest black-eye cable television has ever had to look through. Widespread publicity may make the event a "must-carry" and if it becomes too complicated, cable could finish dead-last in the sprint to the finish line. ■

*—Leslie Ellis*

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# Fiber and finances

## Understanding fiber's bottom-line benefits

**Editor's note:** *This is the first in a series of "Fiber and finance" articles examining the economic benefits of optical fiber from a cable operator's perspective.*

PCN. HDTV. PPV on demand. These are just a few of the future services that promise to change the way America views cable television.

The common thread linking these disparate technologies is optical fiber. With its well-documented performance characteristics, fiber is likely to play an important role in the evolution of the "next generation" of the cable television network.

Increasingly, however, cable TV operators are electing to install fiber in their systems not only for its long-term strategic potential, but because it proves in today as the most cost-effective method for delivering a video signal.

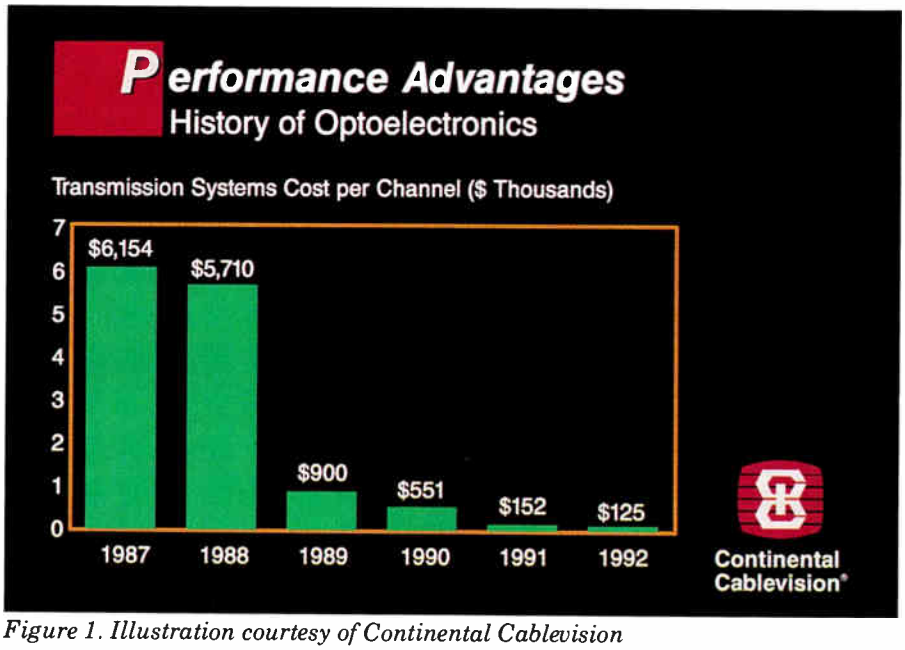


*Figure 1. Illustration courtesy of Continental Cablevision*

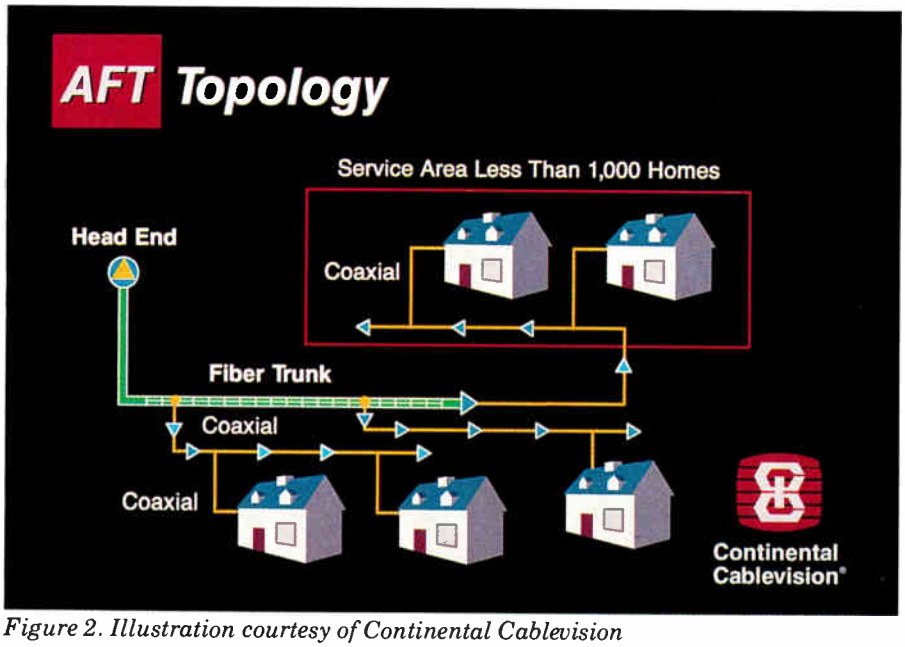


*Figure 2. Illustration courtesy of Continental Cablevision*

Kevin M. Casey, director of engineering for Continental Cablevision of New England, which serves 98 communities and approximately 500,000 subscribers across three states, came to that conclusion after weighing fiber's performance and financial advantages.

"In cable television, fiber is the technology that will dramatically alter the cable television delivery system to accommodate both existing services as well as new businesses yet to be conceived," Casey says. "For us, the future is now with fiber."

*By Jon K. Chester, Market Development Manager, Cable Television, Corning Inc. Telecommunications Prods. Div.*

### Making the fiber decision

In making the fiber decision for his systems, Casey was influenced by two key factors: The steadily declining cost of fiber-optic systems compared to coaxial cable and the need to "future proof" Continental's existing cable plant.

These deliberations were essential because an All Fiber Trunking (AFT) architecture, developed in 1989 by Continental's engineering staff (See *CED Fiber Optics Handbook*, September 1990, p.8), will be utilized on a regular basis for system upgrades and rebuilds throughout the 1990s.

Overall, the MSO's financial modeling, cost analysis and strategic evaluation of lightwave transmission offered a compelling argument for widespread fiber deployment. This approach could serve as a blueprint for cable operators contemplating their own fiber-based systems.

"Most cable engineers are familiar with the technical and customer service advantages of fiber," Casey comments. "We know that fiber delivers signal reliability and quality improvements, along with bandwidth. But there is also a very positive story to tell about the financial implications of

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fiber."

### Coax cost comparisons

Rapidly declining cost per delivered channel may be the most dramatic example of fiber's economic impact on cable television. Continental estimates the cost per channel per link over fiber will be less than $150 by the end of 1991, down from $900 a channel in 1989 (see Figure 1).

According to Casey, typical eight-fiber optical cable costs were significantly higher than one-inch coaxial trunk cable until the mid-1980s, when fiber was used in volume for cable television supertrunking applications. As fiber deployment continued to accelerate throughout the decade, optical cable reached the coax cost threshold in 1987.

By 1990, Continental's analysis indicated that the costs associated with optical cable had dropped by 16 percent, while coaxial cable costs had risen by 19 percent. As a result, optical cable is cost-effective for a wide variety of upgrade and rebuild applications.

In addition, cost reductions in optoelectronic equipment, especially in distributed feedback lasers, have combined to drive down the cost per channel over fiber.

"These cost reductions and the prevalence of fiber have allowed the cable television engineer to design systems of strategic benefit for the years ahead," Casey remarks. "And emerging technologies such as near video-on-demand, interactive services, HDTV, digital compression and perhaps PCN will undoubtedly become integral components of our business; the extent of which will be determined largely by our fiber infrastructure."

> By 1990, the costs associated with optical cable had dropped by 16 percent.

### All Fiber Trunking

Initially, Continental used its AFT architecture in locales the MSO defines as "strategically important," such as high growth, commercially developed areas that may allow the fiber infrastructure to yield additional revenues in future years. Today, AFT is deployed in some rural systems as well.

The AFT delivery system operates on two basic principles: service no more than 1,000 homes with no more than seven active devices cascaded in any one service area.

This framework provides for targeted delivery of programming while reducing the number of customers who may be affected by a complete electronics failure. In addition, Continental believes that the system noise contribution of return path data or video is virtually eliminated, and the service area is positioned for the delivery of interactive services and PCN (see Figure 2).

The cascade limitation is designed to allow for ease of network maintenance and system stability through the deployment of limited cascades of common amplifier devices. Therefore, migration to 750 MHz and beyond can be achieved with minimal change to the network. Because of RF amplifier performance, the limiting factor for 750

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MHz is composite triple beat (CTB), causing cascade lengths to be shortened significantly, which is consistent with fiber trunking.

Continental relies on five criteria to determine if AFT is economically viable for a particular upgrade or rebuild. Those criteria are bandwidth, desired performance, geographic topology, system density and the distance from the headend to the area to be served.

Of these, the two most significant AFT parameters are system performance and supertrunking requirements.

Delivering a high quality picture to the subscriber, in particular, can carry a hefty price tag. The cost per mile of a system designed with a 47 dB carrier-to-noise ratio (C/N) is approximately $15,250. For a system with a 50 dB C/N ratio, the cost per mile rises approximately 30 percent to $19,900 (see Figure 3).

"As an industry, we need to have a better idea of what the customer defines as an excellent picture," Casey comments. "There is a tremendous impact on construction costs as we improve carrier-to-noise performance. After some threshold, it just doesn't provide any perceived benefit."

Continental designs its systems and bases its financial analysis on a 47 dB C/N ratio.

### Extending fiber's reach

Another critical component in all-fiber trunking is the ability to use optical splitting to share the cost of a transmitter with the maximum number of fiber-optic nodes.

In making an AFT determination, Continental pays close attention to the link loss involved in sending a video signal to these outlying nodes, or community units.

The link loss is minimized through the use of directional couplers that split headend laser power between remote optical nodes. A directional coupler, or tap, has an unequal splitting ratio. This means that some portion less than 50 percent of the laser power is coupled to one output port, with the remainder going to the other output port.

The power split for a tap could range in splitting ratio from 5:95 to 50:50 in five percent increments, providing cable television engineers with added flexibility in managing optical power budgets. Continental relies on an average of three directional couplers for every laser transmitter in the AFT structure.

Insertion loss is a key optical performance parameter for cable television system designers. It is the actual loss seen by the transmission system. Insertion loss is made up of the nominal desired splitting loss, plus a portion of the total power lost by the device, known as excess loss, and any non-ideal uniformity in power splitting between the ports.

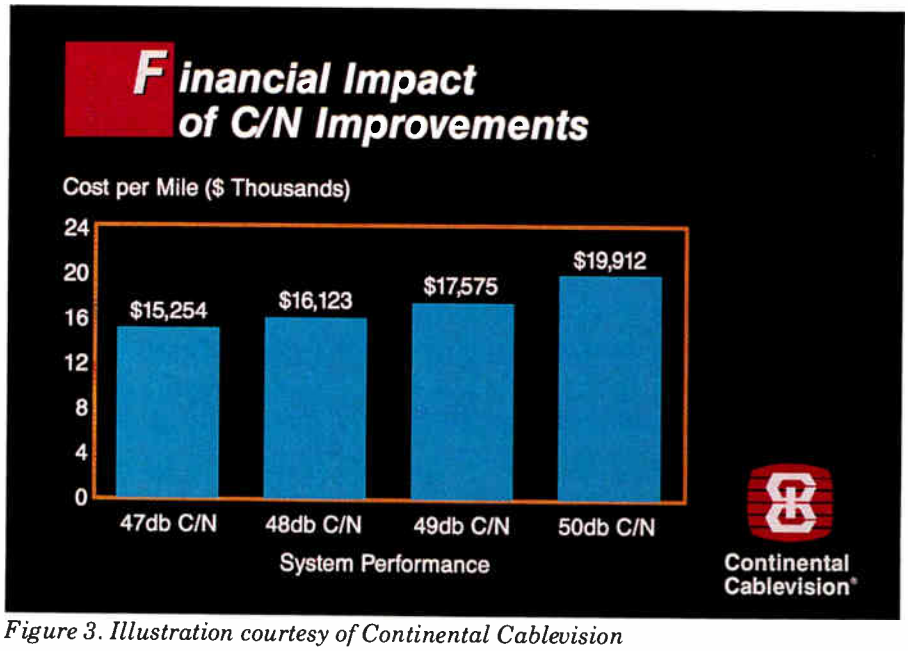


*Figure 3. Illustration courtesy of Continental Cablevision*

Usually, insertion loss is defined to be the maximum loss over the entire range of wavelengths the laser could operate over, accounting for any change in coupler loss over wavelength. Insertion loss should be specified for a given range of wavelengths at 1310 nm and/or 1550 nm.

### AFT advantages

Casey believes that AFT offers significant improvements in reliability and total viewing downtime vs. tree-and-branch architectures. In fact, his estimates indicate that AFT can provide 80 percent less downtime than tree-and-branch (see Figure 4). From a picture quality standpoint, Continental expects AFT to rival Super-VHS. Viewed within a financial context, AFT is designed to maximize Continental's long-term capital investment.

The AFT financial model breaks out project costs in four major categories: labor, cable, optical fiber and electron-

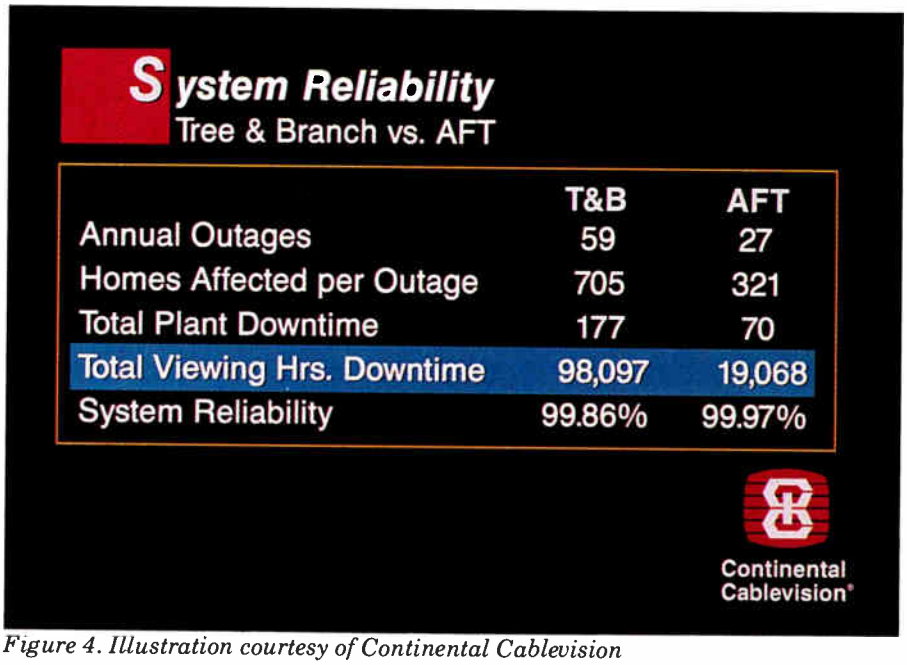


*Figure 4. Illustration courtesy of Continental Cablevision*


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ics. The labor category includes make-ready costs for utilities and police details, and can amount to more than $1,000 per mile. Also in this category are contract labor costs for the placement of strand and cable, including optical fiber and "wreckout" of the old plant. In-house management and administration round out the labor category.

The cable category includes costs associated with distribution and express 0.625-size equivalent loss cable, that can run $1,950 per mile. Continental's fiber-optic system costs, approximately $4,200 per mile, are based on an optical cable containing an average of 12 fibers.

The electronics make up the largest portion of AFT expenses at $8,000 per mile. They include charges for fiber-optic electronics, RF electronics, passive components, connectors, power supplies and accessories.

Total estimated AFT cost per mile is approximately $15,150. By comparison, an all-coax cable system would have cost approximately $14,950, for a savings of only $200 over a fiber-based architecture.

"AFT maximizes the reach of fiber and associated electronics," Casey says. "It enables us to reduce the active device count by at least half an active per mile. Less active devices mean fewer outages and a reduction in parts inventories.

"Essentially, this architecture enables us to shift more of our investment dollars from labor costs to tangible assets, such as optical fiber and system electronics that transcend the balance sheet," Casey continues.

Total estimated AFT cost per mile is approximately $15,150.

Continental estimates that for an incremental capital investment in deployment in the AFT architecture, it can build an infrastructure that will position its network for the next generation of fiber-driven services. This ensures that the investment made today in rebuilding a plant will yield strategic results in future years.

"Competitive positioning is every bit as important as the rate of return on our investment in new delivery systems," Casey remarks. "That's why fiber is an essential part of Continental's philosophy for incorporating technology into our strategic planning."

### Toward a fiber infrastructure

Continental's all-fiber trunking approach was put to the test in a rebuild of one of its New England systems. This system contained just under 200 miles of 300-MHz plant. It delivered 36 channels to approximately 11,000 subscribers. The longest overall cascade was 42 amplifiers from the headend, with a density of 82 homes per mile.

In 1988, Continental's first approach involved a 550 MHz rebuild using two fiber nodes from the headend to central points in the city where 12 amplifier cascades would serve system extremities. Two years later, it became apparent that a full-scale rebuild of the system was required.

The need for increased channel capacity dictated that Continental invest in optical cable, rather than additional

RF electronic equipment over coaxial cable, for this application.

The MSO's engineering staff reviewed a number of different rebuild scenarios, comparing 450 MHz to 550 MHz transmission using All Fiber Trunking as well as conventional designs. In addition, 450 MHz loading with 550 MHz spacing was also part of the analysis.

Given that the system was in the metro Boston area, a major television market, and overlapped a smaller market, Continental determined that more than 16 off-air stations and multiple access channels would require coverage. This would necessitate 78 channels of bandwidth during the franchise term.

Continental immediately ruled out any 450 MHz approach that would restrict it from expanding to 550 MHz because of the prohibitive cost of upgrading.

"If we had built AFT with 450 MHz loading and upgraded to 550 MHz later, the cost to upgrade within the first nine years of the 10-year franchise period would have wiped out any anticipated savings," Casey notes. "In fact, the price tag for deploying 450 MHz electronics during the first nine years, then upgrading the 550 MHz, would have been approximately $270,000 higher than if we have begun with 550 MHz."

Over a nine-year period, an upgrade to 550 MHz would have cost an incremental $26 per subscriber. Continental also examined 550 MHz spacing and RF electronics with a single laser driving 60 channels. However, it was determined that the cost savings were only about $140 per mile with no system power savings to augment this approach. Ultimately, the MSO went with a 550 MHz AFT delivery system.

Continental is installing 35 sheath miles of fiber optic cable for this system rebuild. The individual fiber count per cable averaged 12 fibers.

### Continental's fiber philosophy

For economic and strategic reasons, optical fiber will have a major influence on technology decisions at Continental Cablevision throughout the 1990s. It's all part of Kevin Casey's vision of the future.

"We intend to maximize lightwave transmission's potential in the coming years," Casey says. "Fiber is field-proven and it proves in financially. From a practical standpoint, fiber makes sense today for cable TV." ■

# The 1550 imperative

## Preparing your network for tomorrow's business needs

As the cable industry intensifies its efforts to expand the scope and flexibility of its networks, the time has come to seriously consider the technological advantages associated with optical transmissions in the 1550 nm wavelength "window."

This is all the more the case in the wake of a spate of recent findings that demonstrate the benefits of 1550 technology can be achieved without suffering the penalties that were once thought to be associated with implementation of 1550 transmissions over standard singlemode fiber.

As noted in experiments by American Television and Communications Inc. (ATC), General Instrument Corp., Scientific-Atlanta, Synchronous Communications and others in many publications and industry forums, fiber optimized (dispersion nulled) for operations at 1310 nm is perfectly useful for operations at 1550, either as a result of dispersion compensation techniques or narrow linewidth lasers, which are likely to be the transmitters of choice at 1550.

Summarizing these findings, Dr. Aleksander T. Futro, director of technology assessment for CableLabs, reports in the organization's technology newsletter for February/March that "it is very likely that several types of electronic or optical compensation will be available in the future to facilitate the use of existing standard singlemode fiber with 1550 nm AM-VSB technology. This should eliminate any concern about obsolescence of standard singlemode fiber being installed and used today at 1310 nm."

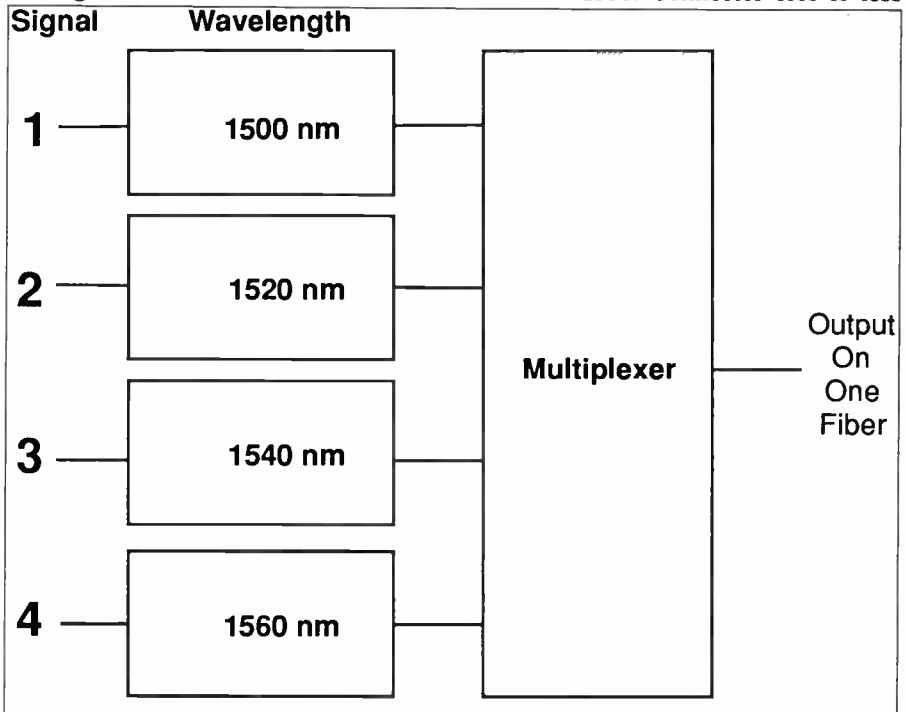
But Dr. Futro also notes that, presently, the industry consensus is that "continued improvement in 1310 nm devices, particularly as related to linearity and output power, may negate many of the perceived advantages of 1550 nm devices for AM video."

### Outlook is changing

This "consensus" concerning the merits of 1310 vs. 1550 for AM video is undergoing rapid re-evaluation and could well change for reasons noted below. But, when it comes to building networks for the long term, as anyone involved in a rebuild must do, the question shifts from the narrow issue of how to cheaply employ fiber for point-to-multipoint distribution of AM-VSB signals to the far more complex issue of how to accommodate the evolution to digital communications and, with it, the expansion of the business base of the cable industry.

In this light, and with the new generation of optical components now coming on stream for use at the 1550 window, the perspective on 1550 inevitably changes. The new thinking about cable television network architectures requires new thinking about 1550.

*By Vince Borelli, President, Synchronous Communications Inc.*




Synchronous Communications' Multiple Wavelength Multiplexer Design

### Intrinsic advantages: 1550

There are two major advantages naturally intrinsic to this wavelength window and many other associative advantages that have to do with the development of components and devices that are married to operations at 1550, either by laws of physics or for reasons tied to the perceived market potential of 1550 as the wavelength of the future.

Fundamentally, the physics of 1550 nm vs. 1310 nm is such that attenuation is less at 1550, detector efficiency is greater and connector or splice loss is lower.

Over fiber dispersion nulled at 1310, attenuation of transmissions in the 1310 nm window is approximately 33 dB/km, vs. 22 dB/Km for transmissions at 1550 nm over the same fiber. And PIN detector efficiency is about 0.5 dB better at 1550. Connector loss is less because the mode field at 1550 is a bit larger, though the difference here is not a major advantage.

