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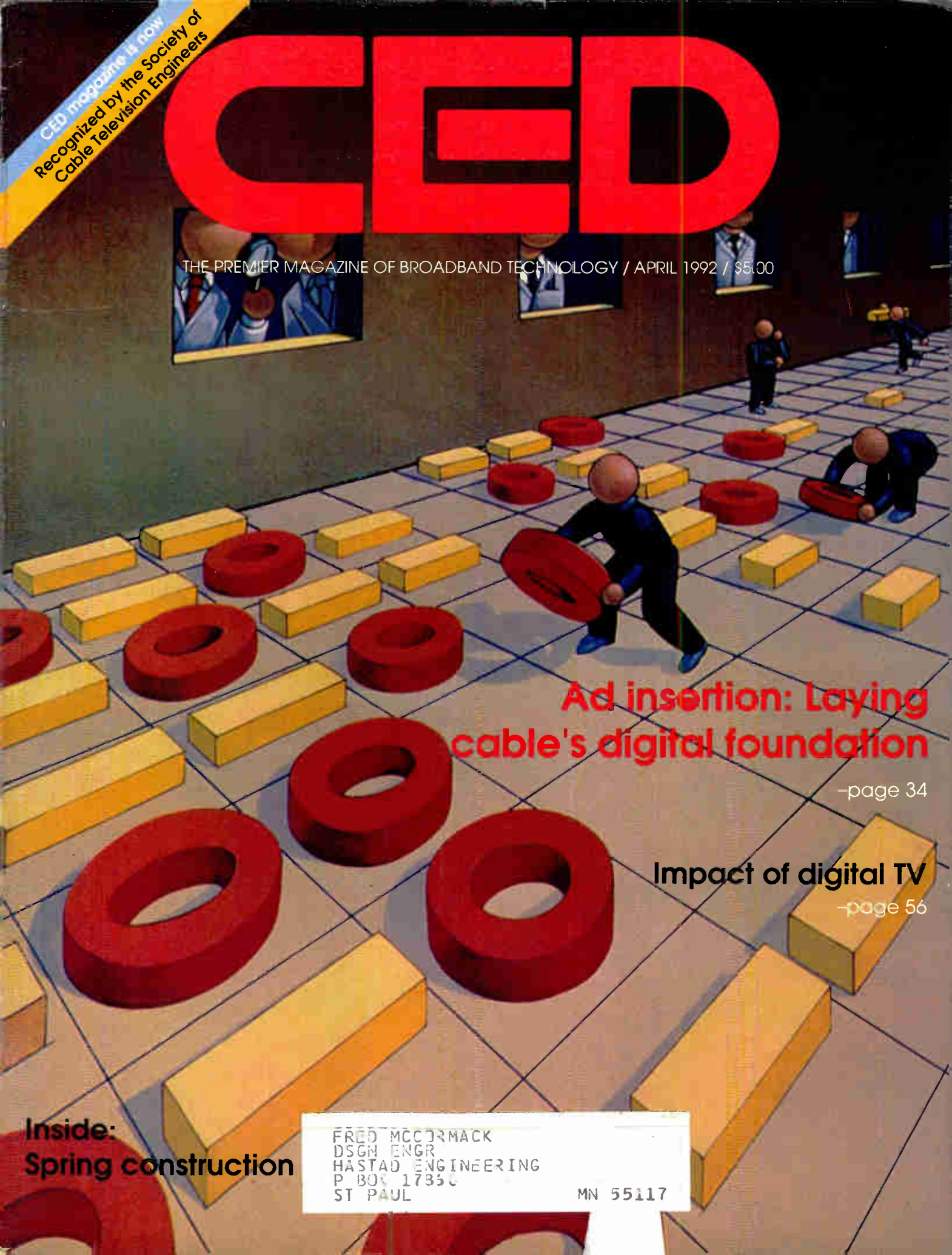
CED

THE PREMIER MAGAZINE OF BROADBAND TECHNOLOGY / APRIL 1992 / $5.00



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CHEAT-SEEKING DEVICE

SIGNAL PIRACY

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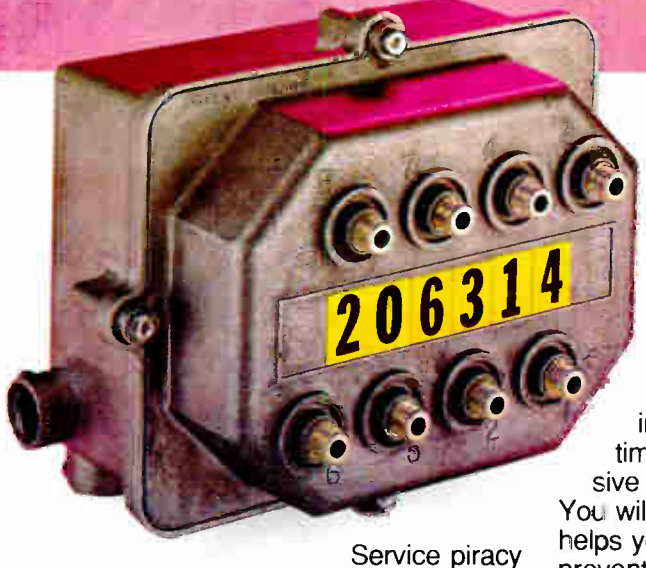