The combination of these advantages is such that, as Dr. Futro notes, the distance a signal can travel for any given performance parameter, assuming equal power, noise and linearity levels of the 1310 and 1550 transmitters, is 35 percent greater at 1550.

### EDFAs

Along with these intrinsic qualities, there are advantages at 1550 associ-

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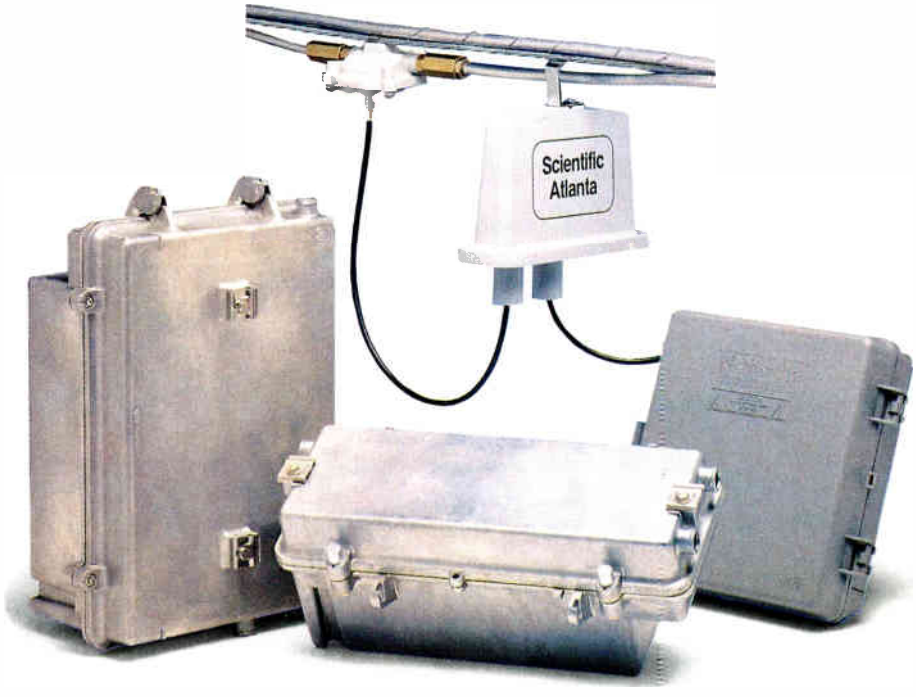


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ated with emerging technology. Some of the technical developments pointing in this direction are well-known, especially with regard to optical amplifiers. Others need to be more widely recognized.

Erbium-doped optical amplifiers have entered the commercial mainstream and are being adopted by a number of CATV manufacturers for use in cable television. Having been demonstrated as extremely linear (no significant contribution to second- or third-order distortion), the outstanding issues regarding fiber amps concern noise contribution weighed against signal gain and costs.

Noise contribution, of course, is important, especially where AM-VSB signal propagation is concerned. But so is gain. If, as has been demonstrated, an EDFA positioned at the transmitter permits splitting of AM signals from a single laser over two or four times as many links for any given carrier-to-noise target as compared to a system driven by a 1310 nm laser, the noise penalty is not this issue. Basically, it's a matter of cost.

The same holds for positioning of the fiber amplifier in the field to achieve amplification at a node and splitting of the signal for deeper penetration over fiber. Only here, given the limitations of 1310 nm technology, the cost/benefit comparison must be made with coaxial cable, and this is a more difficult equation to work through.

But whatever costs one must assign today to optical amps and 1550 nm technology in general, it is inevitable that those costs will come down as the technology gains acceptance.

At Synchronous, we believe the cost/benefit equation will favor 1550 for multiple link transmission from the primary transmitter very soon; probably by the beginning of 1992. How the cost/benefit scenario plays out for field placement of the amplifiers and deeper extension of fiber depends on the revenue value of the business expansion which such extensions allow.

### Multiple wavelength technology

The good news where 1550 is concerned, however, goes well beyond one-on-one comparisons with 1310 technology in the context of today's AM-dominated cable service. For, along with EDFAs, 1550 technology involves the initiation of multiple wavelength multiplexing, which represents the most promising means to multiple service implementation yet seen in cable television.

As new laser structures permit ever narrower linewidths in the primary signal mode, it is becoming feasible to think in terms of multiple wavelengths within a given wavelength window. New multi-quantum well distributed feedback lasers coming into the marketplace operate at linewidths that are a fraction of the linewidths of standard DFBs.

As a result, a number of component manufacturers now have multiple wavelength multiplexers and demultiplexers available or in the pipeline which passively combine and separate lightwaves spaced as close as one or two nanometers apart. In addition, new types of tunable filters are coming on line which permit selection of one wavelength out of many without requiring the complex matching of frequencies and polarities between transmitters and receivers that are com-

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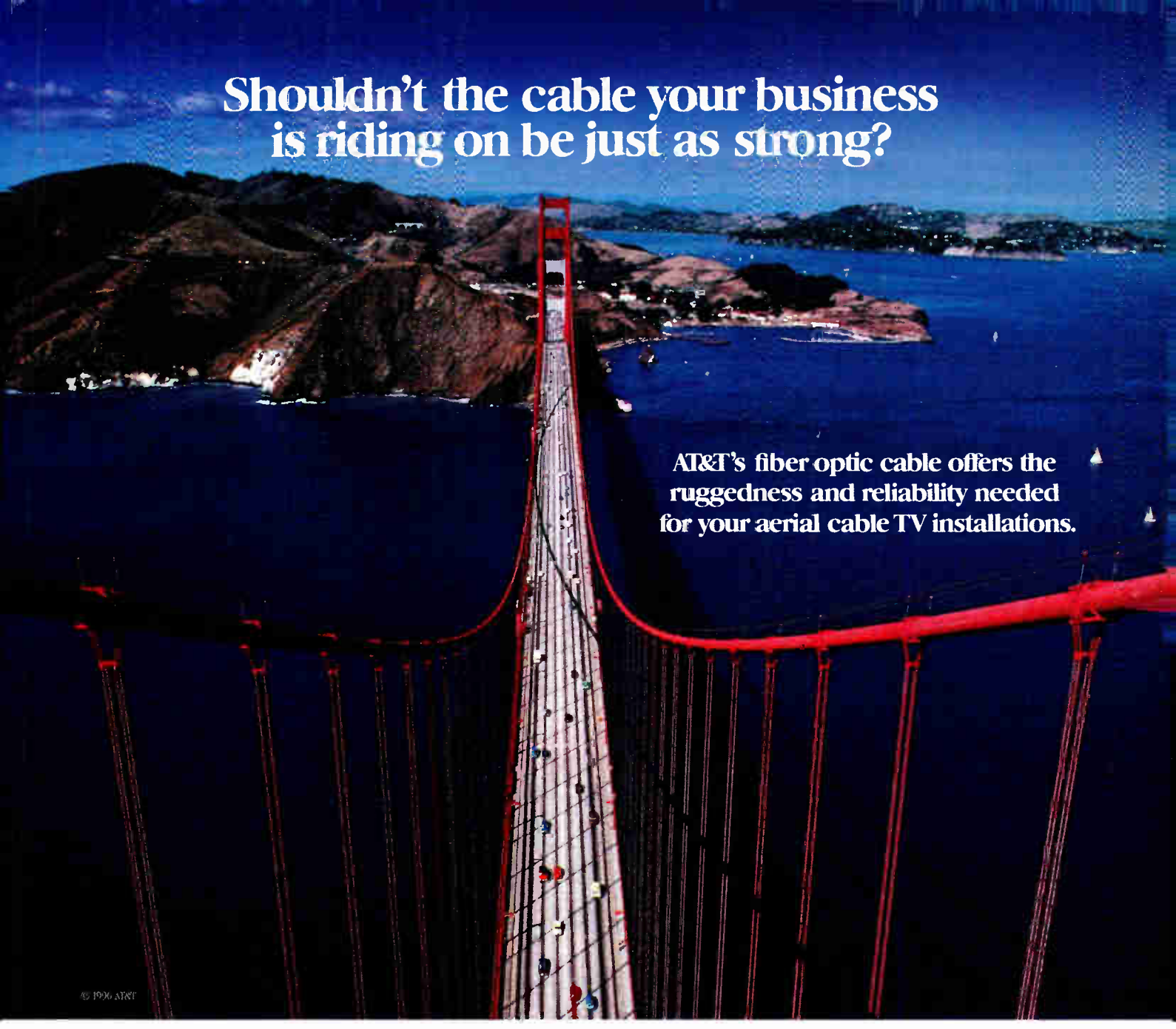


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monly associated with multiwavelength "coherent" systems.

A demonstration of a rudimentary application of this new technology will be held at the SCTE Cable-Tec Expo in mid-June. In the demonstration, signals from four transmitters, operating at different wavelengths between 1500 and 1560 nm, will be combined on to a single fiber and passively demultiplexed at the receiver.

This simple demonstration will illustrate how a cable operator could, for example, put 60 channels of AM, a package of digitally compressed services, interactive educational services and dedicated digital telecommunications services onto a single link, separate them at the node and distribute them on a targeted basis over the feeder plant to designated customers.

There is nothing exotic about this technique, insofar as it uses off-the-shelf distributed feedback lasers and commercially available multiplexers. But what is shown is only the beginning of where multiple wavelength technology is headed.

British Telecom Research Laboratories recently provided a glimpse of the near-term potentials of this technology. In a lab test, BTRL showed that it could employ two EDFAs and 12 narrow linewidth lasers in conjunction with 1x7 couplers and a newly designed tunable grating filter to passively distribute several hundred uncompressed digital video signals over a network capable of serving several million people.

> The important thing right now is to bear these developments in mind as the planning for major construction projects moves along.

As another case in point, IBM recently announced it is designing what it calls a "rainbow" of all-fiber local or wide area network, where a separate wavelength is assigned to each node on the network. Signals are chosen at each node by a tunable fiber Fabry-Perot filter that can select a wavelength from multiple wavelengths spaced as little as one nanometer apart. This filter, produced by Micron-Optics of Atlanta, is commercially available.

A prototype of the first generation of the system, employing passive star couplers capable of serving 32 nodes, was recently demonstrated at IBM facilities in Westchester County, N.Y. The company's goal is to produce a network employing 1 Gbit/second transmitters operating at 1,000 different wavelengths and serving 1,000 nodes before the end of this decade.

The implications of such technology for any type of telecommunications network, including CATV, are obvious. And, of course, it won't require development of 1,000 wavelength systems for this technology to prove useful in cable. Indeed, the emergence of multiple-wavelength and EDFA technologies into the commercial mainstream suggests that operators should not wait to begin factoring these capabilities into planning for major network rehabilitation projects.

### 1550 and planning for the future

The industry's planning for enhancements of cable architectures embraces three major concepts, all of which will be facilitated through implementation

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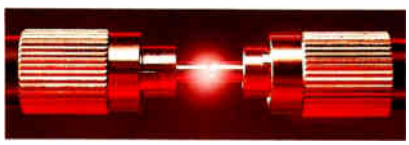

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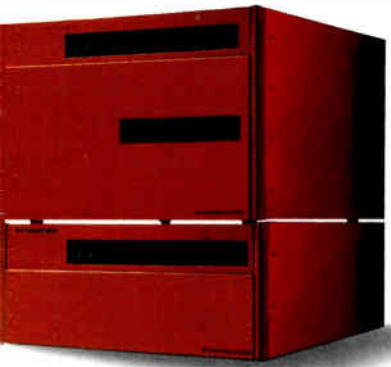

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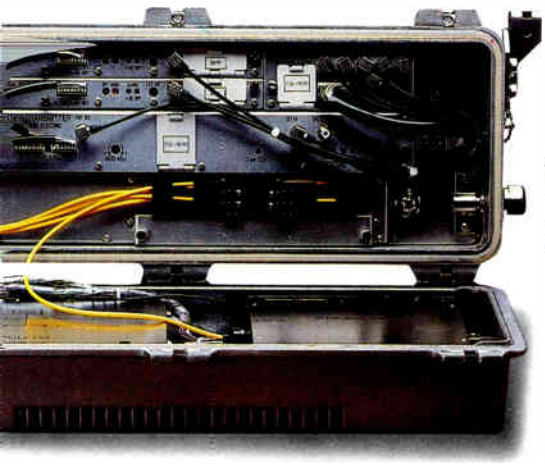

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of 1550 technology:

- Regional backbone interconnectivity (supertrunking). In the wake of industrywide acceptance of fiber as the means to consolidating contiguous systems under common ownership into a single system served by a headend and several primary hubs, many MSOs are looking at ways to establish a regional fiber backbone that serves as a bidirectional, fully redundant regional metropolitan area network linking disparate franchises for transport of everything from local programming and ad insertions to non-entertainment business services.

It's not hard to envision such a backbone, operating as concentric, bidirectional rings, carrying many categories of services, each assigned its own wavelength in the 1550 window. Such a ring might run to 100 km or more to serve a metropolitan regional cluster of separate headends and franchises. It would be all-digital and would require only one or two EDFAs, and its capacity would be practically limitless.

- Provision of multiple types of services over share links beyond the headend into the trunk and feeder portions of the network. The sharing of the distribution network for multiple types of services, including educational, business, PCN, digitally compressed entertainment and standard network entertainment is a prerequisite to cost-effective expansion of the cable business beyond its traditional service base.
- Deeper penetration of fiber, and with it, implementation of a star/bus topology that limits the coaxial plant to serving only 1,500 or fewer customers per fiber node.

Greater use of fiber, of course, goes hand in hand with the layering of many types of services into the distribution network. The deeper fiber goes, the greater the flexibility in targeting services and in varying the categories of service offered to all types of customers. And the easier it is to accommodate upstream communications.

EDFAs, of course, offer the promise of extending fiber as far as necessary, including all the way to the home, if that's where the industry eventually wants to go. Combined with multiwavelength technology, EDFAs open the way for passively distributing hundreds and even thousands of digitally compressed signals to whatever point serves as the fiber termination mode.

Other types of services can be layered in by wavelength and targeted to the node service areas, perhaps in conjunction with co-locating the fiber node with the radio terminal in a PCN network. Upstream, each node could operate at a different wavelength, greatly simplifying the trafficking process in a residential voice system such as PCN.

Without taking advantage of the rapid emergence of new lightwave technology tied to the 1550 nm window, the cable industry would be hard-pressed to accomplish these networking goals effectively.

Fortunately, it looks like the new generation of 1550 products will be coming on line at about the time the industry determines exactly what its market expansion potential is and where it needs to go with its architectures to accommodate that expansion. The important thing right now is to bear these developments in mind as the planning for major construction projects moves along. ■

# The Seattle turf war

## Local loop competition involves some familiar faces

Look to the Pacific Northwest for one of the nation's more interesting experiments in local loop competition. For in Seattle, Wash., Electric Lightwave, an alternate access carrier, will be competing against Digital Direct, an outfit affiliated with Tele-Communications Inc., US West and GTE.

### Ironies within ironies

But the ironies don't end there. Electric Lightwave's parent is Stamford, Conn.-based Citizens Utilities, which provides electric, gas, water, cellular, telephone and paging service in 12 states. And sitting in the chairman's seat at Citizens is none other than Leonard Tow, chairman of Century Communications Corp., the 17th-largest U.S. cable operator.

That, however, still isn't the end of the ironies. ELI's marketing vice president is John Rivenburgh III, who for many years worked for Rogers Cablesystems in Portland, Ore., running that cable operator's institutional network.

In any event, it appears the cable industry will soon find out whether the payback on alternate access, a $150 million business today, is as rapid as the "six months" Dr. John Malone, TCI president, believes it is.

ELI appears to be the first "alt" to build an all-SONET network (at least west of the Mississippi River), having activated a portion of its Portland, Ore. network in February to link a U.S. Sprint point of presence (POP) with a North Pacific Cable POP. In April, Teleport Communications announced it began operating a SONET-based network in Chicago. Both ELI and Teleport Chicago are using AT&T Network Systems digital access and cross-connect systems.

Ops interested in how a cable TV network might provide alternate access services should study the latest thinking on the subject by Optical Networks International, whose new communications infrastructure incorporates such capabilities and reflects the thinking of numerous major MSOs preparing to dip their toes into the new waters (*CED*, May 1991, p.82). Jones Intercable's Jones Lightwave subsidiary and American Television & Communications are among the MSOs who believe alternate access may be a nice fit for cable.

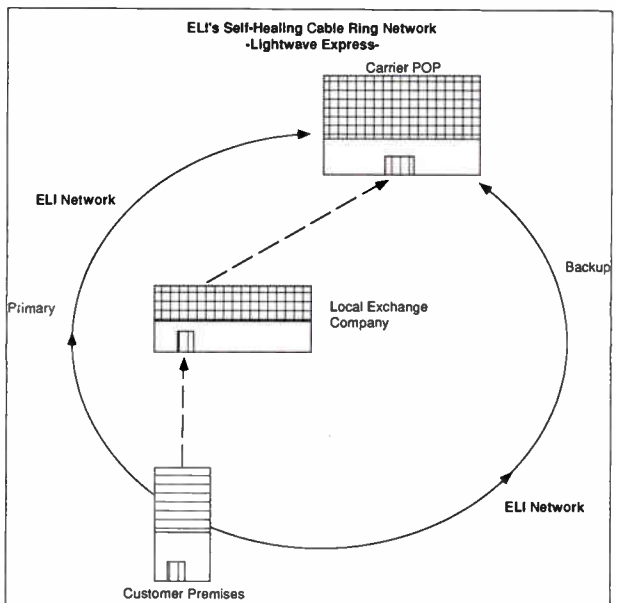


Figure 1

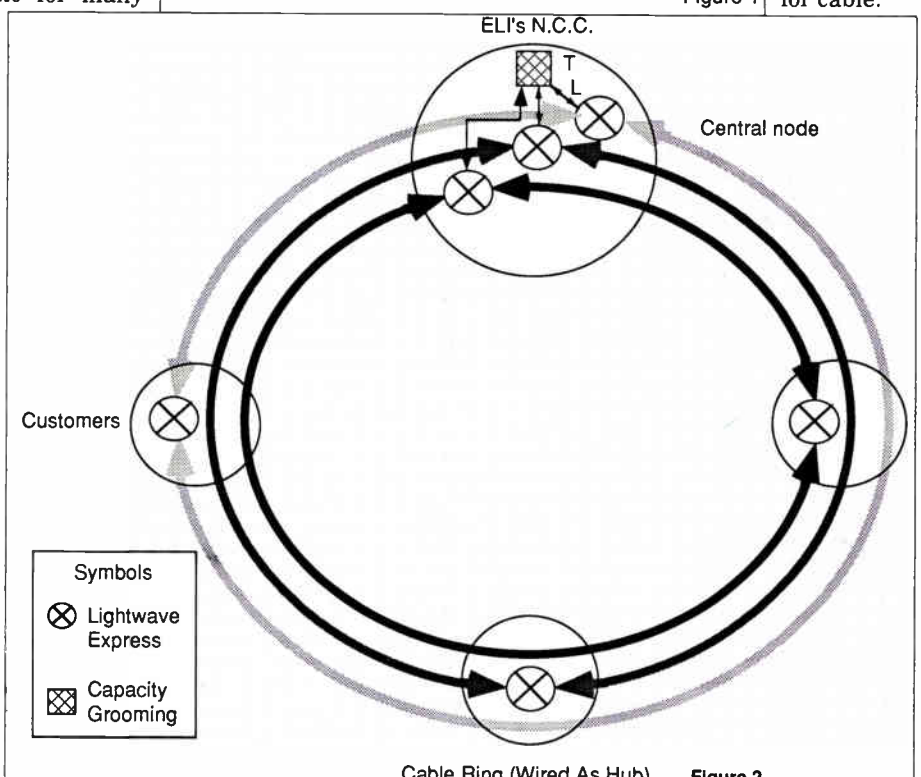


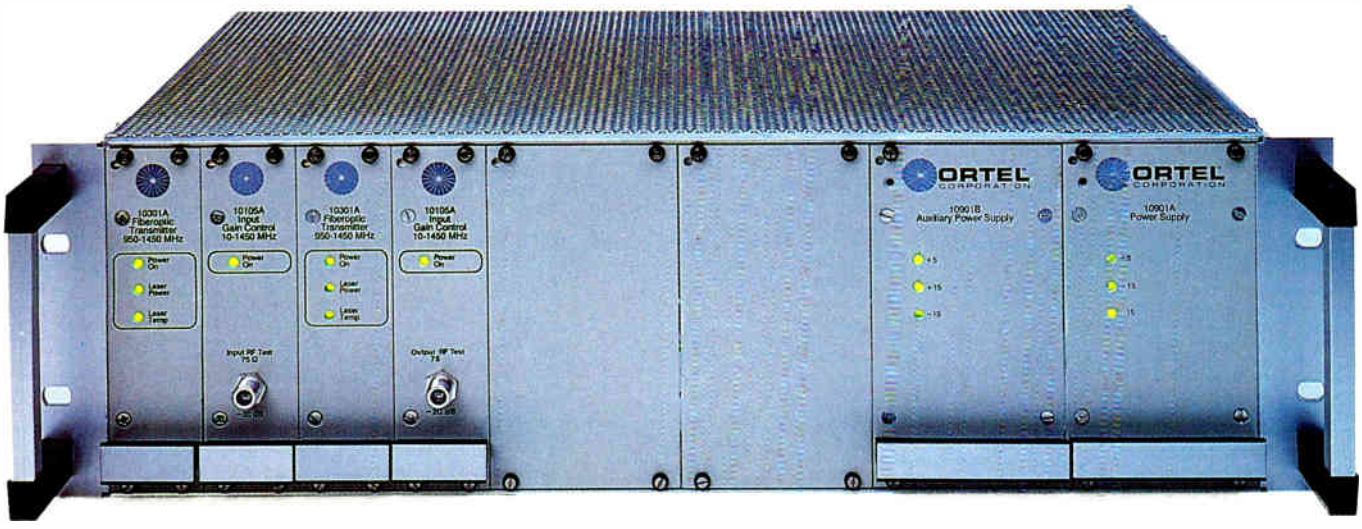
Figure 2

### The battleground

In Seattle, ELI will be squaring off against US West and Digital Direct in the downtown areas. But ELI will face GTE on the east side of Lake Washington, a fast-growing suburban and business park area. Neither ELI nor Digital Direct will find US West and GTE napping.

Aware that a primary attraction for alt customers is circuit redundancy, US West is actively pursuing a whole range of services to provide routing diversity and automatic network

# Freedom package.

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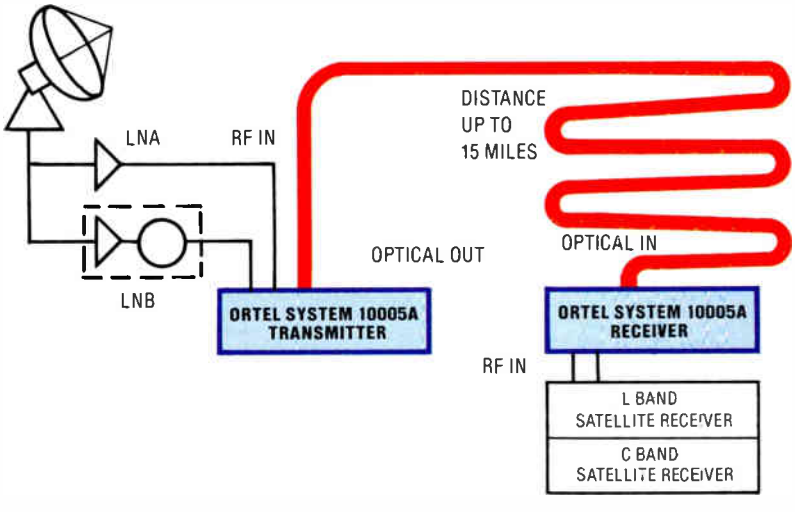


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backup, according to Kathy Stephens, US West director, market support. US West also plans to lobby regulatory bodies for pricing flexibility whenever effective competition exists. That may prove an important weapon in competing with other providers that generally price their services 20 percent to 30 percent below US West's, although they also tout customer service and route redundancy features, Stephens says.