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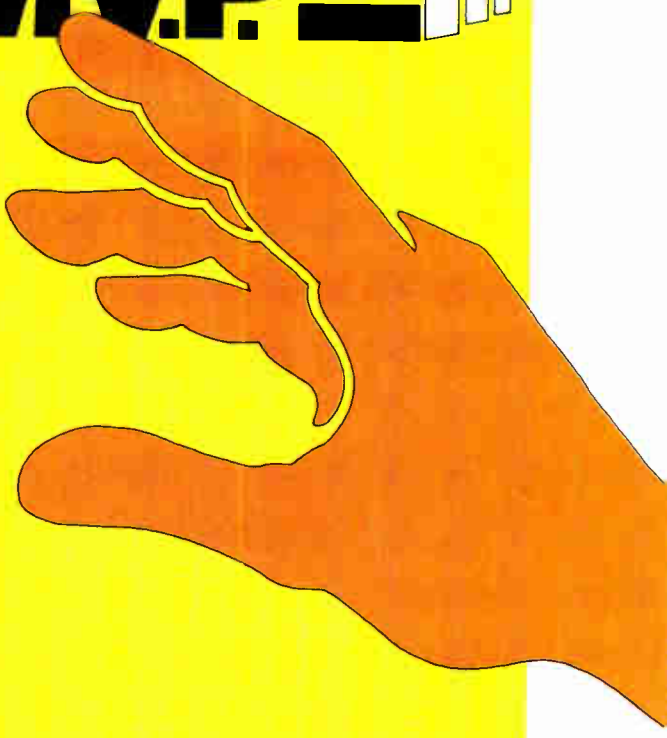

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April 1992 CED Volume 18, Number 4

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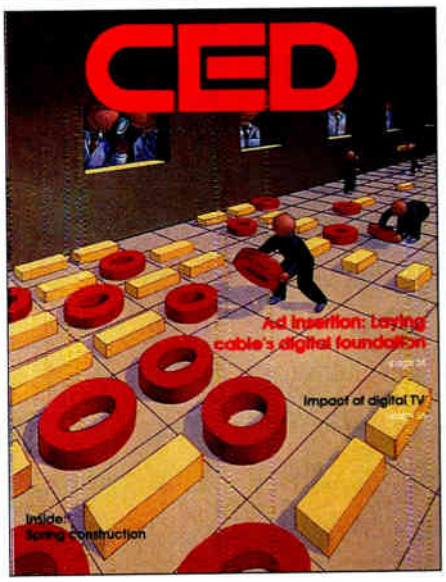

About the Cover:
Cable operators lay a digital network foundation. Illustration by Barton Stabler-TIB

DEPARTMENTS

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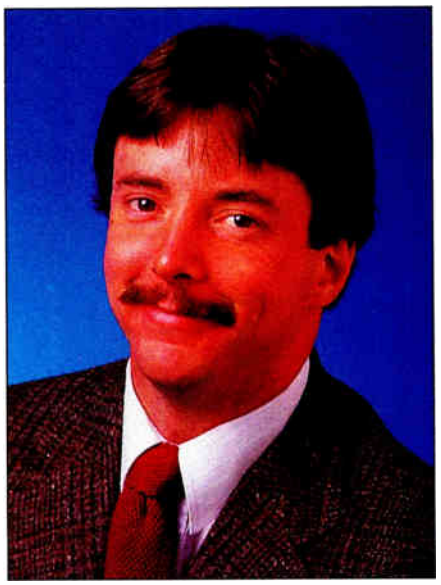
CED

The rolling stone hits the road again

Never one to sink roots too deeply in any one place, Roy Ehman is on the road again. After a lengthy and prestigious career in numerous locations with several MSOs, Ehman has officially called it quits in cable TV and has embarked on a year-long motor home tour of the United States and Canada, accompanied by his wife Betty.

While you read these words, the Ehmans are making their way to Texas. After they spend a little time in El Paso, they'll turn right, head to the West Coast and then travel north. As the weather improves, Roy and Betty will drive to Seattle and Vancouver, across western Canada and the northern United States to the East Coast. From there, they'll turn south, with plans to spend next Christmas in Miami.



By the time it's all over, Roy and Betty will have driven 12,000 miles in their 36-foot "home on wheels," consuming 2,000 gallons of gasoline. While life on the road may not seem appealing to everyone, the Ehmans will have all the comforts of home aboard their 7-ton craft: two TVs, a VCR, a microwave, two bicycles, a tape deck, a ham radio, even a shower and bathtub!

Along the way, Roy plans to visit family members and many of the friends he's made during his years as one of cable's most analytical and pragmatic engineers. Roy even intends to stop in and chat with a few cable technicians along they way: as the industry's "leakage guru," Ehman has already scheduled to meet with a few SCTE chapters and give them his thoughts about signal leakage compliance.

Spending a year "on tour" is entirely appropriate for Roy, who's never allowed moss to grow anywhere near him. The native South African took a similar tour of Europe years ago, with his young kids in tow. After moving to Canada and joining the CATV community some 20 years ago, Ehman has lived and worked in Calgary, Syracuse, Miami, Kentucky and Denver.

Although Roy has refused to wear out his welcome in any one locale, there's no doubt he's left a legacy of quality and precision in each system or corporation for which he was worked. The entire industry owes Roy a debt of gratitude for his tireless efforts to "clean up" cable systems and protect active equipment from lightning and power surges.

Most recently Roy was director of engineering at Jones Intercable, where he doggedly looked after CLI reports and kept track of all the offsets his systems used. Consequently, he's a key reason why Jones has had such an excellent track record when the FCC inspector comes to call. For example, the huge Jones system in Albuquerque was recently visited and not a single leak above 20 microvolts/meter was detected!

I'd like to think Roy's commitment to quality has been evident within the pages of *CED* also. Roy has been a member of the board of consulting engineers since 1985; his input and willingness to provide advice has been important to all of us here. We wish him well during his tour and after he settles down in his new home in Knoxville, Tenn.