ELI plans a business strategy that stands in contrast to policies pursued by many other alternate access carriers (AACs). To date, most have concentrated their efforts on downtown business core areas. And while ELI will do likewise, it plans a "fairly quick move out to the suburbs," says Rivenburgh. ELI's strategy is to chase pockets of business customers in burgeoning suburban business parks, including those that may also have operations downtown, says Rivenburgh. Cable operators may note the similarity between this sort of customer base and their own. Especially in suburban areas, pockets of business customers are interspersed with housing developments.

### A 'ring of rings'

Operators might also note that relatively little cabling is required to build such networks. Ultimately, over a period of perhaps 10 years, ELI envisions a "ring of rings" network stretching 150 to 200 miles in the Seattle area and 60 to 65 miles in Portland. Intitially, though, the network is being constructed in phases, almost on a "build as you acquire customers" basis.

Already, as most other alts have found, the initial customer demand is for access to interexchange (long-distance) carrier POPs. This typically takes the form of interconnections between IXC POPs themselves, said Rivenburgh. The anticipated second stage of ELI marketing will target customer-to-POP connections, essentially allowing a business customer to bypass the local exchange carrier network and run access lines directly to an IXC's point of presence. In a third stage, local area network connections between buildings will be sought, said Rivenburgh.

In building its ring network, ELI has avoided having to dig up streets or fight for conduit space because its network is strung on utility transmission lines that ring most cities, using armored cable or Alcoa Fujikura optical ground wire, said Rivenburgh. Because ELI's network avoids existing LEC cable routes and conduit, it is able to provide a fully "route-diverse" network, a key attraction for many business customers seeking to backup their vital telecommunications systems.

### Coming to a city near you

Rivenburgh professes no special knowledge of how big the access business might be and simply notes that the US West tariff for a dedicated DS-3, 45 megabit-per-second line runs about $2,800, down from $5,400 a year ago. DS-1 lines offering 1.544 Mbps service are running about $275 a month, he says. And while ELI hopes to offer a lower-priced service, company officials say they "sure as heck hope the business doesn't boil down to a pure price issue." In fact, ELI hopes to capitalize on its ability to provide better customer service to "10,000 customers where US West has 100,000," says Rivenburgh.

For its part, Digital Direct appears to have targeted AAC networks in

about 15 different cities including Chicago, St. Louis, Denver, Plano and Richardson, Texas.

Other operators considering similar ventures in medium-sized cities should note the positive impact of a recent Federal Communications Commission decision that could easily widen the market for alternate access from the 20 largest U.S. cities to perhaps the largest 50 to 75 metropolitan areas.

In a unanimous vote, all five FCC commissioners gave their support to a proposal that would open access to local Bell operating comapny central offices and wire centers to independent carriers such as alternative access providers.

Once the proposal has gone through a period of public comment, a final order authorizing the changes could take effective in a year or so. The change would be important because it would immediately change the economics of alternate access, lowering the cost to a smaller or middle-sized busines to connect to an alternate access carrier. Up to this point, only larger firms could typically justify the cost of high-bandwidth private circuits connecting directly to an alt network.

> The cable industry will soon find out whether the $150 million alternate access payack is reachable within Malone's 'six months.'

But the new decision means customers will be able to use Bell local loop facilities up to a central office, then tie into the alternate carrier's facilities, which will be co-located with the Bell central office switches.

At present, as many as 29 alternate access networks are operating or under construction in major U.S. cities, according to Newport, R.I.-based Kessler Marketing Intelligence. By the end of 1991, those firms should be generating $200 million in annual revenues, with the lion's share of the funds generated by customer-to-IXC circuits. According to Kessler researchers, as much as 75 percent of all early revenues are generated this way.

Over a period of time, though, most alts could find that the percentage of business derived by private connections between one firm's branches in a single city, especially to provide local area network interconnections, could grow to represent 65 percent of total business, Kessler researchers say.

And while cable operators dipping their toes into the market typically can offer significant price advantages compared to the local telephone operating company, that may not be the big attraction. For many have found, to their surprise, that the price of service isn't as important to large customers as route diversity and circuit protection. Large customers simply don't want to take the chance that their communications systems can crash because of a cable cut, for example. One operator even found that a local utility was so desirous of circuit protection that it offered free pole attachments as an inducement to construct the alternate network. ■

*—Gary Kim*

# Greater Media's signal security success

**Editor's Note:** *Again this year,* CED *magazine is proud to reprint the winning submissions in the NCTA's Office of Cable Signal Theft Signal Security Ideas Competition. Cable piracy is an issue that continues to nag cable operators everywhere. These two papers should be particularly timely because of the widespread attention given to the subject last month when numerous subscribers were shut down in Queens, New York.*

Greater Media Cable's Philadelphia system passes over 150,000 homes, providing service to over 66,000 subscribing households. In 1990, the system had a pay-to-basic ratio of 140 percent. Approximately 20 percent (representing 90 miles) of the original system is 17 or more years old, and was until recently a 36-channel programmable system in which only Home Box Office (HBO) and The Disney Channel were scrambled. The other two pay services were trapped. This portion of the system was recently rebuilt and upgraded to a 75-channel addressable system.

## Background

The urban Philadelphia market had historically been plagued with persistent theft of service problems prior to rebuilding the original system. The most common forms of theft were made through unauthorized connections at the tap, and by defeating the trap system utilized for two of the pay services.

After introducing addressable technologies and scrambling all but the access and off-air services in newbuild areas, the system was then plagued with a growing black market in illegal chips. The proliferation of counterfeit chips effectively compromised the security of the new state-of-the-art converters which had been introduced.

In addition, the system's revenues were being eroded by the rampant commercial theft of basic, premium and pay-per-view services which were pirated by the large network of neighborhood bars.

*By Mark J. Shuster, Assistant General Manager, Greater Media Cable*

Over the years, the theft of service situation had been brought to the attention of the criminal justice system; however, enforcement response and sanctions were insignificant. In some cases, the sanctions were so minimal, the offenders of commercial establishments viewed the fines as "the cost of doing business." The net result was that the community perceived the theft of cable service as a non-criminal matter.

Prior to the inception of a coordinated theft of service program, Greater Media Cable's Philadelphia system had experienced no effective measure of reducing such theft. Although unauthorized connections were disconnected upon detection, no specific follow-up or tracking of the incident would occur. And, no formalized procedure existed for reporting "tips" of unauthorized service use, and no company employees were responsible for the ongoing detection or follow-up required.

It is estimated from the results of 1990's theft of service campaigns that the retail value of the services stolen in 1990 alone was approximately $1.1 million—a figure that translated to over five percent of the system's annual revenues.

In 1990, Greater Media Cable launched a theft of service program aimed at three key areas:

- To curtail the proliferation of counterfeit converter chips.
- To conduct a system tap audit detecting both active piracy and company error.
- To orchestrate a series of "sting" operations aimed at commercial offenders.

The following summarizes key elements of each of the three areas of focus that were integrated into Greater Media's 1990 business plan.

## Attacking counterfeit chips

To attack the counterfeit chip market within the Philadelphia franchise area, Greater Media retained the services of a private investigator with previous experience as a federal agent for the U.S. Treasury Department. The investigator had set up a number of counterfeit "sting" operations in the past, had experience in establishing a network of informants, and for targeting distributors of counterfeit goods.

The investigator performed a comparative analysis of customer service accounts over several periods of time. The evaluation focuses on changes in customer accounts (for example, downgrading of service to "basic" packages) during the current period in comparison to past periods. The time series evaluation designs indicated that there were certain "unusual" trends in which a number of customers residing on the same street had changed their service to a basic package.

In addition to the analysis, the investigator cultivated credible informant contacts, who then provided the necessary "street" knowledge, designed to enhance information regarding the illegal chip market. This effort also yielded additional converters with counterfeit chips.

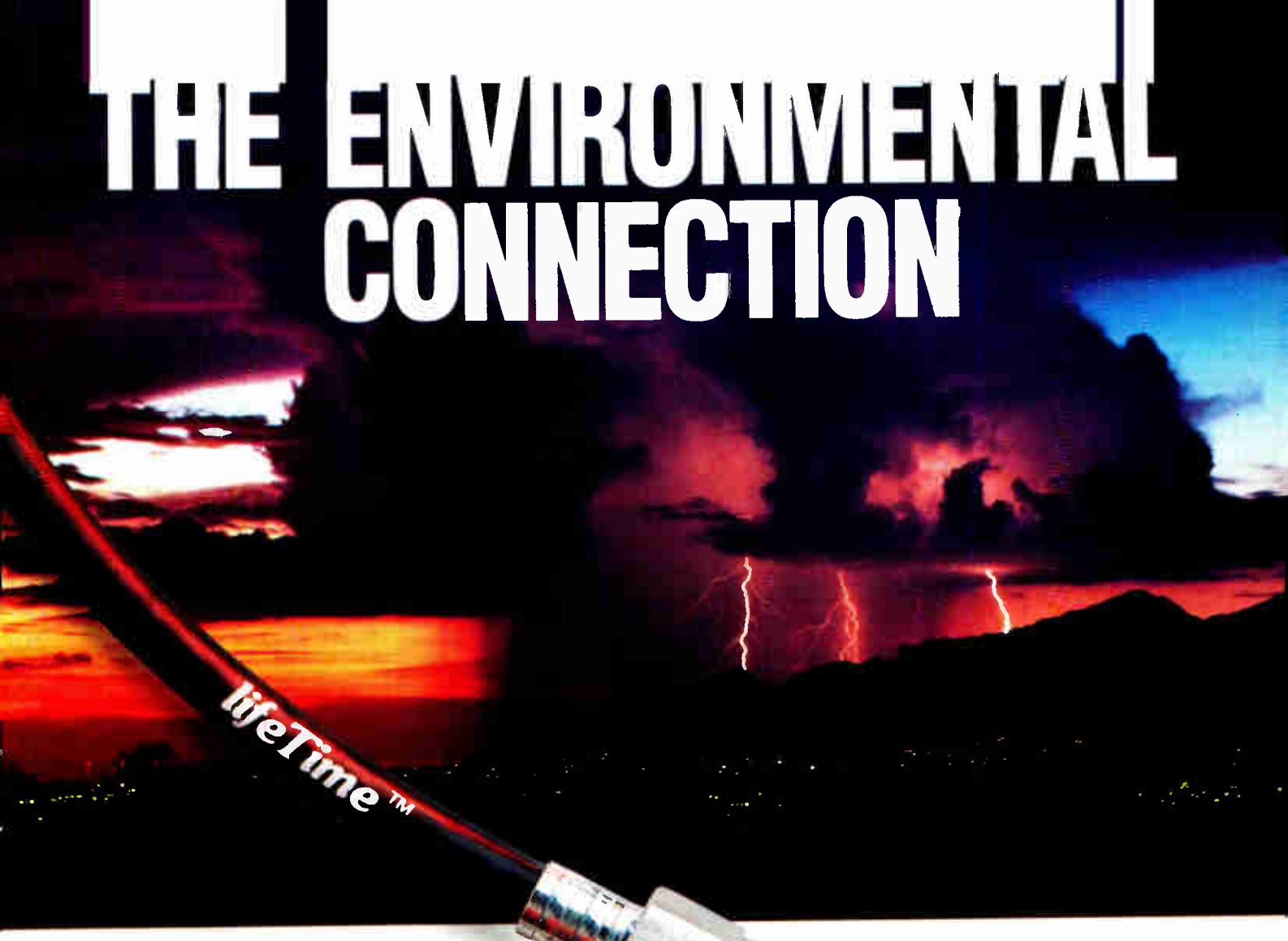
Greater Media Cable then solicited the help and resources of General Instrument's design and engineering staff to develop a customized "disabling signal" that could be sent from the system's headend to effectively disable converters which had been modified with the counterfeit chips.

Each of the disabling techniques utilized by General Instrument and Greater Media Cable were referred to as "bullets." Each bullet released into the system rendered a variety of symptoms that disrupted the reception of the illegal chip users.

Prior to the release of each of the disabling bullets, internal reporting procedures for detecting and following through on each of the leads projected to come in were prepared and distributed system-wide—so that each and every employee was fully aware of the steps to take when an illegal chip user called the system.

Each of these service calls were then documented and "tagged" within the billing system. This allowed easy identification of problem neighborhoods and suspected illegal users, so that technicians in the field could be dispatched to retrieve the equipment for inspection. Then, by designating only two members of the system's manage-

# THE ENVIRONMENTAL CONNECTION

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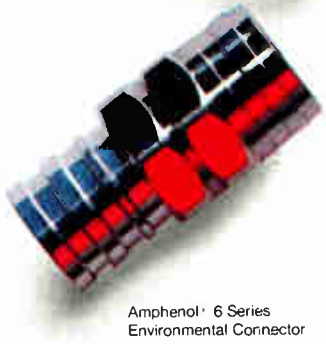

Amphenol 6 Series Environmental Connector

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The Crown Slide-Out Tray Unit is ideal for storing packaged items; while smaller carry-ons can be organized in tie-down storage trays. These trays feature a unique 250-pound capacity slide system, and the heights of the trays are adjustable.

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Reader Service Number 43

ment team to receive all of the leads and compile all data on each discovery, illegal users were contacted by phone and/or certified mail. In the notification, the illegal user was alerted as to the extent of damage made to the equipment—and the severity and penalties involved in such tampering.

Each of the subscribers found to be using an illegal chip—or in cases where equipment was returned with signs of tampering or attempted entry into the converter—were charged $50 minimum. The charge was billed directly to the subscriber's account (pursuant to provisions of the cable company's subscriber agreement).

The results of each of three separate counterfeit campaigns were as follows:

- "Silver bullet" campaign (December 1989 to February 1990): 98 illegals discovered; approximately $5,050 recovered in lost revenue/damage fees.
- "Rubber bullet" campaign (March to September, 1990): 154 illegals discovered; approximately $8,050 recovered in lost revenue/damage fees.
- "Chip blaster" campaign (December 1990): 116 illegals discovered; approximately $6,050 recovered in lost revenue/damage fees.

The high visibility gained through the three "bullet" campaigns resulted, for the first time, in communicating a message to the entire subscriber base that the cable company was no longer willing to tolerate such theft. Moreover, the effectiveness of the three campaigns destroyed the credibility and significantly reduced future sales of the counterfeit chips.

### System tap audit results

As part of a CLI "cleanup" conducted from March through June of 1990, a system tap audit was commenced in conjunction with the CLI inspection, affecting an area representing 15 percent of the system. The cleanup effort required a physical inspection of each and every drop within designated areas of the distribution system.

Over the course of the 90-day period, the auditors/inspectors identified a total of 1,358 unauthorized attachments out of a total of 23,545 homes passed—a 5.8 percent unauthorized connection rate.

The projected annual loss of revenue for this one sample group alone was approximately $407,000.

Unlike past practices which allowed such instances to go undocumented and without recurring follow through, each of the leads were re-inspected on a second and, in many cases, third consecutive visit. All of the leads were turned over to the system's sales staff, and letters were sent to solicit the household to become a paying customer. Each of the non-subscribing leads were tagged for further re-inspections by the system's quality control personnel in future months.

The original system has since been rebuilt and the traps were removed, thereby eliminating much of the theft discovered in the "sample" area. However, this approach has similar applications for other cable operators utilizing traps.

### Commercial 'sting' operations

Until one year ago, individual bar owners could pirate signals easily without being brought to task for their actions. As is common with most commercial cable theft, boxing events were stolen more than other big events because of exclusive distribution rights and delivery methods.

In 1990, Greater Media worked in close conjunction with the regional closed-circuit boxing distributor in the area to set up a series of joint "sting" operations. By targeting the October 1990 Douglas-Holyfield pay-per-view event as the first in a series of stings, the cable company and regional promoter achieved results that yielded widespread publicity throughout a tri-state area.

By utilizing a number of the informant contacts and the street knowledge of system employees who resided within various Philadelphia neighborhoods, we and the regional promoter targeted selected bars in addition to randomly inspecting other commercial establishments during the telecast of the fight.

A private investigator was retained to assist in leading the operation, and sting teams were set up in two-man groups to assure canvassing the broadest number of establishments possible during the time the fight was in progress.

A field observation report designed for the event provided background information in the preparation of affidavits that might later be required for filing suit against the offenders. While in each of the bars where the fight was being illegally shown, the two-man team quickly canvassed the establishment to count the number of patrons, mentally noting redeeming character-

*Continued on page 68*

# Stopping the use of black box decoders

Genesee/Tri-County Cablevision, a Cablevision Industries system located in Batavia, N.Y. serves 30,000 subscribers. The system is set up as an all addressable, scrambled system, in which basic and tier are not scrambled, and six pay channels as well as pay-per-view movies and events are scrambled.

In the system, one two-person audit team oversees 71 franchised communities encompassing 781 plant miles with over 42,000 homes passed. Detection of various forms of theft of service has resulted in criminal prosecutions with resulting publicity. To date, disposition of these cases has been concluded with a 100 percent conviction rate. Because of these efforts and course of action, theft of basic cable has been reduced to one percent or less in most areas, from a previous 10 percent.

Now that theft of service is at a manageable level, the audit department is concentrating on stopping the use of black box decoders. In looking through various magazines, in addition to the "underground" electronics type newsletters, it is evident that "black boxes" are very easy and relatively inexpensive to obtain (See Figure 1).

Our goal is to eliminate the use of black box decoders and to upgrade past users of these devices, as well as to increase public awareness of the seriousness of cable theft. The audit team has three plans to achieve this goal.

### Plan A

When the cable office receives an anonymous call, letter or referral from the field staff concerning a person using a black box, the information is turned over to the audit team. The audit team then lawfully attempts to gain access to the residence reported to have a black box for criminal or civil resolution.

Should the cable thief refuse entry, the audit team will install negative filters on the cable drop feeding that residence. A filter is used for each of six pay channels, and is tie-strapped to the strand to prevent breakage of the tap. While the resident may still have the black box, it will not provide any unauthorized service.

### Plan B

The audit team also does random and selective trapping and will select basic-only subscribers in certain areas of a particular municipality for audit. Once selected, the audit team will trap out all pay channels on drops feeding those subscribers only. This will nullify the black box, if the subscriber has one.

After two weeks, sales representatives will contact each subscriber with an upgrade special. After a period of time, another attempt at upgrading basic subscribers is made, at which time the traps are removed and used elsewhere.

### Plan C

This system is fully addressable. Those who intend to use a black box know an addressable converter cannot be used with a black box decoder, necessitating the removal of the addressable converter issued by the cable company. When the cable office receives a call regarding the use of a black box converter, the call is turned over to the audit team.

> This cable theft program can be readily adapted to any cable system using addressable converters.

The auditor obtains as much information about the device as possible (color, size, length of time used, location in the home, etc.) The auditor is then dispatched to the location. Five minutes before arriving at the location, the auditor, working with the office staff, will have the suspect's converter shut off addressably. Upon arrival, the auditor will ask the resident to check his or her television to see if it is working.

If the suspect is using a black box in lieu of the company-issued converter and responds "Yes, it's working," the use of a black box is verified. The auditor will then explain the test procedure and ask to see the cable television connection. If the subscriber does not allow entry, the auditor is to refer to Plan A.

Occasionally, the subscriber will request the auditor to "come back tomorrow." In most cases, this is a simple ploy to allow the subscriber time to remove the black box from the cable lines and conceal it. On return, "shields" are applied to the F-fitting, so that the converter is locked to the incoming cable line, thus making it difficult to again attach a black box without cutting the cable lines. At this time, the subscriber is advised that a periodic check of the lines will be made to preclude leakage, bonding problems, etc. as a preventive measure.

### Applicability to other cable systems

This cable theft program can be readily adapted to any cable system using addressable converters. Plan A and B can be used in any scrambled signal system, regardless of addressability.

This program was initiated at the time of this entry (early 1991), therefore results are anticipated. Based on various sources of information (informants, etc.), we feel that 10 percent—or 3,000 of our basic subscribers—are using black boxes to receive additional services. Our goal is to upgrade 20 percent, or 600 additional services. At this goal, we will stop annual losses of $473,040 and generate annual revenue of $78,840. In addition, the publicity generated by the arrests of cable pirates, coupled with the uncertainty that the box may not work, will no doubt slow the spread of these devices, while we work at the elimination of the boxes already being used.

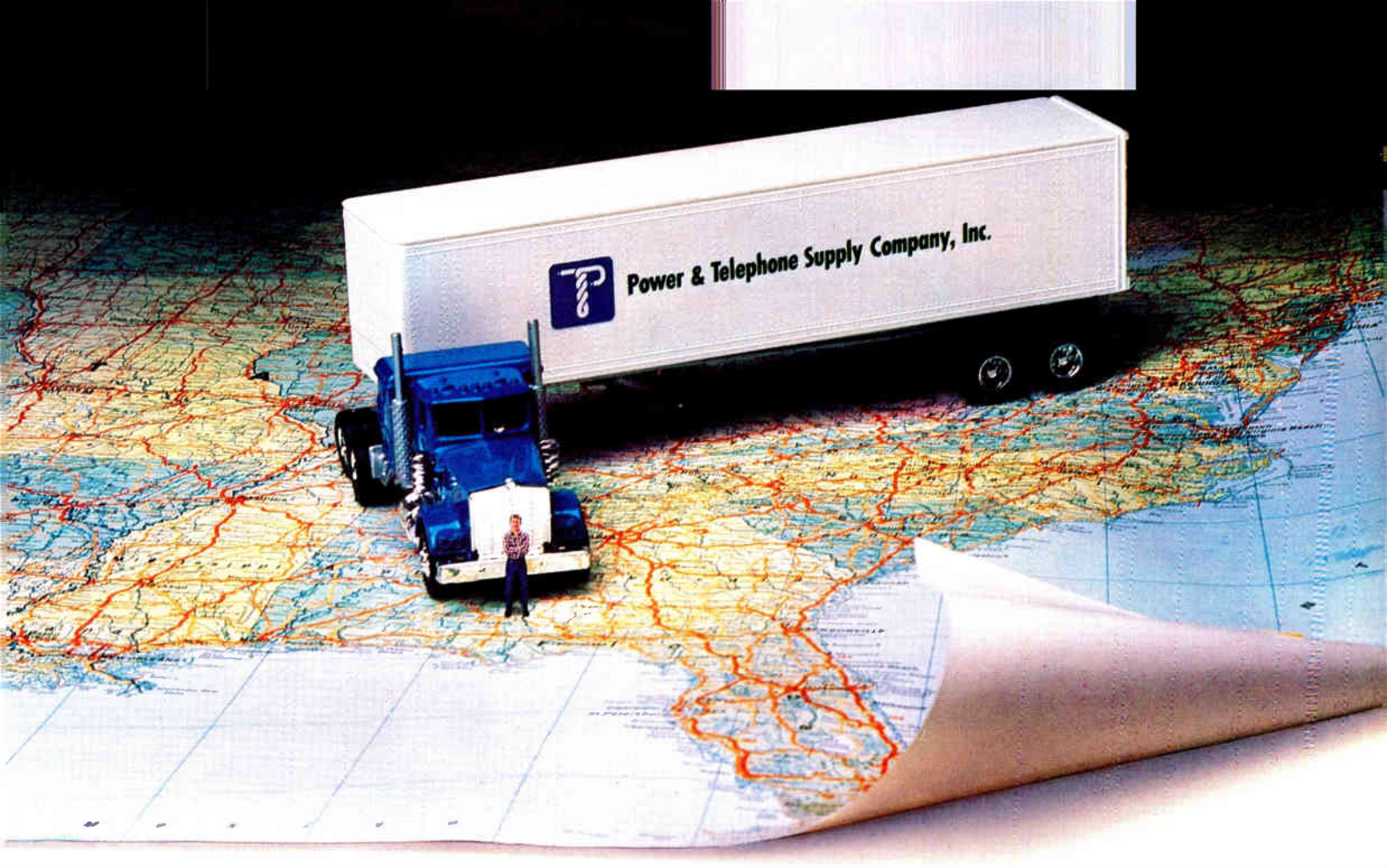
### Trial run

Recently we took Plan C for a trial run. One particular person was reported as having a black box decoder for over a year. He had basic cable and HBO, and therefore would have had to use the system's converter to receive HBO (or a black box). He then allowed us to check the cable television connection.

At that time, we discovered the black box that had been in use for 17 months. The user was arrested on December 17, 1990 by the New York State Police for theft of services and possession of burglar's tools. Cablevision is requesting $1,222.30 in restitution. In addition, this person has retained services and upgraded an additional outlet.

Since the inception of the audit team in 1987, we have received over 244 column inches of newspaper articles and three radio interviews regarding theft of cable services and arrests. ■

*—By Kenneth Daluisio, Senior Auditor Cablevision Industries of Batavia, N.Y.*

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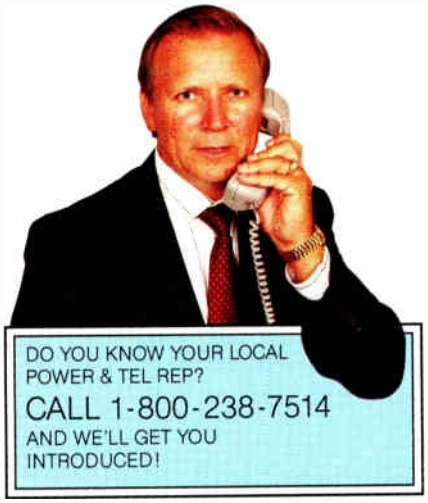


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Reader Service Number 41

*Continued from page 65*

istics of the physical surroundings and employees on duty to be able to recall the environment at a later time. They also noted the segment of the fight being aired at that specific time. The equipment used to air the fight was also noted, to determine whether or not the telecast had been obtained through one of the system's converters or through an independent satellite system.

Each field operation report was completed immediately upon leaving the bar and before departing for the next location.

The end result of the Douglas-Holyfield fight was that five out of 17 commercial establishments inspected carried the pay-per-view/closed circuit event without authorization.

On the following day, each liquor license holder was contacted to provide an opportunity to reach an out-of-court settlement prior to filing lawsuits for the theft.

One of the establishments immediately settled out-of-court for an amount just under $14,000. Four lawsuits were then filed against the other commercial offenders in Federal court seeking total damages in excess of $200,000—damages which equated to just over $50,000 per bar. The complaints filed in Federal court sought damages and injunctive relief under the Cable Act for unauthorized interception, receipt and commercial use of the company's cable service.

To further enhance the success of the effort, and to launch a major media offensive on Greater Media's theft of service, a press conference was conducted at the entrance to the Federal court as the suits were being filed. News crews from four of the major broadcast stations in the Philadelphia market were alerted that the filings were being made.

News crews then accompanied the private investigator and Greater Media Cable officials who served federal summons at each of the bars immediately after the suits were filed. As the film crews swarmed through the bars with lights and cameras, bar owners were presented with federal summons.

Then, additional news footage was taken outside the bars as Greater Media technicians physically disconnected service to all of the commercial establishments.

The fact that cable service is not reinstated until the Federal court action is resolved served as added incentive for the bar owners to settle the suits quickly. The footage was aired on all of the stations' news programs that evening, with two of the stations making it their leading story. There was also extensive newspaper coverage throughout the tri-state area.

The results of the media coverage was so successful in the Douglas-Holyfield sting operation, several bar owners who had been caught illegally exhibiting previous closed-circuit telecasts immediately sought to reach out-of-court settlements with the promoter.

As of February 1991, one additional bar owner had made a pre-trial conference settlement of $4,500. The three other cases remain pending in Federal court.

The success of the Douglas-Holyfield sting operation prompted the initiation of a second sting for the Tyson-Stewart HBO fight in December 1990. The results of the Tyson-Steward sting found three bars who had aired the event illegally. Again, a federal suit was filed against one of the bars seeking damages and injunctive relief under the Cable Act, and the other two license holders were sent cease and desist letters from attorneys at HBO.

Immediately after the results of both of the sting operations were made public, the system's commercial accounts representative sold 23 bars—10 of which involved upgrades for the "commercial" sports service package, which is offered in the franchise area. The projected loss of revenue from the eight illegal commercial establishments alone was projected to be more than $40,000 annually.

Overall, a total of 1,734 separate instances of theft were identified during the 1990 theft of service program. The estimated retail value for the instances identified in 1990 alone exceeded $1 million. This amount does not even include the value of services stolen that went undetected.

A more comprehensive estimate of the "annualized loss of revenues" identified through each of the three campaigns (using the system's actual revenue-per-subscriber figures) is as follows:

- Counterfeit chip campaigns: $167,808.
- System tap audit: $407,400.
- Commercial sting operations: $41,760.

The combined loss total of all three amounts to $616,968.

Among the other benefits that resulted which are more difficult to quantify include:

- Establishment of a database to identify problem neighborhoods and areas in which street dealers have been more prevalent.
- Educating the judicial, law enforcement and franchising authorities on the seriousness of the theft problems in the CATV industry.
- Applying and utilizing state statutes and pertinent provisions of the Cable Act effectively, and which will ultimately lead to other successes.
- Networking and sharing of information among other area operators and industry consortiums on "success stories."
- Educating an employee workforce who can then serve as a system's greatest asset in detecting and following through efficiently on all leads.

As indicated in the case studies outlined above, the positive financial impact which similar campaigns could have for other cable operators is clearly evident and is easy to quantify.

Moreover, the success and widespread visibility which surround each of Greater Media's campaigns and the minimal costs involved in carrying out such efforts when weighed against the monetary gains demonstrate the program's applicability to other cable operations. ■

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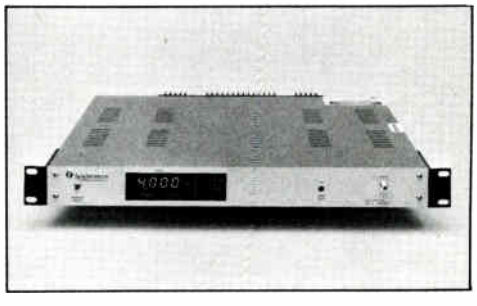

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Reader Service Number 60

# Upgrading with amplified taps

## Exploring a reliable, cost-effective 1 GHz CATV plant

Substantial progress has been made in the last few years in improving approaches to the trunking portion of CATV plant, largely through innovations in broadband analog optical fiber transmission technology. While this provides a trunking system with essentially unlimited potential bandwidth and excellent performance specifications, it leaves the remaining coaxial distribution plant as the weak point in these networks.

This paper presents an approach to distribution architecture, and to tap design, which addresses this issue. This approach greatly reduces or eliminates he use of in-line amplification in distribution plant, and introduces the use of "active taps." This means that the reach of the distribution plant is determined primarily by cable loss, as splitting loss is largely eliminated.

*By James A. Chiddix and Jay A. Vaughn, ATC*



### Conventional Tap Block Diagram

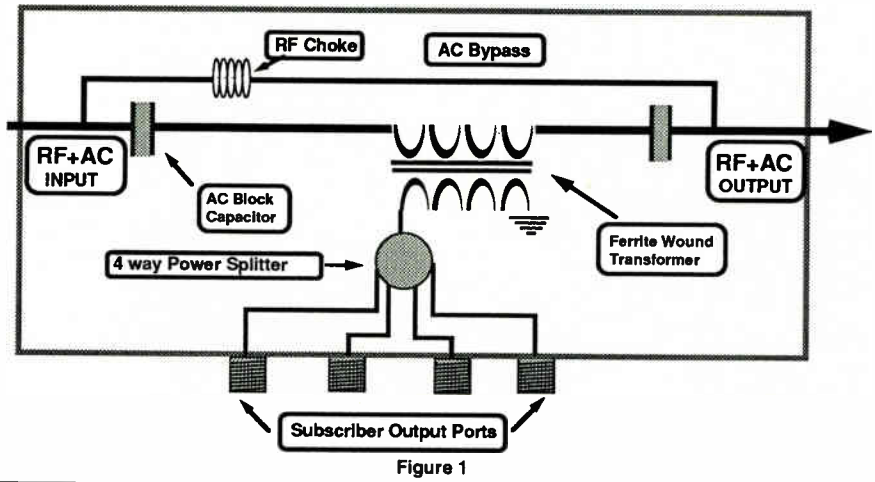


Figure 1

### Feeder Line Reach Model

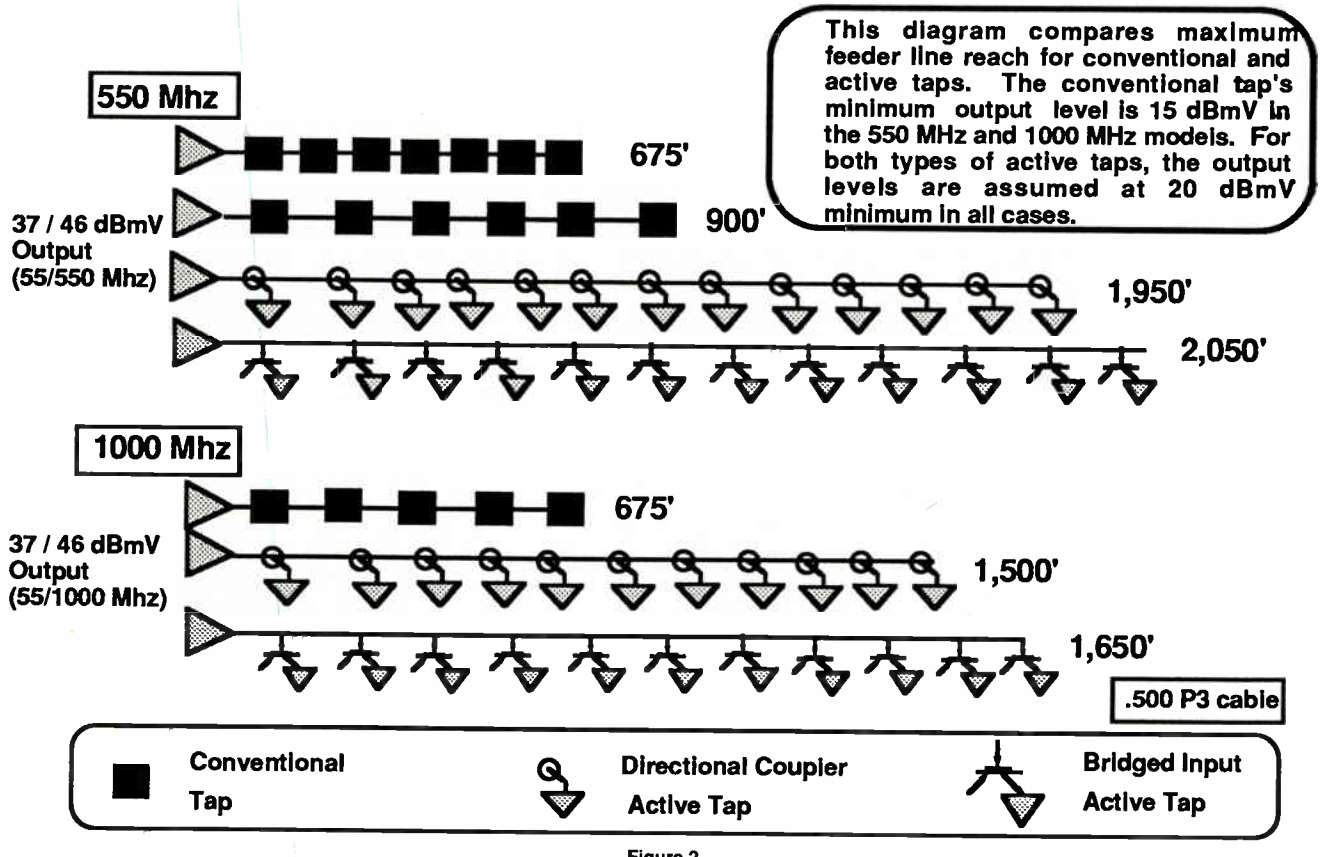


Figure 2

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Reader Service Number 44

## ACTIVE TAPS

Active devices are used to provide isolation and output levels sufficient to drive subscriber drops. The failure of any active device in such a system would affect only the very few subscribers fed by that individual tap.

In addition to an architectural and strategic overview, specific tap design possibilities are outlined, and the capital and operating economics of such a plant are reviewed. This paper is intended to contribute to a dialogue in the cable television industry which may lead to the development of a new family of coaxial distribution hardware.

### Introduction

The cable industry today is in the process of making dramatic changes to its network architecture. Traditionally, cable plant has been designed with two primary elements, the first of which is trunk plant, providing branched coaxial distribution of high quality signals from the central headend (or regional hubs in very large communities) deep into the system, within one or two miles of every subscriber.

The second element is the distribution plant, which consists of a branched and tapped coaxial network passing every possible subscriber in the service area, in sufficient proximity to provide for a service drop distance of no more than 200 feet to 300 feet.

Because of coaxial cable and branching losses, traditional trunk plant requires broadband amplifiers every 2,000 feet or less. The resulting cascades, or series, of trunk amplifiers, with their additive noise and intermodulation distortion, provide practical limits to the achievable bandwidth, reliability, and signal quality of today's CATV systems.[1]

The replacement or reinforcement of the trunk plant with low loss optical fiber can dramatically improve the channel capacity, transmission quality and reliability in this portion of the system. Advancements over the last several years in low noise, high bandwidth, highly linear lasers and detectors have made this replacement of coaxial trunk plant with fiber trunking cost-effective, and much of the new construction and system upgrades now underway take advantage of this technology.[2,3] It is quite feasible to construct high quality trunking plant with a useable bandwidth well in excess of 1 GHz today, using off-the-shelf lasers and detectors.

The evolution of coaxial distribution

plant architecture as bandwidths increase has proven to be more challenging.

### Making passives active

On top of the challenges lies an opportunity. The cable industry, as structured today, is remarkably labor intensive. The drop connection to each subscriber must be physically connected and then disconnected when that subscriber decides to receive or terminate service.

One interesting solution to the formidable problems of bandwidth expansion may be offered by the replacement of today's passive coaxial tapping devices with active devices. This could be realized by the provision of an amplifier for each subscriber or small group of subscribers, coupled to the distribution transmission cables either passively or actively. As will be seen, this may provide an opportunity to substantially extend the reach of coaxial cable without the use of distribution amplifiers, or, alternatively, allow the minimization of amplifier cascades.

The introduction of active electronics at the tap means coming to grips with difficult issues of powering and reliability in an electrically and physically hostile environment. It also carries with it an opportunity to significantly improve operating efficiencies. Once there are active electronics at the tap, there should be little additional cost in providing on/off switching for each subscriber, eliminating a major source of cable industry labor.

In addition to these advantages, active taps, through the replacement of "lumped" gain blocks within the distribution plant by "distributed gain" in the subscriber leg of each tap-off device, should provide an opportunity to improve perceived plant reliability significantly. Even though a much larger number of active devices would exist in the plant, only one would exist between each subscriber and the fiber trunking system. This means that widespread outages would become much less frequent than in today's system architectures, since device failures would generally affect only one or a very small number of subscribers.

There have been several attempts in the past to realize active tap electronics. Each has met with frustration. But the advent of new types of electronics and new techniques to protect semiconductor devices from voltage transients and current surges, coupled with challenges facing the cable industry regarding channel capacity and customer service, may mean that the time has come to revisit this idea.

### The active tap concept

**Current tap technology.** The taps used in cable television systems today have one primary function, which is to tap off a percentage of the broadband RF signal power on the distribution line to distribute to the subscribers' homes. An additional requirement is that they allow 60 volt, 60 Hz powering to flow along the coaxial distribution line, while blocking voltage from the

**Directional Coupler Active Tap- Block Diagram**

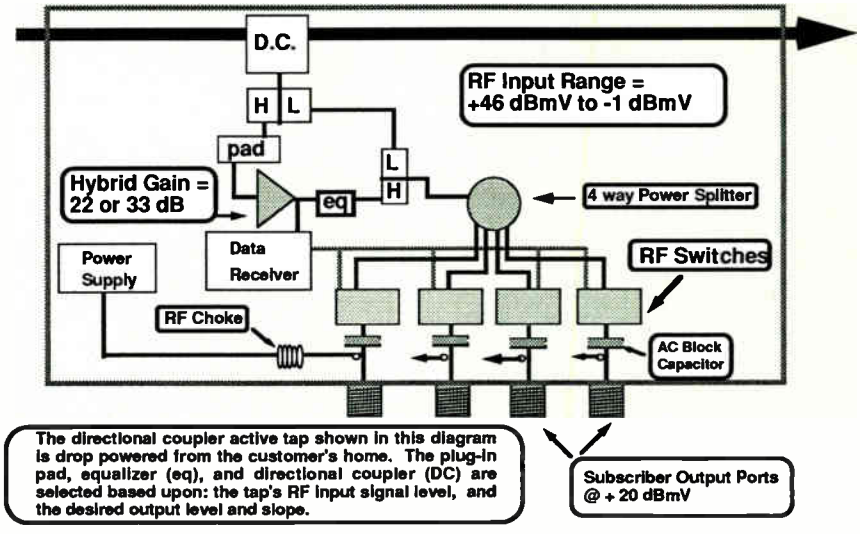


Figure 3

Reader Service Number 46

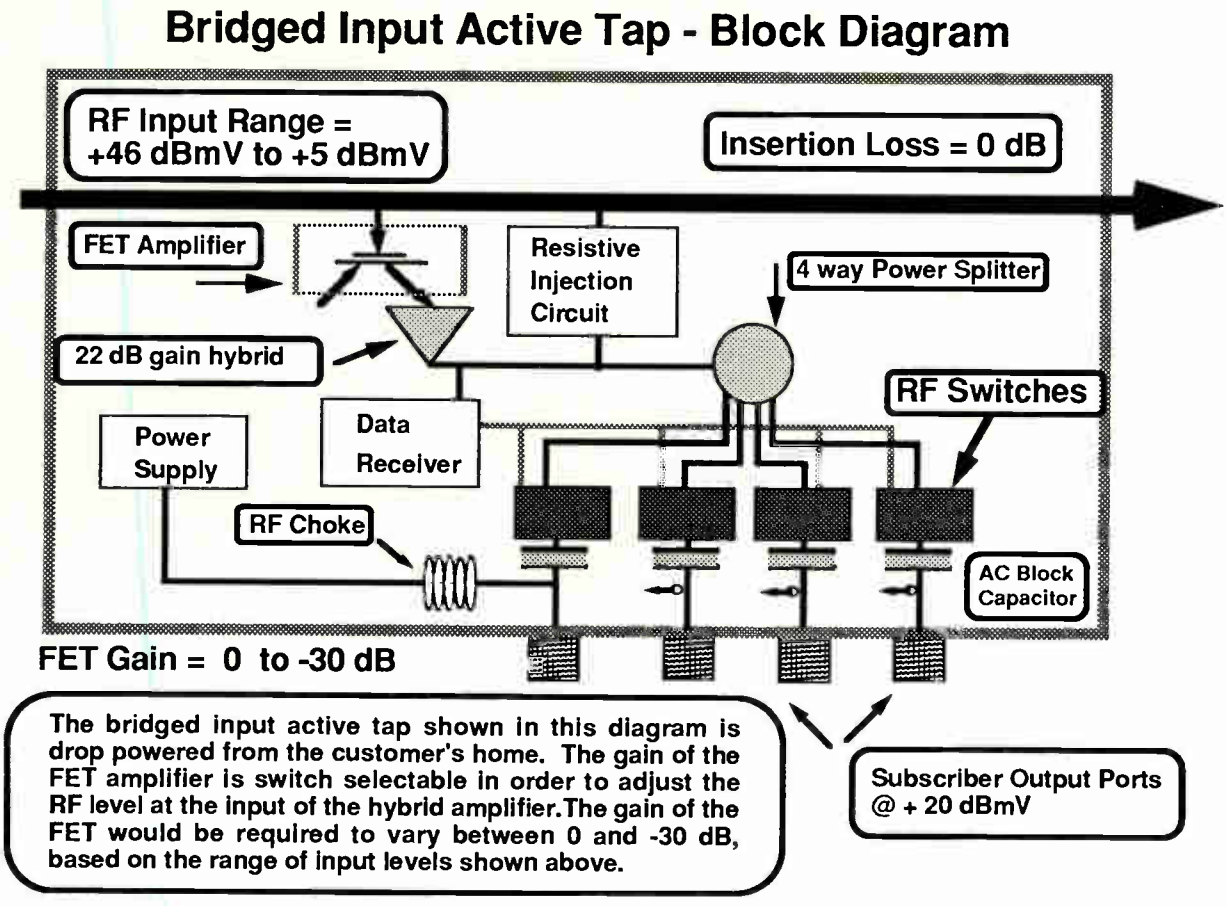


Figure 4

tap output ports which feed subscriber drops.

The conventional tap configuration, shown in Figure 1, is a simple transformer-wound directional coupler, feeding a four-output RF power splitter. In order to achieve AC power-passing capability, an RF choke is added in parallel to blocking capacitors which isolate the RF coupler. The "tap value," or coupling ratio, of the transformer is selected based on the desired percentage of signal power to be tapped off.

Each tap installed in the distribution line attenuates the signal power passing along the line as it taps off signal. The amount of insertion loss varies with tap value. The total insertion loss caused by a tap can be characterized as the sum of: 1) the reduction in signal power resulting from the power split of the directional coupler; 2) the power lost to inefficiencies of the directional coupler's ferrite transformer; and 3) the power lost as a result of the 60 Hz line power bypass, blocking network and associated matching networks. The excess insertion loss, that is, loss in excess of the theoretical value for the power split, can equal or exceed 1 dB and is frequency dependent.

Figure 2 shows the effects of tap insertion loss when combined with cable attenuation in a sample feeder line. The diagram also shows how different cable sizes at different frequencies, along with tap insertion loss, affect the maximum reach after an amplifier, for a given minimum tap output level.

### Directional coupler active tap

A "directional coupler active tap" in a distribution line serves the same basic purpose as a conventional tap. Since the tap, as shown in Figure 3, represents distributed amplification, it allows for distribution plant architecture that eliminates the use of amplifiers after the fiber optic node. Taps need not be capable of passing 60 Hz, 60 volt line power, assuming that the active tap device is powered directly from the subscribers' homes.

The interest in this type of active tap stems from its amplification ability. By having internal amplification, and by locating the RF power splitters after the gain stage, the active tap reduces the amount of signal power that must be tapped from the feeder line. Since less RF power is tapped, the tap's insertion loss is reduced. By reducing the tap insertion loss, the maximum reach of the feeder line is extended.

The directional coupler active tap shown in Figure 3 begins with a high value (low insertion loss) directional coupler feeding a plug-in attenuator pad. An optional diplex filter for low frequency return signals could be installed between the directional coupler and the plug-in pad if two-way operation were required. The purpose of the pad is to reduce the number of different values of directional couplers that would be required. Due to the discrete nature of the wound ferrite transformer, directional couplers are usually only available in 3-dB to 4-dB steps.

In the reach model (Figure 2), 10 of the 13 directional coupled active taps used directional couplers with values of 16 dB or greater. The insertion loss

of these couplers was assumed to be 0.8 dB. Since the theoretical insertion loss of a non-power passing 16 dB directional coupler is 0.1 dB, it would appear that improvements in efficiency could be expected. It is important to note that with a 0.3 dB improvement per directional coupler, there would be an additional 3 dB of signal after the 10th tap. This extra signal might allow an increase of 150 feet in the feeder line reach.