By the way, ham radio operators should note that Roy's call sign is VE6EV—get him on the air and give him your regards.

Roger J. Brown

Roger Brown
Editor

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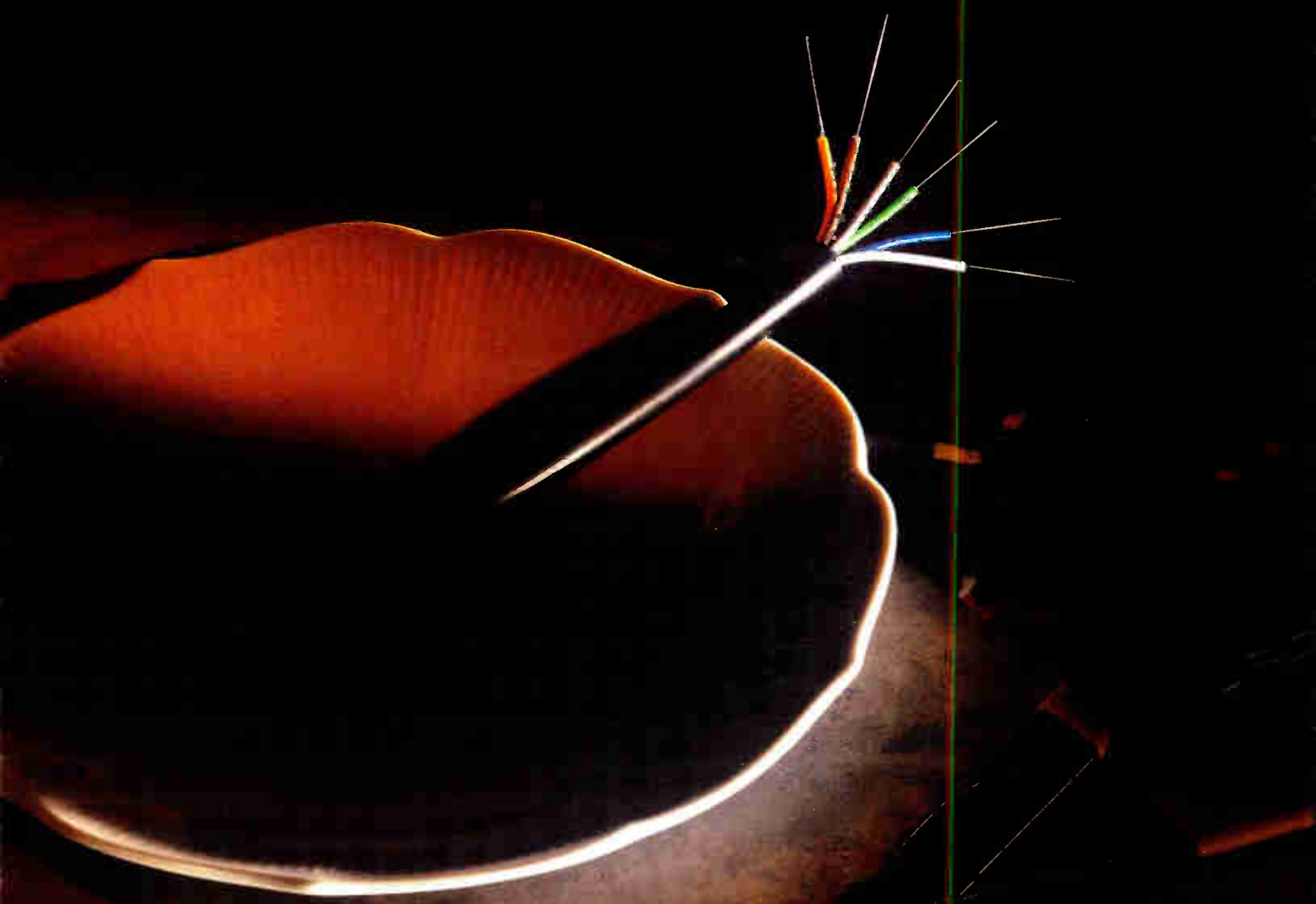

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WAVETEK

FCC issues Report and Order on cable TV technical standards

As *CED* reported last month, the Federal Communications Commission released its Report and Order describing the new cable television technical standards that were adopted unanimously by the Commission in the middle of February.

The final text of the Report has been met with mixed emotions from cable interests (see "Frontline," p. 12) who believe the FCC tilted its Report to favor the interests of local municipalities. However, it remained unclear at press time if there were any plans to ask the FCC to reconsider portions of the Report. The key parameters of the new standards are printed elsewhere on this page.

One of the key provisions of the joint agreement on tech standards hammered out between the NCTA and the National Association of Telecommunication Officers and Advisors, which the Commission used as the basis for the new standards, was the creation of a joint engineering committee that would meet to determine methods and practices of measurement to determine if cable systems are in compliance with the standards. The FCC, however, chose not to formally recognize such a group, noting that it was "neither necessary nor warranted."

Though he was "saddened" with the FCC action, NCTA VP of Science and Technology Wendell Bailey said the joint committee will be formed anyway "to write consistent, repeatable and proper test procedures" in order to reduce the chances for disputes with local authorities.

The NCTA plans to sponsor several seminars in numerous locations that will focus on technical reregulation. The first has been scheduled for Saturday, June 13, in San Antonio, Texas—one day prior to the SCTE Cable-Tec Expo.

Highlights of FCC cable TV technical standards

- Excludes systems of less than 1,000 subscribers.
- Forbids local authorities from adopting standards more stringent than FCC standards.
- Does not require cable operators to improve the quality of signals received by the system.
- Systems cannot remove closed-captioning data and must deliver it intact on line 21 of the VBI.