The plug-in pad is followed by the hybrid amplifier gain stage. This amplifier chip, for the 550 MHz version of the active tap, would be a push-pull type hybrid with a 5 dB to 6 dB noise figure and with 30 dB to 33 dB of gain or less depending upon carrier-to-noise ratio (C/N), number of tap output ports, and output level requirements. (The hybrid gain for seven of the 13 directional coupler active taps shown in the 550 MHz feeder line in Figure 2 could have been 22 dB, while still providing a 20 dBmV output level on four ports.)

The nominal operating output level of the hybrid amplifier would be 30 dBmV to 36 dBmV. It would appear that the operating level could increase to 42 dBmV (with no tilt) before its contribution to overall system distortions would cause the end-of-line performance to degrade below established goals.

Following the hybrid amplifier is a plug-in equalizer. The equalizer is selected based upon the active tap's location in the feeder line (or the degree to which the RF signals are tilted) and the amount of tilt that will be added by the average drop fed by that specific tap. Post-hybrid equalization was selected in order to protect the C/N ratio of the low band channels. Reduced C/N ratio for these channels is a common problem in single stage, high gain amplifiers with front-end equalization or slope control operating with significant output tilt.

Following the equalizer is a directional coupler or resistive tap that would feed signals to a data receiver. Past the directional coupler is a second (optional) diplex filter, which completes the upstream signal path around the amplifier. According to the number of tap output ports needed, a two-, four-, or eight-way splitter would be installed after the diplex filter. Connected to each of the output ports would be a PIN diode switch, which is driven by the output of the data receiver, allowing the on/off switching of the signals at each tap port. The last component in the chain is a voltage blocking capacitor/ powering extractor circuit that allows the tap to be powered from a subscriber's home.

### The bridged input active tap

This device is similar to the previously described active tap except that the directional coupler is replaced with a field-effect transistor (FET) with a high input impedance as a tap-off device. (See Figure 4.) As a result of its high impedance, the tap appears to have a 0-dB insertion loss across the 75-ohm distribution line. This allows the placement of active taps, in unlimited quantity, along the distribution line until the distance is reached where the cable has attenuated the signals below the required threshold for the active tap.

The fact that this technology allows any quantity of taps to be placed on a feeder line makes it density insensi-

tive. The maximum feeder line reach from the optical node is therefore dependent only upon the cable type used and the cable system's bandwidth when assuming constant node output levels. The effect of density on the maximum reach of a conventionally tapped feeder line can be seen in Figure 2 (550 MHz case). By maximizing the feeder line reach, one assures that the fiber optic node will serve the largest number of homes possible.

The differences between this tap and the directional coupler active tap are found between the feeder cable center conductor and the input to the hybrid gain stage. As previously mentioned, the directional coupler in the preceding active tap is replaced with a high impedance, voltage sensitive, FET. This amplifier serves to isolate the 75 ohm hybrid from the feeder line. The gain of the FET could vary from 0 dB (unity gain) to -40 dB. The window of gain variation could be minimized, if necessary, by adding a plug-in pad located between the output of the FET and the input of the hybrid amplifier.

As compared with a directional coupler active tap, the hybrid's gain requirement for the bridged input active tap is significantly reduced. It would appear that a hybrid with 22 dB of gain would suffice in all cases. In fact, hybrid amplifier chips would not be required in the bridged input active taps that were installed within 900 feet of the node, assuming the unity gain FET could directly feed the power splitter.

The amount of gain might be controlled by selectable dip switches in the device. If the gain vs. frequency response of the FET amplifier could also be controlled by switches, this might eliminate the requirement for post-hybrid equalization.

The diplex filter located between the directional coupler and the hybrid input in the earlier active tap would be replaced with a passive or active/passive "injection circuit" for return signals. This injection circuit would greatly resemble a 30 dB to 40 dB resistive tap. Some amount of gain, although less than the loss of the injector circuit, could be added in series. Since there would be minimal flat loss at the low frequencies used for upstream signals, between the active tap and the input to the fiber node, this would seem to represent a workable approach. As long as the negative gain of this circuit (when added to the gain [loss] of the FET amplifier) exceeds the positive gain of the hybrid, instability as a result of positive loop gain would be avoided.

The circuitry following the amplifier hybrid would be the same as that described for the directional coupled active tap.

### Performance requirements

The performance requirements for both types of active taps are listed in Figure 5. The C/N ratio specification for the directional coupled active tap assumes a distribution line level of +46 dBmV maximum and -1 dBmV minimum. In the case of the bridged active tap, the C/N ratio should be met with feeder line levels between +46 dBmV and +5 dBmV. These levels were selected given the expected noise performance of the bridged active tap product.

Both types of active taps should provide a tap port output level of +20 dBmV minimum for two-port and four-port models. For an eight-output port active tap, the output level should be at least +18 dBmV. These output levels are specified at the active tap's maximum rated frequency. The tap should be able to introduce the range of positive slopes as specified in Figure 6. The CTB and CSO performance should be at least that shown in Figure 5, at the minimum tap output levels shown above, when operated with the output tilts shown in Figure 6.

**RF Performance Requirements**

| | Optical Trunk | Optical Bridger | Active Tap | Total |
|---|---|---|---|---|
| C/N | 50 | 67 | 51 | 47.5 |
| CTB | 65 | 64 | 59 | 53 |
| CSO | 65 | 70 | 55 | 53 |

The table indicates the assumed specifications for the optical trunk and the optical bridger. The "total" column indicates the desired minimum end of line system specifications. The column labeled "Active Tap" indicates the performance required of the active tap in order to meet total system specifications.

**Drop Slope Table**

| Drop Length | 550 MHz | 1000 MHz |
|---|---|---|
| 100' | 4.1 dB | 6.2 dB |
| 125' | 4.9 | 7.4 |
| 150' | 5.8 | 8.6 |
| 175' | 6.6 | 10.0 |
| 200' | 7.4 | 11.1 |

The table indicates the amount of negative tilt that will be introduced by the length of RG-6 cable shown in the left column. The negative tilt, in dBs, is specified between 55 MHz and the frequency shown in the top row. Also included in the total negative tilt is the contribution of a two way splitter.

### On/off capability

In order to dramatically reduce connect/disconnect operating labor costs, the active tap should be capable of switching the downstream signal flow on and off at each of the tap output ports. This switching capability would be addressably controlled through the billing system via a data transmitter located at the headend.

The data receiver, shown in the active tap diagrams, would command the switches (pin diode attenuators) to open or close depending on the instructions received from the billing system. This data receiver would be similar to that currently used in addressable converters. The frequency of its discrete data carrier could match that of the addressable converters used in the system.

### Technical challenges

**Powering.** There are two logical

means to power the active tap: from subscribers' homes and via the distribution line. There are advantages and drawbacks to each method. Distribution line powering, used today to power line amplifiers, is straightforward and relatively simple. Given the number of added active devices in relationship to the number of line amplifiers removed, additional power supply locations would be needed.

The assumption has been made that, if line powered, this system would require 30 percent more power supplies. This is based on a power consumption for each active tap approximately equal to consumption of commercially available off-premise interdiction taps. Since the goal of he active tap is to have almost no distribution line insertion loss, the challenge would be to add the necessary AC power passing circuits without noticeably increasing insertion loss.

One solution to line powering active taps without incurring additional losses might be the use of DC powering, particularly for bridged input active taps. In this scenario, current would not be required to pass through a coupling transformer, since it would simply be carried on the transmission line through the tap.

Because the gate of the bridging FET would be directly connected to the transmission line, the gate potential would be that of the DC voltage on the center conductor of the coaxial cable. Biasing would be accomplished through networks attached to the source and drain of the transistor. The amplifier hybrid and data receiver's power could be extracted from the transmission line through a carefully designed RF blocking network. With this direct connection to the coaxial cable, protection from power surges and spikes would be particularly critical.

By powering the unit via the drop from the subscriber's homes, the required number of line AC power supplies in the system would be greatly reduced. This would also eliminate the challenge of designing low insertion loss, AC power-passing circuitry. Powering from the home does, however. create its own problems. For example. if two customers are connected to the active tap, which drop (i.e., home) would actually power the tap? If only one drop actually powered the tap, and that customer disconnected his cable service, an outage for the other customer(s) fed from the tap would occur.

When powering from the home, it would be useful to have power fed to

the active tap on each drop. In that case. the active tap would automatically sense and use the drop with sufficient supply voltage to obtain its power. Two associated costs are the installation of the miniature power supply in the customer's home, and the long-term effects of electrolysis on the drop cable if direct current (DC) powering is used.

The RF signal level provided to the home using an active tap would insure adequate levels on more television sets than is currently provided with conventional architectures. Many cable television systems must use a drop amplifier in the home to provide adequate signal levels for more than two television sets. The active tap, both in terms of functionality and power consumption, is essentially a high quality drop amplifier mounted on the pole, followed by a splitter.

**Installation.** In order to minimize installation costs, it would be useful if the active tap were packaged in an enclosure that could be mounted directly to the existing conventional tap base (for models of taps where the power-passing circuitry is part of the tap face plate). This labor saving approach would eliminate the need to change the tap housing and associated connectors. The other primary aspect of the installation process would be to confirm, or install, the correct value of pad and equalizer (and directional coupler in the DC active tap). If drop powering is used, it would be necessary to install the small transformer and power inserter in the customer's home.

**Maintenance and reliability.** An active tap must be essentially maintenance free. This implies that there should be no potentiometers to adjust output levels, etc. Long-term stability of gain, distortion and frequency response should be engineered into the product. In the same vein, the reliability of the data receiver and its command of the on/off switches must be flawless over time and exposure to the elements.

The product should be able to withstand significant electrical surges and transients as a result of lightning, power utility switching, sheath currents, etc., without damage to the hybrid amplifier, the data receiver, or the FET.

Overall reliability of an active tap product is critical. In a typical 100,000-customer cable system one would find 40,000 to 50,000 active taps. Unlike the addressable converters used today, it would not be possible for the customer to bring in a failed active tap for an over-the-counter exchange.

**Dynamic range.** As previously mentioned in the section on performance requirements, the active tap must function over a wide range of input level conditions. The bridged input active tap should be able to accept at least +46 dBmV with up to 9 dB of slope. This tap should also accept input signal levels as low as +5 dBmV and 9 dB of reverse slope without degradation to the C/N performance. This requires a dynamic range of at least 41 dB.

The dynamic range of the directional coupled active tap is somewhat less critical as a result of the directional coupler and selectable input pad. Nevertheless, this tap should meet target specifications with slopes from 9 dB positive to 9 dB negative, and with signal level variations of -2 dB to +5 dB.

## Economics

**Modeling issues.** There are many ways to imagine deploying active taps. The most likely would be as part of a system upgrade or rebuild. Another way might be as a result of a plant extension project. Plant modification projects, such as serving a new, unexpected apartment building, may be the case where the use of few active taps can save many thousands of capital dollars by eliminating trunk extensions that would otherwise be required.

Previous work analyzing the economics of off-premises addressable interdiction systems has provided examples of ways to deal with the economic analysis of the kinds of costs and savings represented by active tap technology.

In the analysis that follows, the following factors were taken into account:

- Operational savings from reduction of disconnect reconnect labor.
- Capital savings from the elimination of line extenders in an upgrade or rebuild.
- Capital savings from the elimination of drop amplifiers.

Pertinent issues that were not taken into account in the analysis include:

- Added costs to power the plant if line-powered active taps were used.
- Added maintenance costs from having more active devices in the field.
- Added installation costs when using drop powering from the home, which would require the installation of a power supply.
- Cost savings from not having to

power the plant, other than the optical trunk nodes, if drop powering were used.

- Reduced service calls as a result of increased drop longevity through reduced physical disconnects and reconnects.
- Marketing "lift" or increased revenue from "instant on/off" capabilities, e g., weekend service, timely non-pay disconnects.
- Reduction in future converter costs by eliminating the need for front-end pre-amps, since active taps would provide an additional 6 dB of signal at the set in most cases.
- Capital cost savings by avoiding the need to replace the subscriber's drop or internal wiring as a part of system upgrade plans as a result of the high tap output level of an active tap.

### Economic analysis

The starting base assumptions were as follows:

- Annual churn rate of 30 percent.
- Disconnect truck roll equals $16.
- Reconnect truck roll equals $30.
- Cost of capital/yr. equals 10 percent.
- Active tap unit cost of $100.

Other relevant assumptions include:

- 1,000 subscribers.
- 100 homes per mile density.
- 33 taps per mile.
- 3 homes per tap.

**Case 1.** Pay-back of capital (see example, Figure 7), only as a result of truck roll savings for reconnects and disconnects:

- w/60 percent penetration: 5-1/3 yrs.
- w/80 percent penetration: 3-3/4 yrs.

**Case 2.** Deployment of active taps as part of a fiber-to-the-feeder, or fiber backbone system upgrade, taking into account the elimination of capital costs for line extenders:

- Saved line extenders offset 34 percent of capital cost.

w/60 percent penetration: 2-1/2 yrs

**Case 3.** Expanding the previous scenario with the assumption that 20 percent of all subscribers would require a $67 drop amp to be installed if active taps were not used:

- Saved drop amps offset 24 percent of capital cost (collectively with LE's = 58 percent).
- w/60 percent penetration: 1-1/2 yrs.
- w/80 percent penetration: less than 1 yr.
- w/80 percent penetration, 1-1/2 yrs but only 15 percent churn.

### Price goals

The price used for an active tap in the above analysis was $100. This price was derived by starting with a commercially available high quality drop amplifier. This drop amp features a 550 MHz push-pull hybrid, passive return capability (diplex filters), signal equalization, remote power supply and power inserter. The circuitry missing for a DC active tap would be a data receiver, the pin diode switches, an output splitter, and an input directional coupler. Packaging the product for a pole-mounted environment would also add to the total cost.

As the requirements to increase channel capacity cause more systems to be upgraded or rebuilt, system operators will find it necessary in most cases to replace their existing taps. With concurrent needs to increase signal level in the home as a result of higher extra outlet penetrations, increased drop cable attenuation at higher bandwidths, or desired improvements in terminal C/N ratio, the active tap

offers a powerful solution to respond to these challenges.

A complementary, lower gain active tap, with power-passing capabilities, would allow the device to be used in plant modifications, as well as in upgrade or rebuild scenarios with conventional trunk and feeder architectures. The lower gain would cause the active tap to have distortion performance similar to a single trunk amplifier.

The combined offering of these products may permit the active tap to be the tap of choice for tap replacement in all cases except routine plant maintenance. In this scenario, the market potential for an active tap is significant.

With 84 million homes passed in the United States, and assuming three homes per tap, one would estimate that there are 28 million taps. Assume that all U.S. cable systems will be upgraded using active taps by the year 2000, and that the cost of an active tap is $100—the potential market would be $2.8 billion over a nine-year period.

## Conclusion

As we have seen, there are a number of approaches to designing active taps which may be of interest. The simplest is an active device fed with a directional coupler. The addition of an active bridging element may provide additional benefit. It is hoped that this discussion will spark additional thinking and work in these areas. There is significant market potential available for vendors who are successful in developing reliable devices with these capabilities. In addition, this technology promises substantial benefit to the cable operator, as it has the potential to dramatically reduce operating costs, improve perceived customer service levels, and facilitate the development of expanded capacity systems. ■

**Sample Payback Calculation**

-For 60 % penetration & 30% churn
-Case 1 analysis (no capital savings)

INVESTED CAPITAL = ACTIVE TAP COST LESS CAPITAL SAVINGS

(Capital savings present only in Cases 2 & 3)
(12 Month Interest Expense calculated on prior year end invested capital less prior year's cash flow savings)

CASH FLOW SAVINGS = REDUCTION IN ANNUAL TRUCK ROLLS

(In this case, 300 disconnects @ $ 16
& 300 reconnects @ $ 30)

For Case 1, 60% penetration:
Capital Investment = $ 55,000
Annual Cash Flow Savings = $ 13,800

| Year | YE Capital Balance | Cash Flow Savings |
|---|---|---|
| Year 0 | $ 55,000 | $ 0 |
| Year 1 | $ 46,700 | $ 13,800 |
| Year 2 | $ 37,750 | $ 13,800 |
| Year 3 | $ 27,527 | $ 13,800 |
| Year 4 | $ 16,480 | $ 13,800 |
| Year 5 | $ 4,328 | $ 13,800 |
| Year 6 | $ -9,039 | $ 13,800 |

Figure 7

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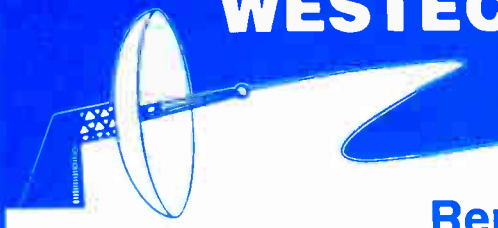

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# Does 1 GHz make sense?

## Operators struggle with compression/bandwidth question

Since the advent of fiber optics in cable-television networks, cable operators have been enthralled with its virtually limitless bandwidth, but confounded at how to take full advantage of it. Fiber cable has always had the potential to offer several hundred, even thousands of channels of video, data and other services. But because of the bandwidth constraints imposed by the coaxial drops that feed signals to subscribers, realization of all that bandwidth to the home has been elusive.

Now, however, two separate methods to reach the 1 gigahertz plateau are being developed. The first relies on the traditional uncompressed RF amplifier while the second is based around the much-publicized digital video compression schemes developed by such firms as Scientific-Atlanta, General Instrument, Skypix and AT&T.

**Who wins?**

Both approaches have received widespread attention, and each seems to carry excess baggage. So, which approach will win out? Like everything else, it depends on the user's needs.

Today, upgrading a system for additional bandwidth beyond the previous 550 MHz benchmark is being driven primarily by marketing forces. Leading operators like Tele-Communications Inc., American Television and Communications and others are attempting to jump-start the stagnant pay-per-view industry by dedicating 240 MHz to 300 MHz of spectrum for the service. ATC, for example, plans to offer approximately 10 movies continuously, staggering the starting time of each film by 30 minutes. Therefore, each movie, lasting roughly 2 hours, would require four channels.

ATC is already in the process of

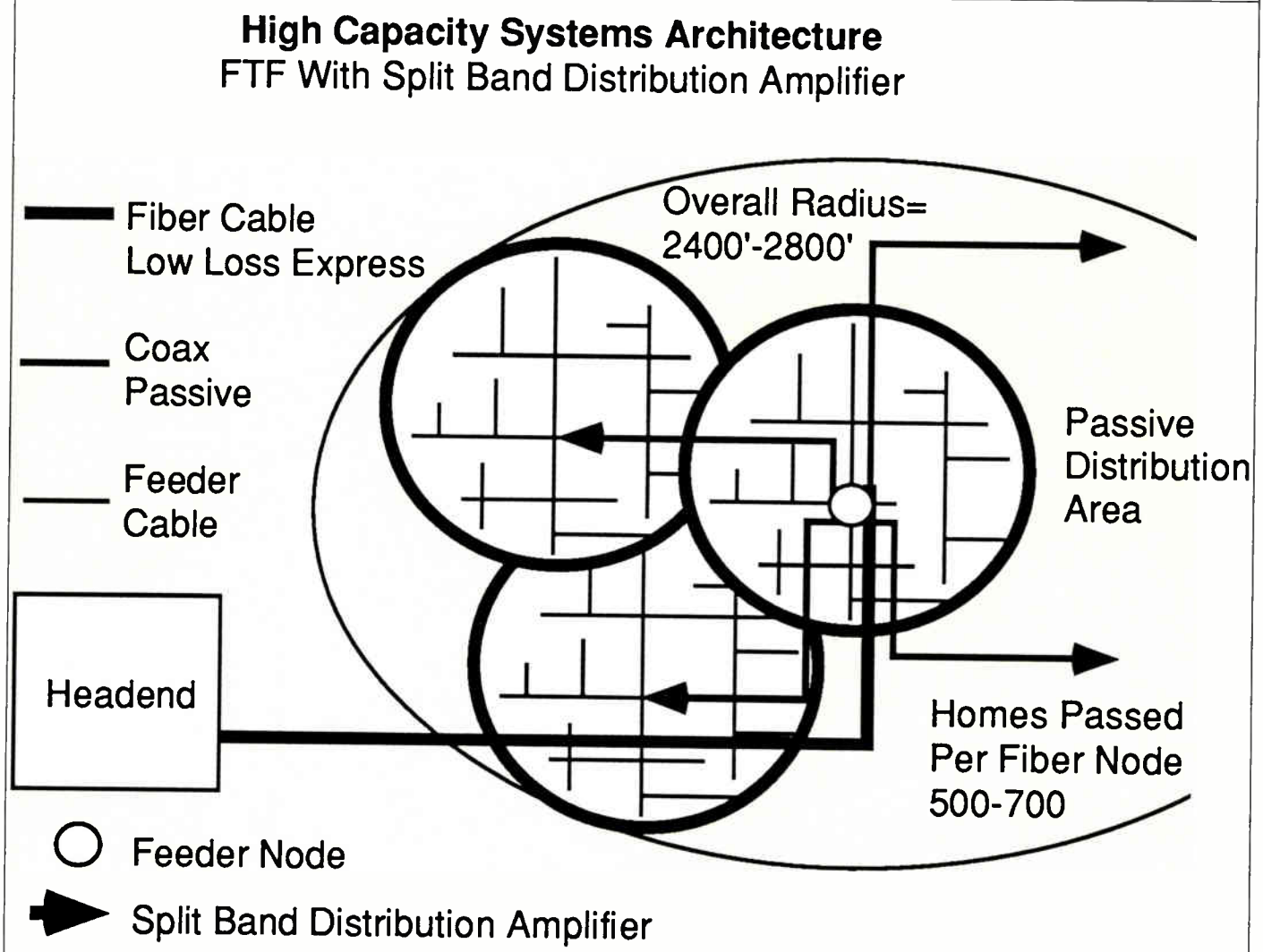


Figure 1 ATCs Brooklyn/Queens system architecture

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overlashing fiber cable in Brooklyn/Queens; the result of the upgrade will be a classic FTF system, that will cost $100 per home passed to perform, said Chiddix. Because ATC wants this technology in place by the end of 1991 in its flagship Brooklyn/Queens system, it is primarily responsible for pushing the envelope of RF technology to make it work. The effect has been profound.

C-Cor Electronics is pulling out all the stops to develop a 1-GHz wideband amplifier hybrid, Nexus Engineering has the task of building the world's first 150-channel headend, Jerrold will deliver the optoelectronics that will transmit the programming over the fiber network, and Pioneer will apply its electronics expertise to make a "user-friendly" converter that tunes 150 channels.

ATC chose the Queens system because of its unusual demographics, said Jim Chiddix, senior vice president of engineering and technology. "It's a fully exploited 550 MHz system," he said. "It has perhaps the highest revenue per subscriber in the industry (approximately $44/month), so it represents today's state-of-the-art in terms of technology and the way it's utilized and marketed."

By offering quasi video-on-demand, ATC will determine if additional revenue can be extracted from the market purely from supplemental programming choices. If so, other ATC systems are candidates for 1 GHz upgrades.

"The question is, when we're looking at a Rochester (N.Y.) that's due for an upgrade in the next few years, should we push it to 550 MHz—or is there additional revenue if you take it to the full bandwidth potential of the coaxial cable?"

Obviously, ATC execs believe the incremental revenue is there—as long as the cost premium for 1 GHz gear is kept to a minimum. "We think the (price) premium, once the equipment is in volume production, will not be more than 10 to 20 percent to go to 1 GHz instead of 550 MHz. That's a preliminary estimate," Chiddix said.

### Good timing

Others privately scoff at ATC's numbers, at least for the short-term. They argue that manufacturers will spend millions to develop 1 GHz equipment and initial prices will have to reflect the cost of R&D. Others, however, note that because the project is being performed during an economic slowdown, vendors are much more willing to provide materials at lower profit margins just to get the equipment order.

Regardless of what they believe, other operators are anxiously awaiting the results of ATC's foray into multichannel PPV. Chiddix is aware of the pressure: "I think if the industry sees us do this—we demonstrate that the hardware is indeed ready and we generate additional revenue—it will have a profound effect on the industry. I think it will cause anybody who's going to do any kind of an upgrade to ask if it shouldn't run all the way (to 1 GHz). It may even cause people to ask whether they shouldn't accelerate their upgrade (schedules)."

It will take time to see if Chiddix's thoughts pan out, but he has support for the approach. Joe Van Loan, senior vice president of engineering for CableVision Industries, expects the cost of 1 GHz equipment to ultimately be about $40 to $50 per customer. "If that's the case, we're better off getting the (bandwidth) capacity."

However, Van Loan isn't convinced there's a real need for additional bandwidth—yet. He notes that since 1976, few systems have added more than 25 channels to their systems (he says that old 12-channel systems now typically offer 36 channels and old 30-channel systems have moved to about 54 channels) and doubts that operators will need 100 more channels anytime soon. "I'm not convinced that video compression will be embraced by the industry, any more than Comband was" 10 years ago, said Van Loan.

He admits that multi-channel PPV, if successful, could prove him wrong, but Van Loan has reservations about the service's chances for success. "Initially, I thought PPV, as a movie service, would really take off, but that business has become an event business, not a movie business."

### Hybrid timetable

Arguing the merits of PPV as a business, however, is beyond the scope of this article. The technical issues of deploying a fully loaded 1 GHz system is not. Specifically, the issues surrounding the RF amplifier are key to making the system work.

Generally, there are two methods of passing 1 GHz through an amp: the "wideband" approach and the "split-band" method. The former involves development of a hybrid that can pass that much bandwidth at the noise and

distortion parameters acceptable to cable networks. The latter relies on breaking the signals into two groups and separately amplifying the groups.

To date, there is no commercially viable wideband 1 GHz hybrid, although it is under development and may be shown by C-Cor Electronics during the SCTE Cable-Tec Expo in Reno in the middle of June. Others, like hybrid manufacturer Philips Components, is developing a 1-GHz device for the long term, but plans to support the split-band method for ATC's New York City project because of the time constraints dictated by ATC's upgrade schedule there.

According to Todd Hendrix, Philips' product marketing manager for RF and microwave semiconductors, Philips plans to pair its brand-new 750 MHz hybrid (scheduled for a third-quarter 1991 formal introduction) with a UHF hybrid module that is now under development to deliver 1 GHz of usable bandwidth. Hendrix says there isn't time to "tweak" a wideband hybrid that can be manufactured with consistently high performance numbers. "I don't see how it (ATC's system) can be (supported with) anything other than the split-band approach," he added.

But C-Cor isn't so sure. Bob Beaury, director of marketing, says his company plans to begin shipping 1 GHz amplifiers to ATC by the end of the summer. He agrees that the R&D effort hasn't been easy and was disappointed he wasn't able to show a working model at the NCTA Show in March. Yet he remains optimistic his engineers can build a suitable device in time.

C-Cor has no long-term desire to become a hybrid manufacturer, said Beaury, but reluctantly jumped into the R&D process when it became frustrated with the pace of development of 1 GHz active components. "We're not racing against them (component suppliers), we're just trying to push the envelope of development."

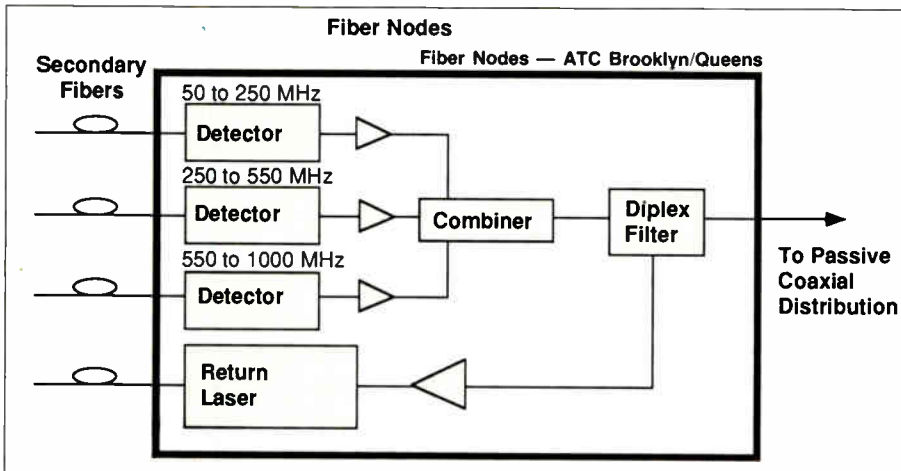
In fact, that may be what is happening. Although Philips officials says 1-GHz hybrids won't be ready this year, they say a device should be ready by the end of 1992 or early 1993. "ATC has upped the time scale for 1 GHz by 18 months. The pressure (to develop a hybrid) is more intense than ever," said Hendrix.

### Alternative methods

Despite their belief in the 1 GHz approach, Beaury and Chiddix don't believe that operators have to choose between compression or more bandwidth. Depending upon the approach taken, cable systems can take advantage of the low cost of upgrading to 1 GHz and then digitally compress some channels to add capacity when that technology becomes viable.

David Large, director of engineering at Intermedia Partners, sees three major ways to deliver more bandwidth throughout the network:

- Take today's bandwidth capability and create "granular networks" by breaking them via FTF into small cells that serve about 500 subscribers. This would allow operators to deliver a group of channels to all subscribers and "narrowcast" others or even put them on switches to create "customizable" channels in which the subscriber takes control of the channel.
- Deliver about 30 of the most popular services to everyone and place the digitally compressed channels above that tier to provide a total of about 200




channels. Under this scenario the granular network isn't necessary. The advantage to this approach is its compatibility with interdiction and the consumer friendliness of that technology.

- 1 GHz bandwidth. Large says this isn't as easy as it sounds, however. For example, there is no "cable-ready" consumer electronics for 150 channels and televisions will have to be re-engineered to handle that many channels.

But he, too, seems content with 550 MHz. Intermedia presently has no systems with more than 450 MHz of capacity and is just now planning some 550 MHz upgrades. But Large says Intermedia plans to embrace interdiction for signal control and was encouraged by the new, lower price point set by Zenith and Magnavox for such devices.

### The case for compression

At the other end of the spectrum, there are those who believe compression will render obsolete the whole need for a gigahertz of bandwidth. Bob Young, director of product marketing for RF distribution products at Jerrold Communications, believes the advent of compression has the potential of relieving the requirement for 1 GHz devices.

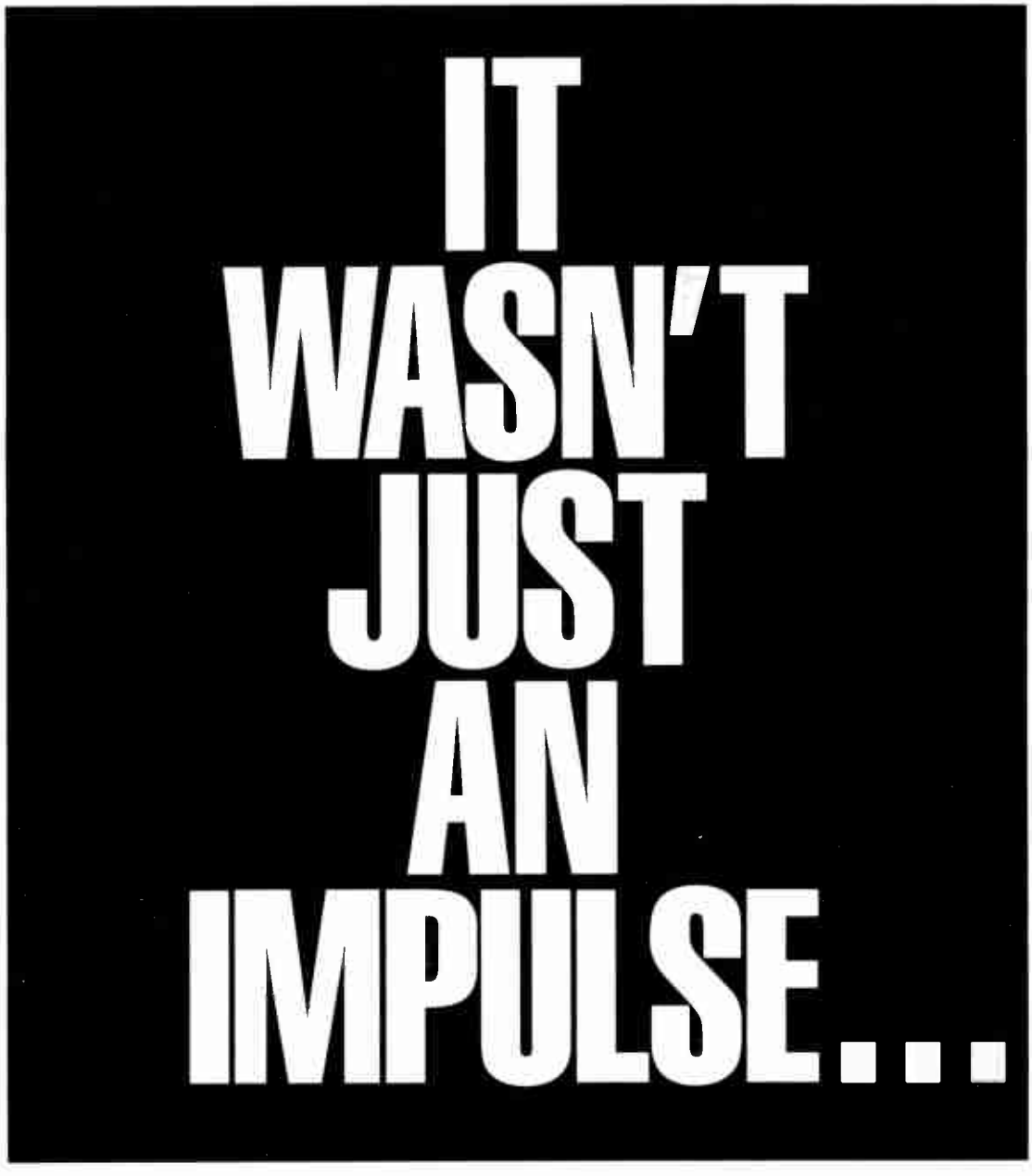
Compression has placed a "major cloud" over the need for more bandwidth, Young said. And while nothing precludes operators from combining both technologies, he said the cost would be prohibitive.

Instead, Young advocates upgrading to 550 MHz via fiber optics, then adding compression on top to reach 1 GHz. Standard channel assignments can be used up to 450 MHz and then 4:1 compression can be used to supply as many as 200 channels to subscribers.

(It is important to note that Jerrold's sister company, VideoCipher, is a leading video compression vendor. Both companies are divisions of General Instrument.)

So, where do operators go from here? If they follow historical trends, they'll take different paths, yet end up in roughly the same place. But no matter how one looks at it, there's only one way they're headed: up. ■

*—Roger Brown*

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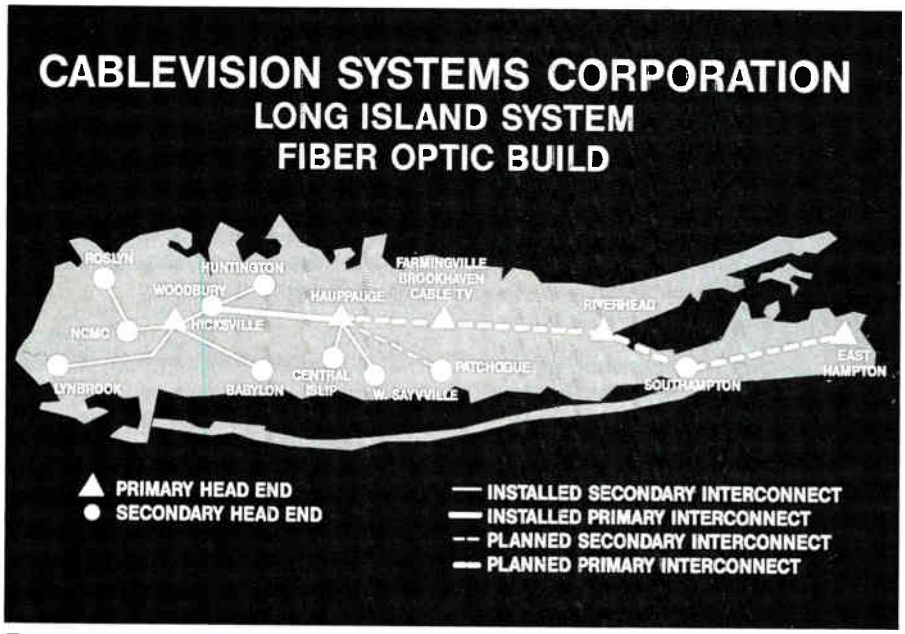


*Figure 2. Courtesy of Cablevision Systems Corporation*

to deliver attenuation performance of 0.25 dB/km at 1550 nm and 0.35 dB/km at 1310 nm. This performance was guaranteed as a maximum for each individual fiber, as opposed to an average for all fibers within the cable.

Titan fiber was the essential component in Siecor's fiber optic cable design, since supertrunk applications often involve more fiber handling because of shorter lengths, high fiber-count cables and more splices per kilometer.

Increased handling is likely to place additional demands on fiber's mechanical performance. Because it is tougher and more durable than standard single-mode fibers, Titan fiber is better able to withstand the kind of rough handling that can occur in cable television installations.

A titania-doped outer cladding glass forms the tough reinforcement that makes Titan fiber more abrasion and fatigue resistant. During the outside vapor deposition (OVD) manufacturing process, titanium dioxide ($TiO_2$) along with silica is deposited directly in the outermost portion of the cladding glass matrix (see Figure 1).

The addition of titania reduces the possibility of nicks and scratches during handling, mechanical stripping, splicing or connectorizing. The tougher cladding glass also increases the fatigue resistance of Titan fiber, making it more forgiving of unexpected, incidental strain than standard single-mode fibers.

An acrylate coating adds to the fiber's abrasion resistance. Titania does not affect the fiber's glass geometry specifications or its light-carrying ability.

The result is a fiber more reliable during installation and more reliable after the fact. Titan fiber is compatible with other standard single-mode fibers and with current field practices.

"The craft sensitivity of the fiber was of prime importance to us," comments Johnson. "Abrasion resistance and the possibility of simplified installation in the field were also very compelling. All these factors played into our decision. Given the world we're working in, Titan fiber was superior to anything else."

### Supertrunking scenario

The basic appeal of utilizing optical cable to overlash a cable system's existing coaxial plant is obvious. Fiber can deliver a clean signal further into the system without the need for additional amplification.

It also allows for increased channel capacity without requiring a complete rebuild of the system. However, some industry observers predict that the quest for additional bandwidth will ultimately mandate all-fiber trunks if channel capacities are to grow beyond today's 500 MHz, 80-channel limit to 750 MHz or 1000 MHz (1 GHz).

With fiber trunking, a system designer can reconfigure existing amplifier cascades, thereby eliminating some of the elements that contribute to signal interference. Shorter amplifier cascades mean better pictures for the subscriber.

A typical coaxial trunk can run for 10 miles and may require 25 amplifiers and three to five power supplies. Replacing the coaxial trunk with optical cable will remove a substantial percentage of that electronic equipment, reducing both power costs and the expense of trunk rolls to repair faulty or damaged electronic devices.

### Cablevision trunking network

Cablevision has committed to supertrunk applications over several years in Boston, Cleveland, New York City, Connecticut, Long Island and New

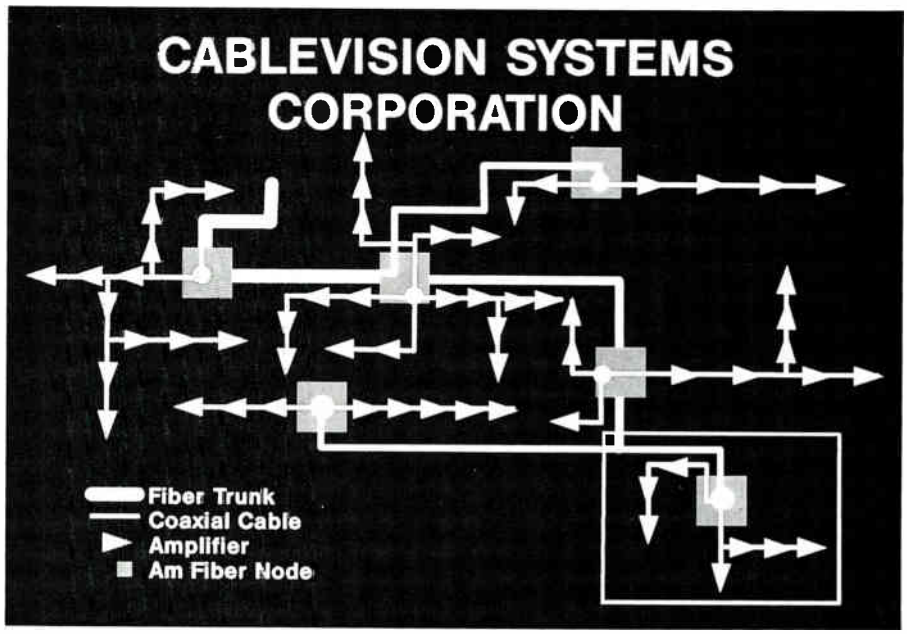


*Figure 3. Courtesy of Cablevision Systems Corporation*

Jersey. The MSO's "phased-in" upgrade of Cablevision of Long Island, for example, is indicative of its long term fiber planning (see Figure 2).

The Long Island system's coaxial network currently serves seven receive sites from a central microwave setup. It provides approximately 39 channels and cannot be expanded any further.

An optical cable supertrunk, directing frequency modulated (FM) optical signals from the central headend, will provide the capacity for 94 channels with 64 channels allocated for current use and 30 held in reserve. When the initial phase of the upgrade is complete, 28 to 39 amplifier cascades will be reduced to "mini areas" with cascades of six amplifiers or less (see Figure 3).

Cutting back on the number of amplifiers between the headend and the subscriber also reduces the probability of large scale outage because of the reduced number of electronic components.

The next phase calls for amplitude modulated (AM) signals traveling over fiber to penetrate deeper into the cable plant, segmenting the system into smaller subscriber modules, each no more than three amplifiers from fiber termination and headend quality video.

Therefore, an amplifier cascade that once served the entire community of Babylon, Long Island would now serve no more than 2,700 homes.

### Final phase: mini-nodes

The final step in Cablevision's fiber evolution involves the creation of an all-fiber network of "mini-nodes," fiber links that serve an additional 100 secondary hubs or "micro-nodes."

The micro-nodes, each capable of serving 25 homes at two outlets per home, will be placed throughout a neighborhood as close as 300 feet from the farthest drop. The fiber running from the micro-node into the home can provide television, data and voice transmission, both upstream and downstream.

By "cellularizing" its system, Cablevision will have the capability to segment its program offerings based on the demographics and interests of individual neighborhoods. Breaking out a system into small clusters of homes would offer a host of possibilities for local advertisers.

This sophisticated fiber-based network could use separate fibers in a common cable to provide transport of video, voice and data service for residential and commercial customers.

> 'If we plan to stay competitive, we need to continue investing in technology.'

### Toward a broadband network

The design may also support the combination of cable TV with wireless telephone service. Cablevision, Cox Cable Communications and Time Warner Inc., among others, have applied for experimental licenses with the Federal Communications Commission (FCC) to test a new wireless telephone service—PCN. Similar in concept to a "downsized" cellular phone network, PCNs could rely on relatively low cost transmitters attached to nodes throughout a cable TV system.

This series of neighborhood transmitters would route telephone calls via radio signals to subscribers within a limited operating area.

Under this scenario, Cablevision's fiber-based system architecture would enable it to provide a variety of telecomunications services—virtually an integrated broadband network—from a central facility.

### Looking toward the future

Al Johnson has seen the future of cable television, and it's made of fiber. "Cablevision is serious about harnessing the potential of fiber optics for cable television," he says. "Naturally, the economy causes you to take a hard look at any technology expenditures, but that's not all bad. It enforces an extra sense of discipline. If we plan to stay competitive, we need to continue investing in technology."

In these interesting times, cable operators who support fiber-driven advancements will not only survive the "nervous '90s," but may thrive as well. ■

# Cablevision plans optical amp, compression tests

While Johnson and his boss Wilt Hildenbrand, VP of engineering support and customer relations, might be lone voices singing the praises of 1550, they're singing a happy tune. The two engineers are "encouraged" by the performance of the new 1550 nm lasers they've seen, and there's no wondering why. When Cablevision lit up its Cresskill franchise on Long Island, the new laser performed like a champ, delivering 54 dB carrier-to-noise, 65 dB composite triple beat and composite second order at the end of the line—on non-dispersion shifted fiber cable.

Johnson is confident that dispersion will not be a limiting factor in their systems: "Fiber dispersion is not the problem, laser chirp is." Johnson is confident that research and development of new lasers with narrower linewidths and better RIN factors will continue to provide them with well-performing systems. "The (1550) lasers that are available now are (as good as) the 1310 lasers were a year and a half ago," said Johnson.

By the time this article is read, Cablevision was expected to be testing an optical amplifier. Hildenbrand and Johnson ultimately want an amp that provides a minimum of +13 dBm of output power so the signal can be split to 16 output fibers. An amp that only delivers +10 dBm of output power limits splitting to just eight fibers, said Johnson.

### Digital compression

While Johnson and Hildenbrand might be taking a different approach to fiber, you can bet the rest of the industry will be highly interested in two other tests it plans to perform in the next six to 12 months. Cablevision has already signed on as the first operator to test General Instrument's DigiCable compression system. And, as part of its experimental FCC license for testing personal communications networks, Cablevision will test signal propagation in the CARS microwave band.

Testing of DigiCable will occur sometime before the end of calendar 1991 in both the brand-new New York City system and the older Long Island system, both of which have some fiber optics in them. But it's the coaxial portion of the plant that offers up the most challenges, according to Johnson. Issues like group delay and microreflections will be looked at to help determine how much forward error correction is necessary to keep the picture perfect. The effect of the built-in echo cancelling circuitry will also be tested.

### Prototype testing

Cablevision will downlink the DigiSat signal and then remodulate the data signal digitally for delivery throughout the system. A "handful" of prototype digital-to-analog converters will then be bicycled to different subscribing homes and the output will be tested, said Hildenbrand.

> 'The (1550) lasers that are available now are (as good as) the 1310 lasers were a year and a half ago.'

It's the in-home converter that is the truly important piece of the equation, Hildenbrand says. Specifically, Hildenbrand wonders if it can it be deployed and then handle later improvements to the compression algorithm without modification or replacement.

Hildenbrand is excited about the opportunities compression seems to offer. Maybe it can allow an operator to increase his channel capacity without rebuilding the system. And what happens to the traditional "cable TV" business when compression advances to the point where video can be compressed at the T-1 rate?

Johnson points out that digital delivery of satellite programming is coming about at a convenient time. "As operators work with fiber to build a better pipe to the subscriber, headend problems really show up," he says. So it's important that the satellite link be upgraded at the same time—or it becomes the new system weak link.

### PCN tests

Cablevision is also readying itself for tests of personal communications networks. Hildenbrand looks at this project as a three-phase process.

The first phase consists mainly of signal propogation studies to determine which frequencies are the best. Cablevision plans to conduct the test in the CARS band, something no one else is planning. By testing in the CARS band, Cablevision can determine if PCN equipment will interfere with CATV signals without interfering with anyone but themselves.