The key parameters include:

Aural center frequency: 4.5 MHz ±5 kHz, measured at subscriber terminal and at headend.

RMS voltage differential: 10 dB to 17 dB below visual carrier.

Visual signal level: at least 3 dBmV, measured at end of 100-foot drop attached to a tap; at least 0 dBmV, measured at any subscriber terminal.

Amplitude characteristic: ±2 dB from 0.75 MHz to 5 MHz above lower channel boundary limit, measured at subscriber terminal.

Carrier-to-noise ratio: At least 36 dB immediately; at least 40 dB within one year; at least 43 dB within three years. Measured at subscriber terminal.

Signal level to coherent disturbances: 47 dB for coherent channel systems; 51 dB for non-coherent channel systems. Measured at subscriber terminal.

Terminal isolation: At least 18 dB, measured at terminal (if necessary).

Hum modulation: No greater than 3 percent, measured at subscriber terminal.

Color signals, as measured at headend at least once every three years—
Differential gain: Not greater than 20 percent
Differential phase: Not greater than 10 degrees
Chroma delay: Within 170 nanoseconds

Proof-of-performance tests:

Semiannual tests on a minimum of four channels, with one channel added for every 100 MHz of bandwidth or fraction thereof (systems with 216 MHz bandwidth need to test only five channels).

A minimum of six points must be tested within each mechanically continuous set of cables. An additional test point is required for every 12,500 subscribers.

Visual signal level tests: During any 24-hour period, each channel's level must be within a range of 8 dB; within 3 dB of adjacent channels; and within 10 dB of any channel in systems offering up to 300 MHz of bandwidth. A 1-dB increase is allowed for each 100 MHz of additional bandwidth. Tests are to be conducted twice yearly; four times during the 24-hour period. Tests are to be performed after the signals are descrambled.

ATC offers new interface concept

Cable operators may be getting a lot of heat (again) because their cable convertors don't interface well with consumer electronics equipment, but it would be inaccurate to say engineers aren't giving the problem a lot of thought. This time it's American Television and Communications that is floating the idea of a cable "demarcation" point located on the side of the house.

ATC's idea, called Point of Entry or POE, is being examined as a way to provide subscribers full access to all the features on their televisions and VCRs, prompting them to purchase more pay-per-view events (which means more revenue for the operator). The idea was presented to the public for the first time in late February during a CATV symposium sponsored by Raychem Corp. The concept is expected to be discussed during a technical session at the National Cable Show in May.

POE, as envisioned by ATC engineers Dave Pangrac and Jay Vaughn, would process a full 1 GHz of bandwidth and provide either 450 MHz or 550 MHz output into the home. The outdoor housing would be modular in nature, allowing operators to implement two-way communications. It could also house two tuners, allowing viewers to watch two PPV events or movies at the same time. When it makes economic sense, digital tuners, microprocessors and devices such as voice/data modems could be implemented, Pangrac said.

The idea is hardly a new one. Tele-Communications Inc. devoted a lot of time and resources to a similar "on-premise" approach, but recently re-committed itself to set-top descrambling convertors for its national addressability campaign. But this time, ATC is eyeing the concept with digital compression and 1 GHz of bandwidth in mind. Pangrac said such a device would use ex-

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isting components commonly found in a convertor, but would rearrange them.

By creating a modular system, ATC would find it simpler to upgrade to new technologies as they are brought on line. For example, the operator recently purchased 156-channel set-tops for its 1-GHz upgrade in Queens, but what happens when compression is a reality? The separation of the convertor into components "positions the (outdoor) box for the future," Pangrac said.

The idea is very similar to the one advanced by Cable Television Laboratories late last year. The CableLabs project, called Adaptive Interface Unit, consists of an electronic "card cage" that would utilize plug-in "cards" to perform functions such as signal descrambling, stereo delivery, enhanced picture resolution, etc.

Pangrac said this approach would actually be less expensive than placing multiple set-tops in a home because historically, the operator has spent more money maintaining convertor cosmetics than electronics. ATC plans to test the concept this summer in conjunction with at least one power company, said Pangrac. By placing the unit in front of the power meter, the device can monitor energy consumption and help utilities with load management, which has become an important issue with utilities.

Pangrac emphasized that the project is "purely experimental" and, outside of the planned tests, may not necessarily be implemented in any of the MSO's systems.

TV Answer contracts for terminals

Having made significant strides in jump-starting a nascent interactive television industry already, TV Answer is almost single-handedly driving the market. The Reston, Va.-based company has announced a deal it made with Hewlett-Packard whereby HP will supply about 1.5 million home units, which will be about the size of a small VCR and carry a $700 retail price tag.

TV Answer was instrumental in persuading the FCC to grant 1 MHz of radio frequency spectrum for interactive video and data services (IVDS). The company has already developed prototype in-home units, a wireless remote control with a joystick and completed a two-year study and test of the technology on the Media General cable system in Fairfax, Va.

TV Answer's system requires a data stream to be sent from a service provider to TV Answer headquarters, where the data is sent via satellite to cell sites. These two-way cell sites distribute the information to individual homes for display on the television and collect the responses made by viewers.

TV Answer officials estimate cell sites can be built for less than $30,000 and the company has already contracted with Hughes Network Systems to supply as many as 10,000 cells, a deal worth a reported $120 million.

Watch for deals between service providers and TV Answer next. The TV Answer service is expected to get going in about a year.

GI demos HDTV over cable

Unfurling digitally televised flags and airing compact disc quality patriotic music, General Instrument Corp. attempted last month to pull ahead of its competitors in the race to become the standard transmission system for the nation's high definition television.