This portion of the test will determine receiver sensitivity and how that relates to the number of microcells needed in a given area. The number of cells relates directly to the overall cost of the network, and cells are expected to carry a significant cost.

Phase II of the test consists of acquiring CARS-band terminal equipment and continuing the testing process and the final phase is full-blown formal testing of digital data. Does it make sense, economically and technologically? If it does, when can it be added to system rebuilds/upgrades?

### Wireless LAN

In addition, Cablevision will explore the possibility of hooking the wireless LAN equipment, incorporating spread spectrum technology, to its system computers. The result could be an operational benefit from computerized dispatching for service and installation calls.

According to Hildenbrand, Cablevision applied for its experimental PCN license for three reasons: to understand the business and learn more about interference and frequency "cohabitation"; to find out if the concept of the "wireless" drop is viable (especially in light of the fact that Cablevision likes to build two-way systems); and to learn more about emerging technologies like voice, PC links, etc.

"Why does everyone focus on (the) voice (capabilities of personal communications networks)?" wonders Hildenbrand. "There is so much more you can do—voice is the smallest part of it."

*—Roger Brown*

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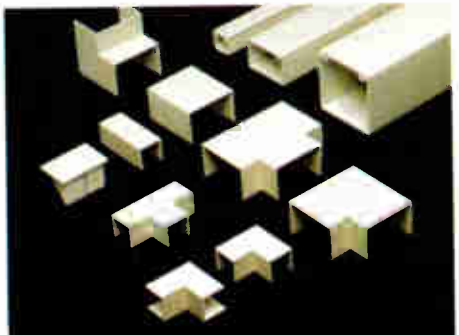

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Reader Service Number 61

# Fiber optic cable designs

You've gone through the cost analysis and have decided that fiber optic cable makes the most sense for the upgrade of your cable system. Now it's time to go out and buy the cable. New players and terminology hits you like a ton of bricks—it seems like everyone has a reason why their fiber optic cable is better than the next guy's.

What points are important, and how can you be sure you are comparing "apples to apples?" This paper will help illuminate fiber optic cable and the relative tradeoff of different designs and constructions.

## Design objectives

The design objectives in fiber optic cable are fairly simple. The first concern of the cable designer is to protect the glass fiber from the oustide environment. The fiber must be protected from the physical rigors of being installed and placed for up to 20 years in the outside plant. These include forces such as impact, tensile, twist, and compressive loads.

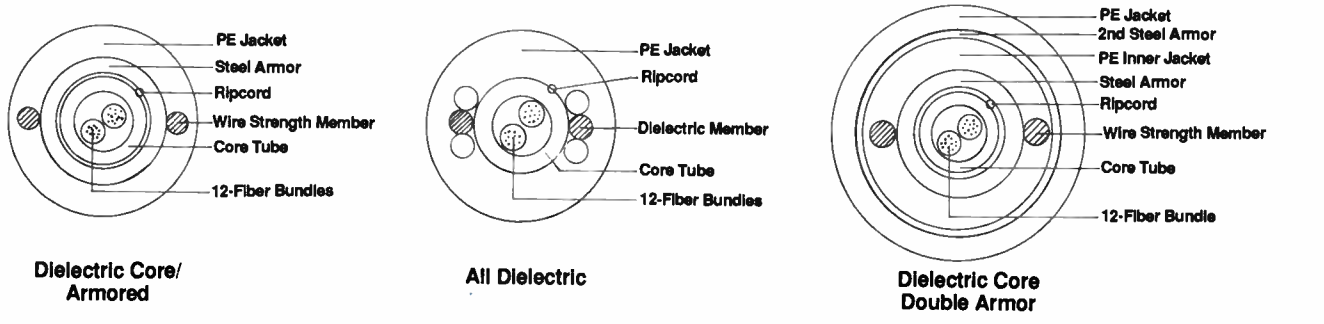
In addition, the fiber must be protected from any moisture. The fiber itself is degraded by moisture and if water were to get into a cable and freeze, it could physically crush the fiber. Probably the most critical design parameter is temperature performance.

## Temperature concerns

The typical specificed operating temperature range of fiber optic cable is from -40 degrees Celsius to +70 degrees Celsius. The design problem is that the fiber has a coefficient of expansion on the order of 10e-7, while the majority of the plastics used in fiber optic cable design have coefficients of expansion on the order of 10e-5. Therefore, when the cable is subjected to temperature extremes the plastics expand and contract 100 times more than the glass fiber. If the fiber optic cable is not designed correctly this coefficient of expansion differential could impart forces onto the fiber which would manifest as drastic increases in attenuation or, in the extreme case, fiber breakage.

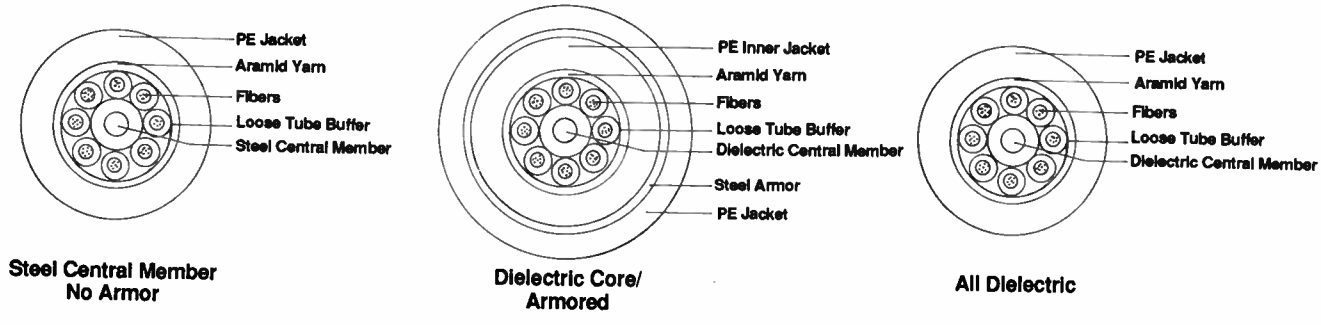
The cable designer offsets this differential in coefficient of expansions with high modulus, low coefficient of expansion materials such as fiberglass

*By John C. Chamberlain, Comm/Scope, Inc.*




**Center Core Tube Construction**

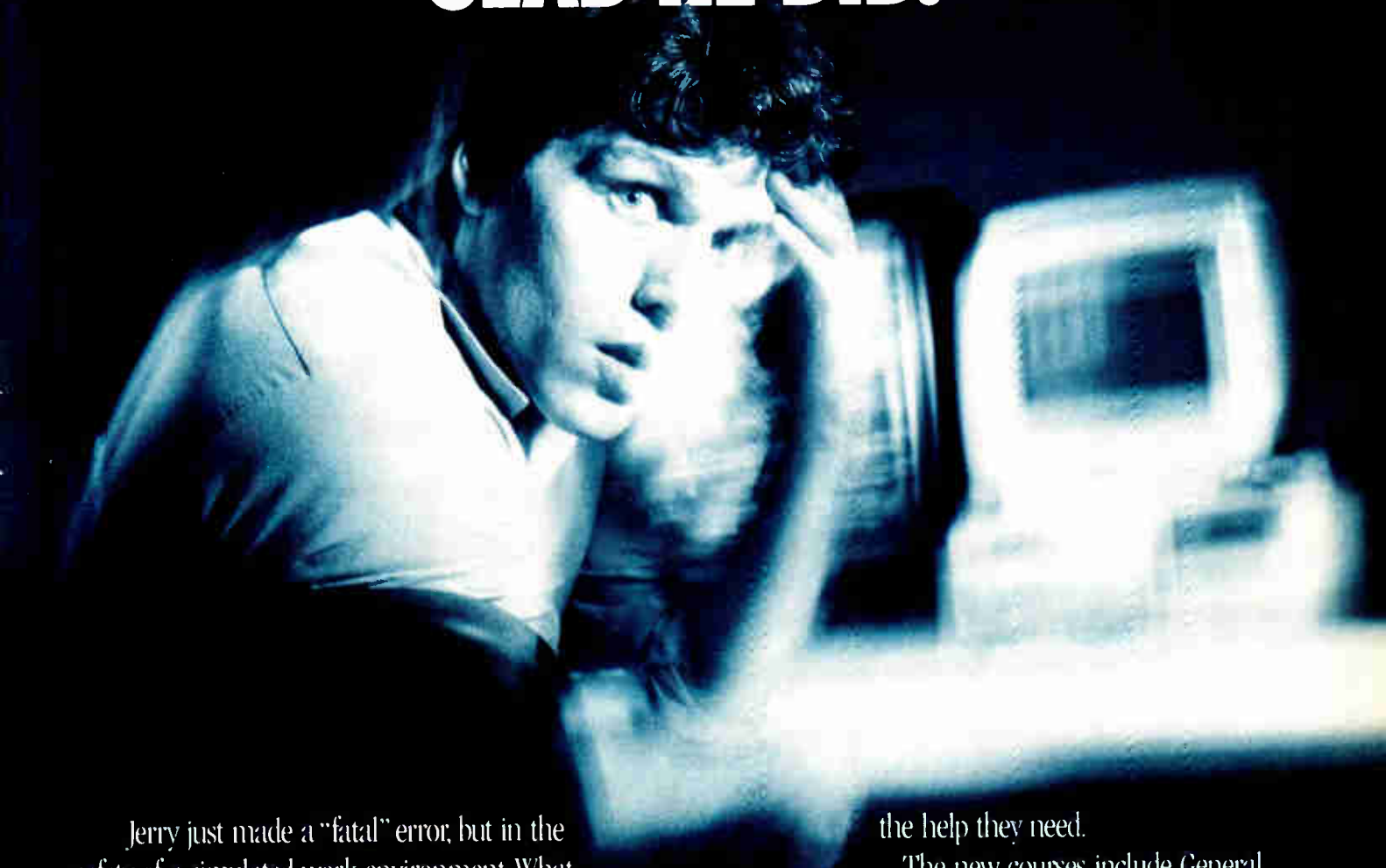
Figure 1




**Loose Tube Construction**
Figure 2

The typical specified operating temperature range for fiber optic cable is between -40° and +70° Celsius.

# JERRY BIRNS ELECTROCUTED HIMSELF TODAY. AND HIS BOSS IS GLAD HE DID.



Jerry just made a "fatal" error, but in the safety of a simulated work environment. What better way to learn about *the myth of insulated gloves?* It's just one of the many, many interactive exercises in the new technical training series from Mind Extension Institute™ Inc.

This is interactive-video training at its best. The student is truly involved every step of the way; responding to questions, making decisions and correcting mistakes. And, because the instruction is self-paced and one-on-one, anyone at any time can get just the help they need.

The new courses include General Safety, featuring the top ten safety issues in cable, and Installer Training, a nuts-and-bolts course that will challenge even the seasoned installer.

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Reader Service Number 63

**Look for us at the SCTE Cable-Tec Expo, Booth #705, in Reno, June 13-16**

# WHAT'S AHEAD

## SCTE

*Following is a list of SCTE technical seminars with contact name. If known, location and seminar topic are listed.*

**June** 11 *Cascade Range Chapter* "Holiday Inn, Wilsonville, Ore. Contact Tom Hansen, (503) 265-2263.

**June** 12 *Delaware Valley Chapter* "Baseband video and audio—theory and maintenance for headends." Williamson's Restaurant, Bala Cynwyd, Pa. Contact Robert Lauer, (215) 853-2200.

**June 13-16** *Cable-Tec Expo '91* To be held at the Reno/Sparks Convention Center, Reno, Nev. Contact SCTE national headquarters, (215) 363-6888.

**June** 19 *Golden Gate Chapter* "Engineering management and professionalism." Contact Mark Harrigan, (415) 785-6077.

**June** 19 *Great Plains Chapter* Contact Jennifer Hays, (402) 333-6484.

**June** 19 *North Central Texas Chapter* "Towers and Headends and Grounding and Lightning Protection," with Roy Ehman of Jones Intercable. Contact Terry Blackwell, (214) 578-7573.

**June** 19 *Tennessee Chapter* To be held at the Ramada Inn, West Memphis, Ark. Contact Don Shackleford, (901) 365-1770.

**June 26** *New Jersey Chapter* "NCTA standards, New Jersey performance requirements, distortion measurements, H/E measurements and sweeping." Contact Jim Miller, (201) 446-3612.

**June 26** *San Diego Meeting Group* "Safety, first aid and CPR." To be held at the Elks Lodge, Oceanside, Calif. Contact Frank Gates, (714) 492-4606.

**July** 3 *Gateway Chapter* Contact Kenneth Gage, (314) 576-4446.

**July** 8 *Satellite Tele-seminar program* "Cable's weakest link—tap to TV (part two)" and "Signal leakage equipment calibration" with Don Runzo of ComSonics and Steve Windle of Wavetek RF Products. Videotaped at Cable-Tec Expo '90 in Nashville, Tenn. To air from 1 to 2 p.m. Eastern time on transponder 6 of Galaxy I.

**July** 9 *Chattahoochee Chapter* "Surge suppression and preventative maintenance." To be held in Calhoun, Ga. Contact John Williamson Jr., (404) 376-5259.

**July** 9 *Desert Meeting Group* "OSHA." Contact Chris Middleton, (619) 340-1312, extension 258.

**July** 11 *Wheat State Chapter* Contact Mark Wilson, (316) 262-4270.

**July** 11 *New York City Chapter* BQ Cable Training Center, College Point, N.Y. Contact Rich Fevola, (516) 678-7200.

**July** 13 *Cascade Range Chapter* BCT/E examinations to be administered in categories III, IV, V and VII. To be held at Paragon Cable TV in Portland, Ore. Contact Tom Hansen, (503) 265-2263.

## SIECOR

Siecor Corp. will sponsor a four-day, hands-on fiber optic training program designed for craftsmen and contractors who install, splice and test fiber optic cable in a cable television environment. Following is the date for the program "Fiber Optic Installation, Splicing, Maintenance and Restoration for Cable TV Applications." For info call (800) 634-9064.

**July 9-12**
**August 20-23**

## NCTI

The following training courses have been announced by the National Cable Television Institute (NCTI):

**July 9** Fundamentals of Supervision Seminar for CATV Personnel, Seattle, Wash.

**April 10-11** OSHA Compliance Seminar for CATV Operators, Seattle, Wash.

For more information on NCTI's new training seminars, contact Michael J. Wais at (303) 761-8554, or fax inquiries to (303) 761-8556.

## Trade Shows

*SCTE Cable-Tec Expo*
**June 13-16** Reno, Nev. Contact SCTE, (215) 363-6888.

*Wireless Cable Show*
**July 21-23** Denver, Colo. Contact the Wireless Cable Association, (202) 452-7823.

*Eastern Show* **August 25-27** Atlanta, Ga. Contact Nancy Horne, Southern Cable Television Association, (404) 255-1608.

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# Fiber attractiveness grows

Fiber optics will play a bigger role in rebuilds and upgrades scheduled for both this year and next, although some managers still express concerns about the technology's expense.

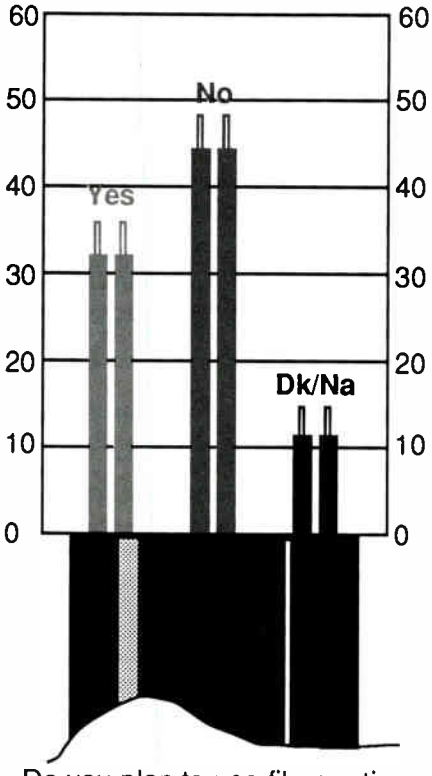
The increasing affordability of fiber, meanwhile, appears to parallel renewed interest among GMs to rebuild and upgrade their systems.

According to the February 1991 Cable Poll of 400 general managers, half expect to either upgrade or rebuild their system by the end of 1992. Of this group, 36 percent plan to use fiber technology.

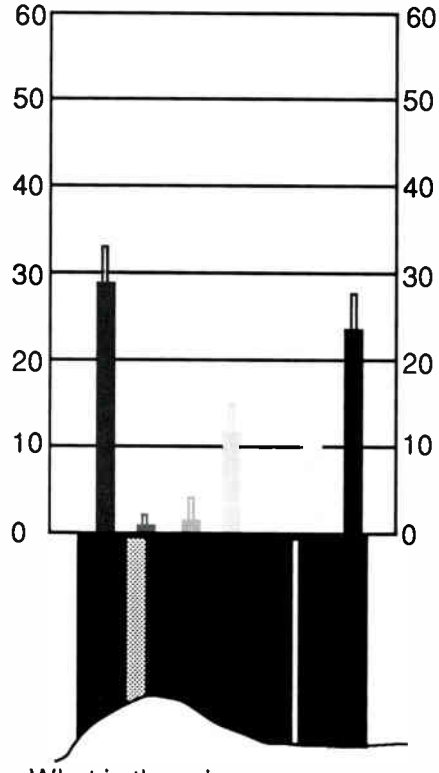
For the most part, fiber is being deployed by systems serving more than 50,000 subscribers. In this category, more than 70 percent of GMs planning rebuilds say fiber is part of their rebuild strategies. In the mid-sized system category—those operations serving between 10,000 and 50,000 households—52 percent of GMs eyeing rebuilds are planning to deploy fiber.

Geographically, Northeast systems are more inclined to include fiber in their rebuild strategies than systems located in the rest of the country.

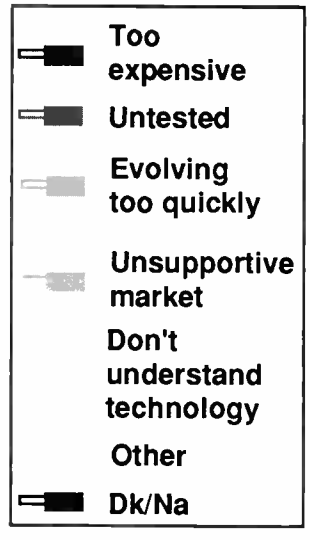
Systems planning rebuilds or upgrades span size and location parameters. As expected, larger systems are more inclined to rebuild/upgrade plant than smaller ones. Systems in the Northeast and South appear to be more likely to launch construction projects




Do you plan to use fiber optic technology in any upgrade, rebuild, or expansion projects in 1991 or 1992?




What is the primary reason you will not utilize fiber optic technology for your projects?



than systems in the Midwest or West, according to the Cable Poll.

Even as fiber deployment grows, there remains a fair degree of confusion among GMs about the technology's costs and impacts. Of those not using fiber in rebuild/upgrade plans, 33 percent say fiber technologies are still too expensive. Another 16 percent, meanwhile, say the market won't support the investment necessary for them to install fiber.

Fiber economics, meanwhile, are also causing some GMs to postpone upgrade/rebuild plans, mostly due to concerns about costs. More than 20 percent say they are postponing construction projects until they feel more confident that fiber prices won't drop much further.

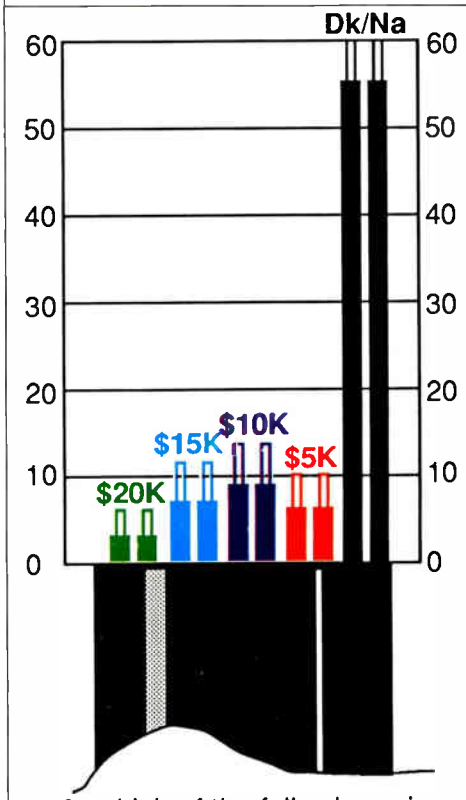
On the other hand, almost 60 percent say fiber prices don't have any bearing on their future construction plans.

Of those managers expressing concern about costs, a slightly higher percentage work at larger systems. Conversely, those GMs who say cost isn't an issue tend to work at smaller—below 10,000-subscriber—operations.

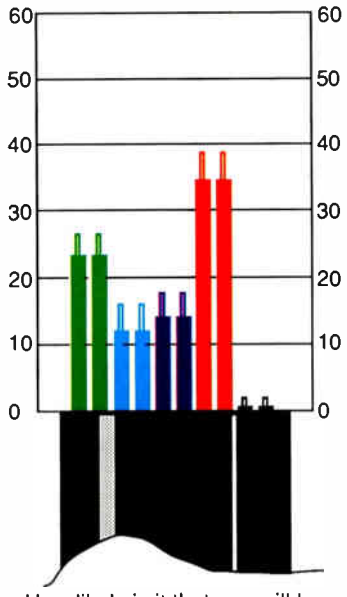
Still, there are certain price points that are more attractive than others. Most of the sample had no idea what price would induce them to deploy AM fiber equipment, reflecting unfamiliarity with the technology. But of those with an idea, the biggest segment—13 percent—said they would use fiber if they could purchase a receiver/transmitter link at or below $10,000. Eleven percent cited $15,000 as the price point; 10 percent said they would deploy fiber at $5,000 per link.

Costs notwithstanding, some recently developed fiber architectures, such as fiber-to-the-feeder, have forced some GMs to take another look at how fiber will fit into their projections. According to the Cable Poll, 34 percent of GMs assessing fiber say so-called FTF strategies have affected their construction blueprints. ■

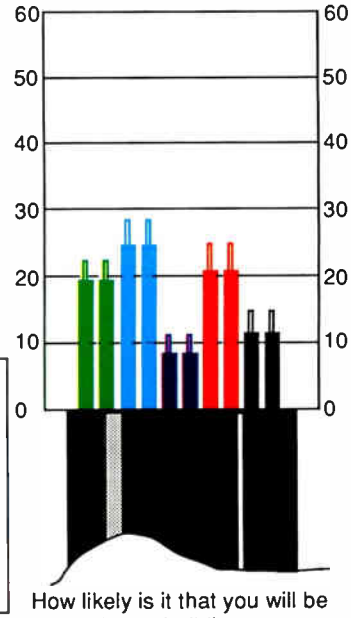
*—Chuck Moozakis*



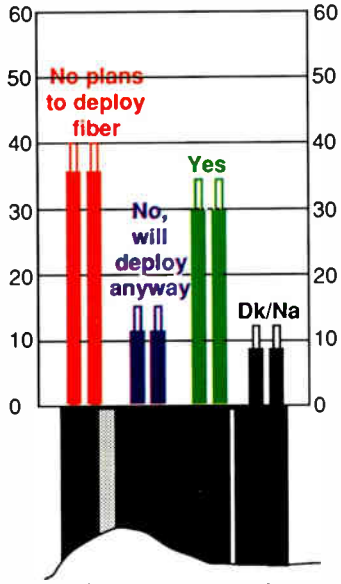

At which of the following price points would you deploy AM fiber optic equipment? (for one AM receiving/transmitter pair).



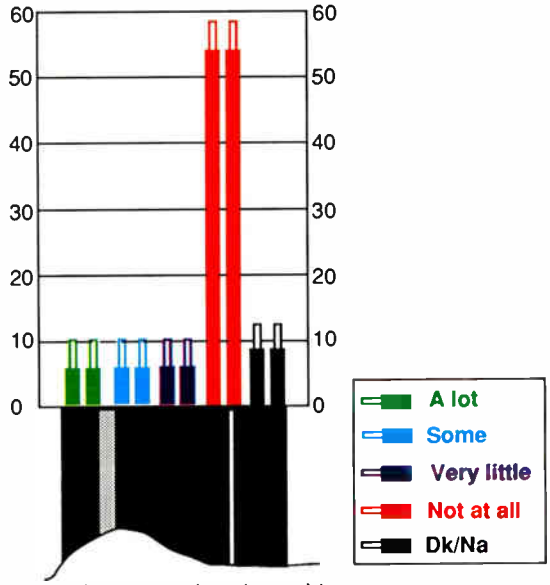

How likely is it that you will be upgrading, rebuilding or expanding your system in 1991?




How likely is it that you will be upgrading, rebuilding or expanding your system in 1992?




Has the development of fiber-to-the-feeder technology made any impact on your rebuild/upgrade plans?




To what degree has the rapid pace of fiber product pricing and development caused you to postpone upgrade/rebuild plans?

# Preparing cable's supervisors

The results are in and they don't look good: Cable's supervisors need help. According to a recent survey by the National Cable Training Institute of 100 technical, CSR, sales/marketing and administrative supervisors, most—87 percent—report being promoted "from the ranks" with little or no initial training on the fundamentals of supervision.

In fact, 81 percent of those surveyed reported "no training" when promoted or hired to a supervisory position, while 19 percent cited limited training including night classes and "self-training."

After donning the supervisory cap, however, the picture brightened—slightly. Thirty percent of cable employers reportedly offer some type of formal (classroom style) training, while 78 percent extend formal training in "some areas"—mostly out-of-house seminars on topics including "train the trainer," "time management" and "conflicts/management/supervisor."

### Educational assistance needed

Comments written by the surveyed supervisors strengthen the plea for educational assistance. "Not only would supervisory training be helpful, but also cross-training on the basics in other departments would help me to become more familiar with the processes of the company—and the company's function as a whole," wrote one respondent.

"All supervisors need ongoing training," comments another respondent. Included in a "wish list" of possible training areas that would assist this seemingly forgotten middle-management layer were topics such as:

- Discipline/counseling
- Time management
- Hiring and interviewing
- Terminations
- Planning and organizing
- Performance appraisals
- Employee communications
- Company policies, practices and procedures
- Delegating

And to that end, the NCTI is offering a new seminar entitled "Fundamentals of supervision," aimed to guide and assist cable's supervisory force. The next scheduled session is July 9 in Seattle, Wash. For more information, contact Michael Wais at (303) 761-8554.

### Easy ground-mount installs

**Alpha Technologies** has announced the development of a new PS (pedestal support) system for one-step solutions to ground-mount power supply enclosure installations. The pre-formed pedestals are constructed of high denisty polyethelene and can be used with Alpha's UPE, UPE/M, PWV/PED, PED/M and PMD/PED ground-mount enclosures. For info, call (206) 647-2360.

### Strand software works within AutoCAD

**Systems West** has introduced its new Strand Accelerator software, a package offering users automated intelligence when constructing strand poleline and underground routings. Designed to operate within AutoCAD, the software is supplied with aerial and underground library symbols and incorporates AutoCAD display environments, icon pull-down menus and sidebar menus.

Automatic features include: Trimming of line and arcs (to compensate for inserted symbols), scaling and placement of drawing entities into assigned layers, placement of house counts and pole numbers, and centering of footage labels. An auto-routing feature rotates and aligns all strand graphics and information based upon a street's angle, which "takes the guesswork out of working with angles," company officials say. For more information, call (714) 857-2885.

### New half-inch molding

**Cableready Inc.** has introduced a new half-inch size steel molding for use by installers in cable, sound, telephone and computer operations. The new smaller molding, SR050, has built-in wire ties and self spacers and is available in four painted colors and two wood grains. It attaches the same way as larger sized molding products by snapping over the clips mounted every four feet, making "fishing" the wire or cable unnecessary.

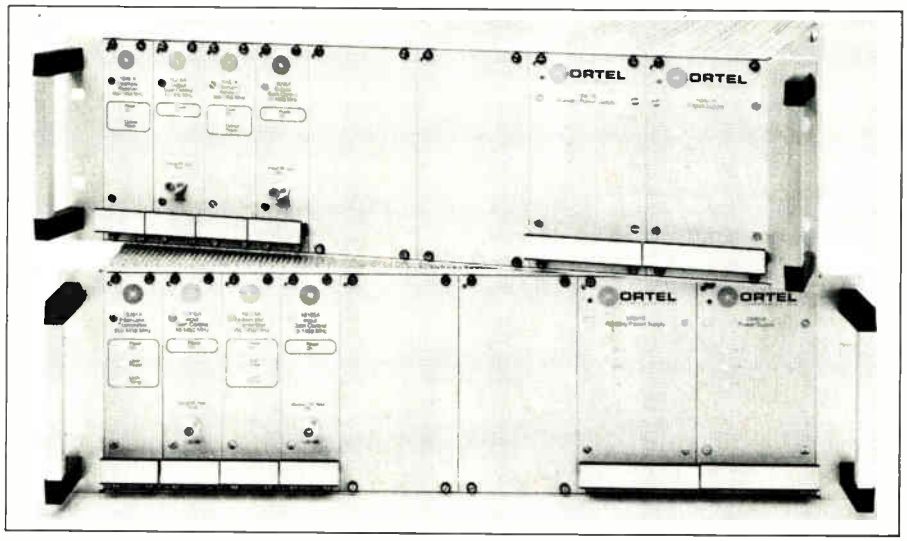
Also under development is a patent-pending entry key designed for use with the smaller molding. The key releases installed molding, allowing service personnel quick entry into the system for modifications or maintenance. For more information, call (303) 595-4952 or fax inquiries to (303) 595-4766.

### New TVRO fiber optic link

New from **Ortel Corp.** is the 10005A TVRO fiber optic link, used to transmit the LNB output from a satellite earth station antenna to a remote receiver or headend over distances up to 15 miles with a single fiber cable.

"With this system, you can place your antenna far from terrestrial interference and still have your main earth station facility or headend close to the community it serves," says Ortel director of marketing Larry Stark.

The system can transmit 12 chan-




*Ortel's TVRO fiberoptic link*

# Promotions and additions

Cable-television engineers lost a friend last month when industry veteran Cliff Paul died following surgery to implant a heart pacemaker. He was 71 years old.

For years, Paul was cable's friend at the FCC, and devoted much of his time to answering questions, sifting through stacks of microwave applications, working out compromises between CATV and the FAA, and more.

A native of Rye, N.Y., Paul was one of the first 30 people hired by the NBC television network and worked for 26 years as its technical director. He was also one of the first engineers hired by TelePrompter when it was founded. He later became the first chief engineer for New Jersey's Office of Cable Television and was the chief architect of the New Jersey Interconnect. He then went on to become a staff engineer at the FCC's cable television branch in 1978.

Paul was the first person inducted into the SCTE's Hall of Fame and was that organization's Member of the Year in 1982. He is survived by his wife, Beatrice, of Port St. Lucie, Fla. and son, Clifford M. Paul of Sparta, N.J.

In other news, **C-Cor Electronics** has appointed **Frank E. Sheley** to VP, sales and marketing. Sheley was most recently senior VP and manager of Amcore Financial Inc., a bank holding company. Prior to his work at Amcore, Sheley has ten years of cable television experience as the VP and general manager of Rockford/Park Cablevision in Illinois.

*Richard Converse*

**Richard L. Converse** has been named VP of operations for **Texscan Corp., Communication Products Division.** Most recently, Converse was the VP of operations for General Instrument, Jerrold Distribution Systems Division.

**Larry L. Seehorn** has been named director of engineering at California-based **Alamar Electronics**. Seehorn was most recently founder and president of Seehorn Technology and Horizon Software, two companies involved in software-based editing product development.

**Cable Services Group** has named **Thomas McClung** director of quality in the Omaha, Neb.-based CSG office. McClung was previously director of administration for the Nebraska Furniture Mart. McClung will serve as the key resource contact in developing and implementing the quality improvement process at Cable Services Group.

**MetroVision Inc.** has announced a number of corporate promotions. Named senior VPs are **Richard C. Hickman**, **Donald A. Smith**, and **Ernest R. Olson**. MetroVision also named five new VPs, including **Thomas G. Bjorklund**, Livonia, Mich.; **James D. Brown**, Lincoln, Neb.; **John E. Mankin**, Waco, Texas; **Ronald D. Murray**, Palos Hills, Ill.; and **Roger C. Wells**, Capitol Heights, Md. The new VPs are also MetroVision's five regional managers.

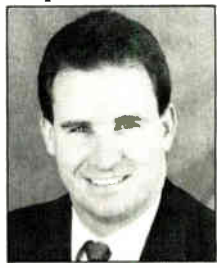
MetroVision also named **Bradford P. Hunter** treasurer and assistant secretary, and **Suzanne Allen** secretary of the company.

Denver-based **Coaxial Analysts Inc.** has announced several personnel changes. **James B. Mackenzie** has accepted the role as Coaxial's new president. He succeeds **Ross W. McPherson**, the company's founder, who will remain chairman. Mackenzie has been with Coaxial Analysts for 12 years, serving the last eight years as vice president of the mapping service division.

*James Mackenzie*

In addition, **Carmen L. Skeehan** formerly director of the design division, has been named VP of design services, and **G. Charlene Tatum**, formerly controller, has been named Coaxial's new VP of finance.

**Patrick Sim** has been named director of operations for **Jerrold Communications**. In this new position, Sim is responsible for production planning in Jerrold's manufacturing operations in Mexico and Taiwan and traffic and purchasing functions in Hatboro, Pa. ■



*Patrick Sim*

nels from a single polarization. Each plug-in unit mounts into a standard 19-inch rack-mount chassis which includes an AC power supply and rear panel RF and optical connectors. System RF input also provides current-limited DC power for the LNB. RF parameters of the 100005A are passband range of 950 MHz to 1450 MHz, baseband S/N ratio at 15 miles of 60 dB and input/output impedance of 75 ohms. For more information, call Ortel at (818) 281-3636.

### CONTEC, S-A ink deal

**CONTEC International** and **Scientific-Atlanta** have reached an agreement that calls for S-A to provide training to CONTEC personnel for the repair of the supplier's addressable and non-addressable post warranty converters.

For info, call (518) 382-8000.

### Coaxial RF fuse holders

*JFW's RF fuse holder*

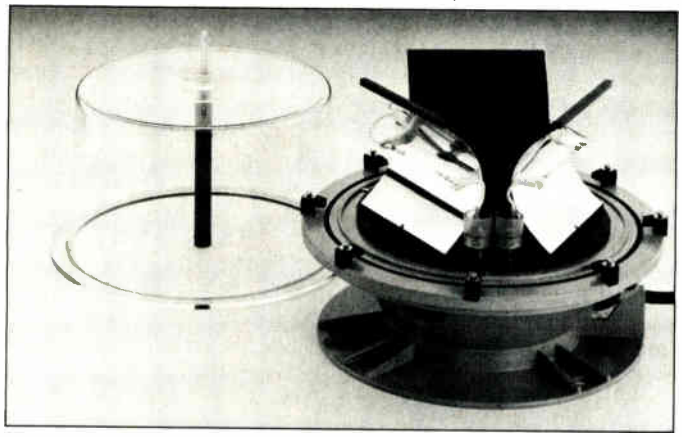
New from **JFW Industries** is the 50RF line of coaxial RF fuseholders, designed to prevent RF overload of attenuators and test instruments. Fusing levels from 200μW through three Watts are available as standards. All models use an inline picofuse, while some models are panel-mountable and the fuses replaceable from the front panel.

BNC, TNC and N connector options are standard, and SMA, SMC and SMC are also available. Other options include internal diode limiting to decrease fusing level and speed.

For more information on the fuse holders, call (317) 887-1340 or fax inquiries to (317) 881-6790.

### Obstruction beacon

**EG&G Electro-optics** has announced a new medium-intensity obstruction warning beacon, the FlashGuard 2000, designed for day/twilight and night use on towers or other tall obstructions ranging from 200 feet to 1,000 feet tall.



*EG&G's Flashguard 2000 beacon*

According to company officials, the patent-pending FlashGuard 2000 represents a new generation of obstruction warning beacons, because it does not employ a Fresnel lens to focus its light energy. Instead, it relies on a trio of linear flashlamps, each with its own parabolic reflector, to achieve higher output and full 360 degree coverage with a minimum of line input power.

"We wanted to devise a state-of-the-art obstruction warning light that would deliver a narrower beam, consume less power, create less wind loading on the cellular or other tower on which it was placed, and require less maintenance," explains EG&G manager of systems development Ray Radford.

Each unit, priced at less than $2,100, comes with an FAA Compliance Certificate. EG&G expects delivery in mid-1991. For more information, contact EG&G at (508) 745-3200.

### Broadband data modem

New from **C-Cor Electronics Inc.** is the C-series line of broadband data modems, designed specifically for CATV applications. The new line includes the C10, C20 and C60 models. The C10 is a slow speed 9600 baud unit designed for simple telemetry and data applications. The C20 offers synchronous and asynchronous data communication at speeds of up to 19,200 baud. The C60 is designed for high speed synchronous applications at speeds to 64,000 baud.

For more info, contact C-Cor at (814) 231-4450.

*—Leslie Ellis*

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# 1 GHz consumer electronic interface

When I accompany service technicians and visit subscriber's homes, it is painfully obvious that subscribers still have a lot of discomfort and inconvenience with the way consumer electronics equipment such as the TV receiver and the VCR interface with the cable system.

Several new technologies which are intended to increase the utility and attractiveness of cable service will simultaneously make this situation even more difficult.

### 1 GHz cable

In March of this year, a project was announced to construct a 1 GHz bandwidth cable television system in two neighborhoods of Queens, N.Y. This will be accomplished by year end. Approximately 10,000 homes will be passed by this cable system, and 4,000 are expected to be connected by the beginning of next year. All 830,000 passings should have full service available during the next few years. If, as expected, subscribers like the new services to be offered, 1 GHz cable will be commonplace in five years, and pervasive in 10 years.

What does this mean for the consumer electronics interface with cable? Stated in its simplest terms, for the 1 GHz cable systems, there is no such thing as a "cable-ready" TV or VCR. No one has produced a tuner for use in television receivers or VCRs connected to cable that will perform satisfactorily with 150 channels of NTSC loading. For the cable subscribers in Queens, a set-top converter will be mandatory for access to all these channels.

Gigahertz cable has been a topic for discussion for at least a couple of years in the EIA/NCTA Joint Engineering Committee. (The EIA is the Electronic Industries Association and the NCTA is the National Cable Television Association.) About half of the participants have been from cable and the other half from the consumer electronics industry. While none of the participants should be surprised by this development, there may be some shock. The shock comes from the impact this will have on the increase in the consumer electronics designers' workload.

*By Walter Ciciora, Vice President of Technology, American Television and Communications*

### Video compression

Video compression is another technology which will have a major impact on the consumer electronics interface with cable. Compressed video needs to be de-compressed. This requires either circuitry external to the TV or VCR or built-in. The third alternative, of course, is the plug on the back of the TV. This is only possible if the modulation scheme is compatible with the RF processing in the TV. At this point in time, too much is going on in the video compression arena to make solid judgments on this issue.

### The driver

Lest we think that 150 channels is more than anyone can use, let's take a closer look at what will be offered in Queens. Currently, that cable system has a bandwidth of 550 MHz with 75 channels. The subscribers' reaction to these channels is best summarized by noting that these subscribers have signed up for more optional services than almost anywhere else in the country. They chose to purchase an average of $45 worth of video a month. This is well above the basic offering. The additional 75 channels made possible by the expansion to 1 GHz will carry mostly multi-channel impulse pay-per-view (IPPV) services. Much of the IPPV will be of a new variety: near video on demand (NVOD).

Here, popular movies are repeated every "X" minutes. If X is less than the length of the movie, more than one channel will be required. A commonly discussed value for X is 30 minutes. I feel that X for the most popular movies should be slightly less than the average drive time to the nearest video store. Because the average American family spends about $15 a month on movie rentals, NVOD has an opportunity to generate substantial new revenue.

### What can you do?

The challenge for the consumer electronics industry is two-fold: To quickly bring to market television receivers and VCRs which will be fully compatible with 1-GHz cable which offers NVOD, and to anticipate the need to be compatible with video compression.

Failure to do this may finally bring the dreaded situation where the logical purchase for the subscriber is a monitor for the connection to the video and audio outputs of the cable box. This is not in the best interest of the consumer electronics industry, nor of the cable industry, and especially of the consumer.

All parties are best served if a truly cable-ready product is available for consumer purchase. This reduces the capital investment required of cable and the hardware maintenance problems. This also reduces the intrusion into the subscriber's home which builds resentment and predisposes the subscriber to be intolerant of other problems.

### Joint effort

The engineers from the consumer electronics industry are a creative group who truly want to do what is best. They don't fully understand our industry and its unique problems. Conversely, most cable technologists don't appreciate the constraints under which consumer electronics design must operate. The EIA/NCTA Joint Engineering Committee is a place where both sides can better reach understandings and work together to mitigate these problems.

those of you who can make it to Chicago, where most of the meetings are held, to call Tom Mock of the EIA at (202) 457-4975 and find out how you can participate in the next meeting. Together, our two industries can work to the benefit of our common interest: Our subscriber, their customer. ■

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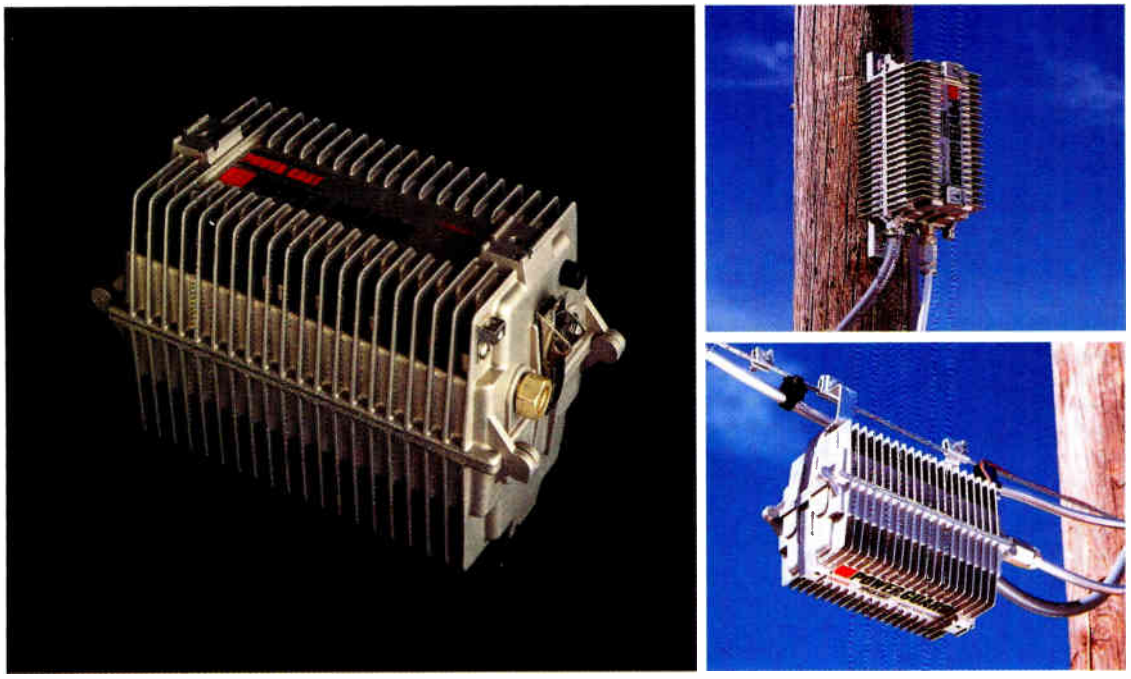

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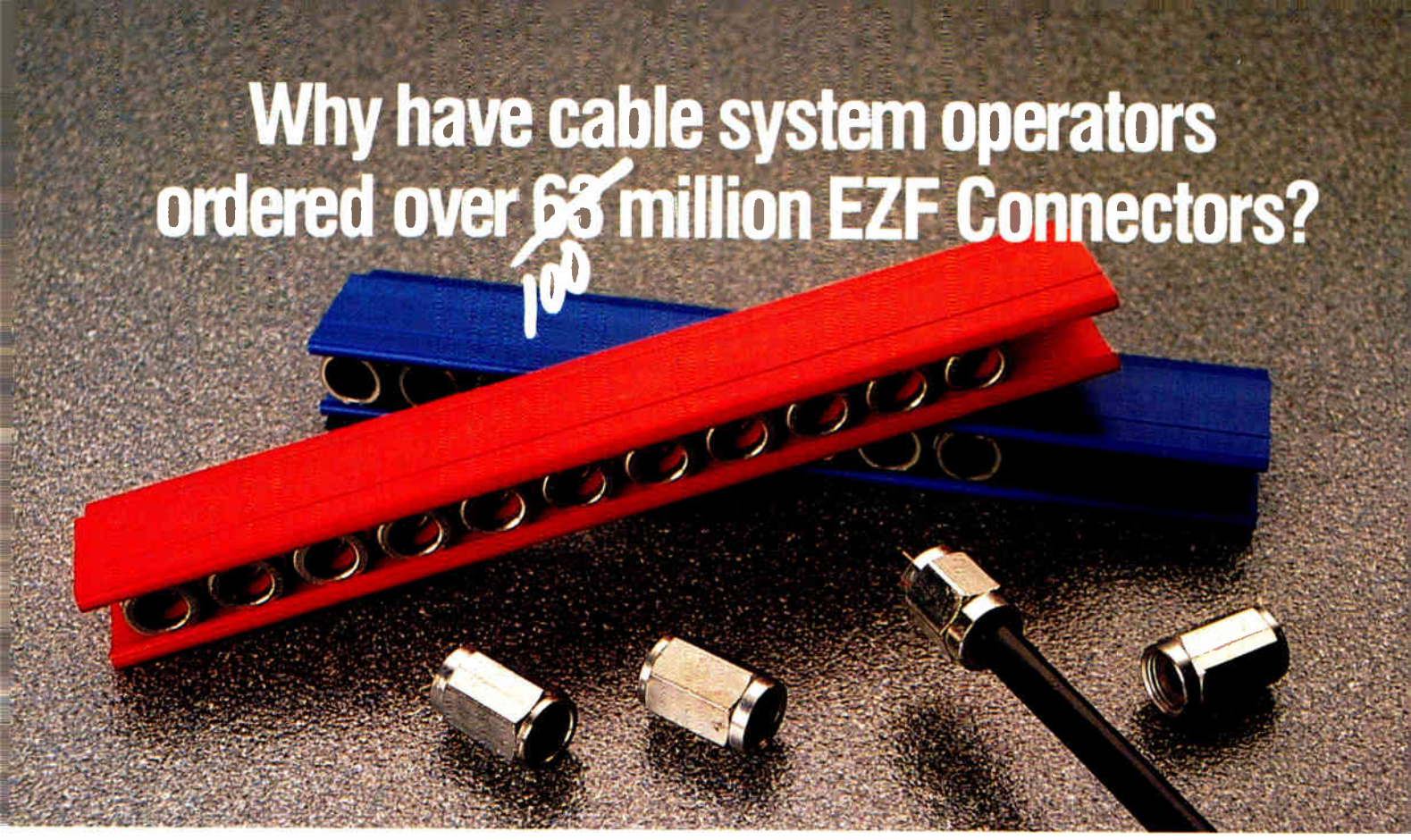

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