On March 23, a 15 minute broadcast from the Washington, D.C. suburbs to a small room in the U.S. Capitol was the first time a digital high definition television signal had been carried over the air. The signal was also picked up and sent through the Capitol's cable system for airing.

A tape played at local public broadcasting station, WETA—which interrupted its programming day for the test—was digitized, broadcast from a standard television transmitter and picked up by a Radio Shack antenna mounted on the Capitol roof line. The tape was roughly half NTSC and half HDTV, with an American flag beginning and ending the HDTV section.

Other HDTV sections of tape included a rodeo scene, some time-lapse photos of blooming flowers and an underwater scene, all of which GI has shown in some of its earlier HDTV demonstrations. The segment ended with a new aerial shot of the Statue of Liberty with "America the Beautiful" playing in digital audio sound.

A small invitation-only crowd gathered in the Thomas P. O'Neill Jr. room of the Capitol to see the live broadcast. Federal Communications Commission Chairman Alfred Sikes, Commissioners Ervin Duggan, Andrew Barrett and James Quello were among those watching.

"This is the first time any of us have seen digital HDTV," Sikes said. "I think it's a breakthrough because of quality. I think this is a big breakthrough because it's digital."

The broadcast of the digitized signal should help resolve the conflict many have seen developing over HDTV between broadcasters and cable, Sikes said. "As we get closer and closer to reality, I think a lot of these fears will start to fade," Sikes predicted.

GI's DigiCipher system is one of six systems vying for consideration as an HDTV standard.

It is one of two systems that can be considered entirely American made, without any investors representing interests outside the U.S. GI completed its technical tests for HDTV consideration at the Advanced Television Testing Center last month.

The system being developed by AT&T and Zenith Electronics Corp. is now being tested at the center. When tests of all systems are finished—sometime in early summer—the FCC's Advisory Committee on Advanced Television Service will evaluate the results and recommend a standard to the FCC.

If GI's DigiCipher is selected as the standard it will probably take about a year and a half for computer chips to become available for use in the first HDTV sets, according to GI officials.

In transmitting over the air, DigiCipher used a 32 quadrature amplitude modulation scheme, lower than the 64 QAM scheme the company is using for video compression on cable systems. The lower modulation is to compensate for the open nature of a broadcast system, according to Woo Paik, vice president for advanced development for the VideoCipher division. "UHF or VHF is a much more hostile environment than the cable environment," Paik said at the demonstration.

In addition, GI is relying heavily on its adaptive equalizers to iron out glitches in pictures. "Without that, nothing works unless you're very close," Paik said.

But, as with other compression schemes, DigiCipher was able to send a clear signal using only a fraction—roughly two percent—of the power necessary to send NTSC signals, Paik said. The test demonstrated DigiCipher could work in almost any environment.

"This came from the cable industry," said Hal Krisbergh, president of GI's Jerrold Communications division. "Certainly it's expected that cable will be a very early adapter of high definition television technology."

By Roger Brown and Chris Nolan

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Notes on tech standards

At long last the FCC has released its Report and Order on original docket 85-38, which later became docket 91-169. This has been one long, difficult process and there are many people to thank for their efforts. I won't go into that again because in a column not long ago (*CED*, November 1991, p.16) I used names and companies when I went over the basic outline of how the filing had been accomplished.

The point of that column was the final joint proposal for a new set of cable technical standards, which the interested parties had filed at the FCC. I am pleased to say the Commission has adopted *almost all* of the joint proposal.

Joint consultations

A part of that analysis, of course, will be consultations between the teams from the franchise authorities and the cable industry. I sincerely hope that any differences we have can be dealt with swiftly so we can decide to either accept this package as is or seek some changes in certain areas. By and large, the Commission left the most important things intact.

The cable industry engineering side had maintained all along that only certain parameters are necessary to generally define a state of good health for a television signal. While these few parameters do not completely describe a good signal, the practical effect is that if these parameters are in the correct ranges, a reasonably good picture will result (unless something else is malfunctioning).

Specifically, we are talking about visual signal level, carrier-to-noise, intermodulation products and hum:

- The Commission left intact our recommendations for visual signal level of +3 dBmV at the end of a 100-foot test drop and 0 dBmV at the input of the first authorized terminal in a subscriber's home.
- Noise performance must be improved from 36 dB to at least 40 dB within one year of the date of adoption of the FCC rules, and improved further to at least 43 dB two years later. This is a change from our proposal of four years after the date of adoption.
- Intermodulation products cannot exceed 51 dB for non-coherent systems and 47 dB for coherent systems. Here, both specs are related to tests using modulated carriers and time averaged. A small change in the rules here would indicate that HRC systems will do well at 47 dB, but that IRC systems will probably have to meet a higher number.
- Hum cannot exceed 3 percent.

There are myriad other parameters, of course. The question is, how will any of them affect our ability to do business?

Closed captions

In particular, a couple of touchy points were raised by the Commission's changes. First, the joint parties had offered language regarding closed captioning, agreeing that no cable operator would deliberately remove closed captions carried on line 21 of the vertical blanking interval (VBI). The Commission went somewhat further, saying that an operator would deliver the captions as received at the headend.

Exactly how this language is written and how the Commission resolves another proceeding on closed captioning will determine the level of burden on cable operators. It is clear the Commission does not intend for the debate between the scrambling systems and closed captioning circuitry (docket 91-1) to be subsumed by the language in this document.

The Commission also stated that while it was pre-empting the provision of video or video-like signals in the setting of technical standards, it would not pre-empt in the area of non-video signals. While I find this somewhat troubling, I think we should listen carefully to the other words the FCC has attached here:

"Thus, while we are not prepared at this time to pre-empt in these areas, we strongly urge state and local regulatory authorities not to establish their own standards. Moreover, we remain prepared to revisit this issue and to adopt exclusive federal regulations as necessary to achieve the objectives of the Communications Act."

So, while the Commission will not issue rules regarding data transmission or other non-video signals, it signals its intention to keep a close eye on how these services evolve.

Test point problems?

I have a dimmer view of the ramifications in the other area where the Commission deviated from the joint proposal. In the FCC's original proposal, it proposed six test points (an increase over three in the old rules) for each mechanically continuous set of cables within a cable television system. In our deliberations, the issue of what would constitute a mechanically continuous set of cables was constantly debated. Both the cable interests and franchise interests realized that this debate would likely take place at the local level.

Thus, both sides (almost simultaneously) came to the conclusion that we had to find a better way. So, the issue of testing was based strictly on the total number of subscribers within a system. We proposed six test points, plus one additional test point for every 12,500 subscribers over the first 12,500 subscribers.

The Commission has decided to adopt our proposal, plus its own. Let's look at the effect the FCC proposal would have on a system with 250,000 subscribers and 10 AML radio paths. Under the old rules, the system had to test at 30 locations. Under the joint proposal, 25 points would have to be tested. Under the new, improved (?) FCC proposal, there would be 80 test points. I don't believe this is at all necessary or fair; we will have to look long and hard at this issue to determine how to deal with it.

More remains to be done by the joint committee. Specifically, the writing of the test procedures that will be used to accomplish compliance with these parameters should forge new relationships between the franchise side and cable operators.

Service to the subscriber is what it is all about. When we are delivering services to subscribers who pay good money for them, we should strive to do the best we can. These standards represent an objective, measurable threshold which will help achieve that. **CED**

By Wendell Bailey, Vice President, Science and Technology, NCTA

ONI OPTICAL NETWORKS INTERNATIONAL

Optical Network News

The following highlights are from Optical Networks International's quarterly newsletter.

■ ONI begins work on Star-Star-Bus architecture

Using externally modulated lasers by Harmonic Lightwaves, Optical Networks International has begun working on a "Star-Star-Bus" architecture which enables operators to position cable systems for future services, such as alternate access, PCN and video-on-demand. The 500 home per node architecture increases reliability, simplifies powering, reduces micro-reflections, and allows for an easier upgrade to higher bandwidths.

(See related story in the April, 1992 issue of *Communications Engineering & Design (CED).*)

■ Technical agenda set for NCTA

NCTA Technical session attendees can look forward to an unprecedented program this year. Be sure not to miss these:

Technical Implications of Alternate Access and the Cable Operator	Andy Paff, ONI
Digital Transmission Fundamentals for Cable Engineers	Ed Callahan, ANTEC
Leading Edge Photonic Technologies	T.E. Darcie, AT&T
The Evolution of CATV to Broadband Hybrid Networks	Carl McGrath, AT&T
Planning PCN Networks for Cable TV Networks	Lawrence Gitten, AT&T
A Comparison of Leading Edge Image Compression Technologies	Arun Netravali, AT&T
Passive Optical Network Architectures and Applications	Clive Holborow, AT&T

■ ONN readers rate Optical Tech Tips "must read"

In a recent survey, ONN readers repeatedly listed Optical Tech Tips as the section most often turned to when receiving the newsletter. Optical Tech Tips deals with fundamentals of equipment use, such as the article on OTDRs in the Winter 1991 issue. For the upcoming Spring issue, the column will discuss the correct way to use a fusion splicer.

(Please mail or FAX your suggestions for future topics to ONI.)

■ "FiberLoop" used to store fiber cable

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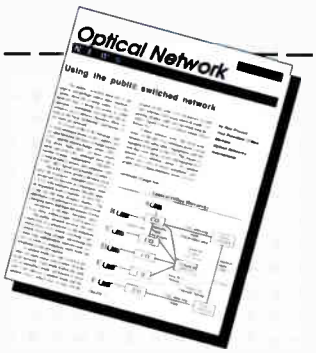

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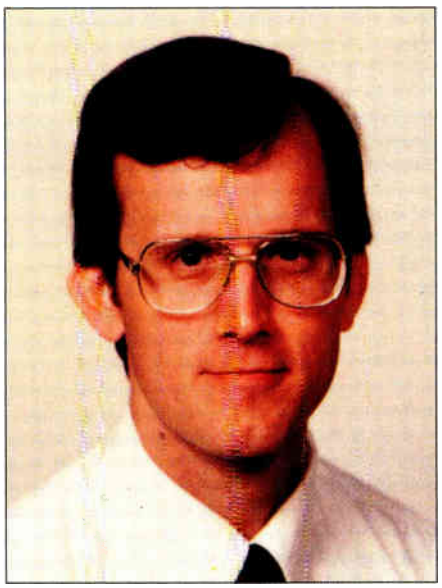

Network considerations

As an industry, it's rare for us to consider any rebuild activity, without at least deploying a few nodes of fiber in order to minimize amplifier cascades. As we look to the future, however, there is so much more to be gained through the *strategic* deployment of fiber that it behooves us to contemplate what our networks need to look like five or 10 years from now.

No longer should fiber deployment simply be a method of minimizing amplifier cascades. Instead, we need to ensure that we are looking over the horizon at future technologies, trends, and markets/applications, understand what their "network" requirements will be, and deploy enough fiber, *strategically*, to ensure that our networks are ready for the challenges ahead.

Competitive access, PCN/PCS, ad insertion, compression technology, two-way interactivity, and the trend toward demographic segmentation will all tend to dictate the network topologies of the future.

Tapping into $20 billion

Competitive access, or what used to be called "telco bypass," is an area of extreme interest these days. Tapping into the $20 billion (1990 dollars) access market, at the invitation of such companies as AT&T, MCI and Sprint, is certainly enticing, but will only occur "in a big way" if we deploy fiber with architectures that will give these potential major customers the confidence that network reliability will not be an issue.

AT&T has indicated, for example, that in order for us as an industry to tap into its portion of that $20 billion, the fiber networks we deploy must be capable of full digital transmission, and with future compatibility for migration to SONET (Synchronous Optical Network). In addition, the network must provide extreme reliability through self-healing "ring" type architectures, with network telemetry and control (status monitoring) to let us know *before* the network is about to go down.

Competitive access will also require that we deploy our networks, fiber nodes and splice points in close proximity to major businesses, schools, local exchange carrier central offices (COs), and inter-exchange carrier points of presence (POPs). In short, not only must fundamental architectures change, but the route over which we deploy our fiber, the amount of fiber deployed, and perhaps even how it is bundled, relative to our fiber carrying traditional video entertainment services, must be reviewed as well.

Personal Communications Systems (PCS) are another reason for us to reconsider our traditional methods for fiber deployment. If we truly believe this too will be another revenue source, either as a common carrier of these services or as the service provider, then we must begin to evolve our networks into an infrastructure that will easily accommodate such services. Since, by its very nature, PCS is a small cell-based communications structure, the implication for us is that we will need to service these cells as standalone "service areas" on the order of 200 homes or less. But since PCS won't be here for several years, the creation of service areas of less than 200 homes might not make financial sense—yet. If we're smart, however, we might just find a way to deploy enough fiber to perhaps migrate from 2,000-home service areas to sub-200 home service areas when it does make financial sense.

Service areas

Ad insertion and programming are demanding greater demographic segmentation, which in turn requires a market-segmented or service area structure. The ability to target an ad for a local merchant only in the areas he would like for us to target, rather than blanketing the entire franchise area with the ad (once the technology is made available to do so) will be of great benefit to us as well as to our potential advertising customers. In addition, the ability to market targeted program material, segmented by lifestyle, could also provide the needed impetus for the sale of those types of products.

On the other hand, the need for regional or national coverage for certain types of ad material implies the need to consider ad interconnectivity with adjoining MSOs. All of these issues imply the need for a "service area" structure in our networks, with fiber nodes located in specific areas, as dictated by the marketing and ad sales departments, more so than for particular technical reasons. It is therefore critical that we technical people continue to consult with marketing and ad sales as we deploy fiber for the future.

Compression technology, while it doesn't specifically dictate any architectural requirements for deployment of fiber, will quickly lead us into the world of digital transmission. Certain applications of the technology, such as near-video-on-demand, however, will tend to dictate a service-area network structure because of the classical "traffic" issues associated with trying to supply large volumes of customers with whatever they want to watch, whenever they want to watch it. It is much easier to accomplish this feat, for example, with a broadband feed to 200 homes than it is with such a feed serving 30,000 homes.

Blurred vision

In addition, as compression moves us closer to the deployment of full digital networks, SONET-based compatibility, and the continued infusion of high-speed data, we will continue to see the blurring of the traditional telco/video transmission boundaries, and will thus be required to provide extremely reliable, self-healing, fully redundant, ring architectures in order to remain competitive with the telcos.

As you can see, we have a lot to think about as we deploy today's networks in preparation for future applications and opportunities. The way it looks today, these architectures, if not actually deployed today, will need to be easily evolvable to a combined ring and service area structure. But as you will see in future columns, with a little planning, and a little extra cash up front in the deployment of fiber, we can be prepared for whatever may come along. CED

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

Meet the modulator that's igniting a revolution in cable.

Future hybrid digital/analog transmission systems will require advanced, multi-purpose modulators. If you envision conventional fixed-channel modulators as the technology to take you into the 21st Century, you have obviously not seen the Standard TVM450S.

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Vive la Révolution!

Infrastructures

Mirror, mirror on the wall,
Whose infrastructure is best of all?

Depends on who's holding the mirror

Obviously, the telephone companies have the best network in place for voice and data communications worldwide. Even at the local residential and small business level, they are unquestionably better suited today than cable TV to full duplex voice and medium speed data.

Just as obviously, however, cable TV has the best network in place for one-way, broadband multichannel video distribution to the public. Within its service area, cable TV even has the superior infrastructure in place for point-to-multipoint transmission of voice, multichannel or single channel video, and high speed (multi-megabit per second) data.

Telephone companies must be appalled at the $400 billion price tag reflected in the mirror for putting fiber into 90 million households, and perhaps another 10 million commercial premises.

On the other hand, blue sky and rosy scenarios have too long deluded cable TV with the appearance of two-way capability. Only within the last three or four years has the AM fiber optic revolution begun to provide a broadband technology for cable TV capable of overcoming the noise collection and ingress problems of the sub-split, two-way analog tree-and-branch architecture.

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

Bandwidth is the LEC's problem

The telephone industry has done an exceptional job of installing optical fiber between central offices and local access and transport areas (LATA) in the United States and worldwide. The RBOCs alone have installed more than 2.3 million fiber miles, just within the last five years.

The intrinsic bandwidth capability of optical fiber, while not unlimited, is measured in tens of gigahertz. Practically, however, the useful bandwidth of an optical fiber system is limited more by the characteristics of the input and output terminal facilities and data protocols than by the characteristics of the fiber itself.

Nevertheless, effective bandwidth horizons are expanding at a near explosive pace to take advantage of fiber's enormous intrinsic capability.

Fiber installation, for local loops within the exchange area, remains in a stage of development, with no clear indication as to future progress. Nine telco trial installations providing for video as well as voice are currently planned or in progress, involving only 100 to 500 test homes in most cases. An additional 25 trials are scheduled, or in progress, each providing voice but not video to 100 to 500 test homes.

Cable already has a 1-GHz path to the home while telco, at best, has no more than 1.5 MHz. For video distribution, cable TV is the fairest one of all—hands down.

The prospects for fiber to the curbside or pedestal are far more favorable than for fiber to the home, for either telco or cable. The RBOCs not only face the same high cost per home as cable TV for the optical network interface (ONI), but must also deal with the high and painful cost of writing off undepreciated copper pairs before replacing with fiber. No wonder they are lobbying for accelerated depreciation!

Until existing copper has been replaced with fiber (or coax), the bandwidth available to telco subscribers will be limited to that of the copper pairs. Recent reports indicate the probability that *usable* NTSC TV pictures (not HDTV) could be transmitted on some of the existing copper pairs using an asynchronous digital subscriber line (ADSL), aggressively compressed to 1.5 Mbs. Picture quality of ADSL is reported to be *as good as VCR*, or *no better than VCR*, depending on the point of view.

How long, and at what cost, will it take telcos to replace 80 or 90 million residential local loops? Until this is accomplished, video delivery by telcos will be limited to one VCR-quality signal at a time, available to customers by video dial tone (VDT) at undetermined user cost.

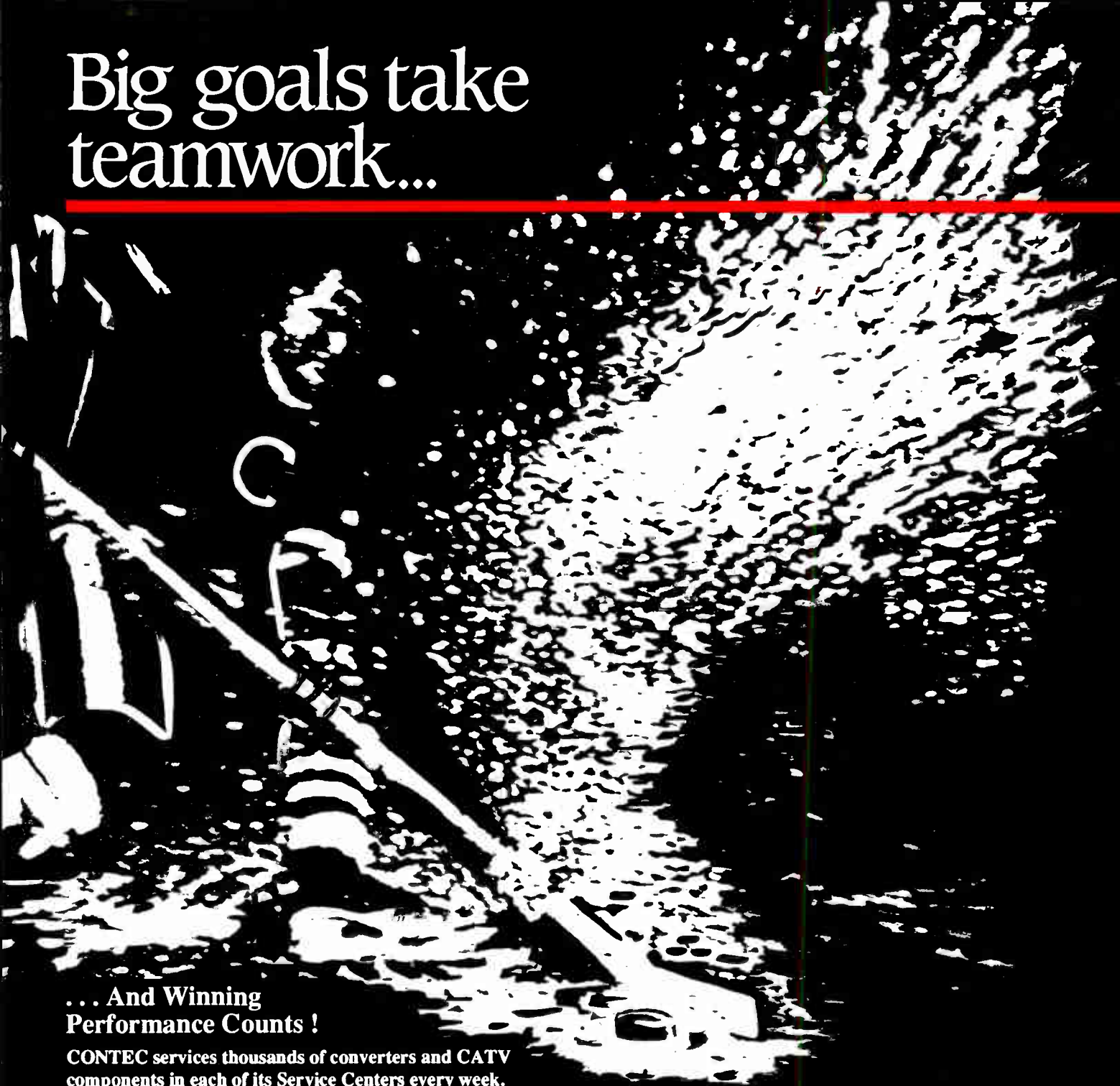
Coaxial drops are cable's advantage

Cable TV has relied on sub-split tree-and-branch architecture to provide two-way capability. When sufficient maintenance effort is applied to minimize ingress and noise accumulation, this technique can be useful for the relatively slow data transmission rates needed for PPV ordering, security alarm, meter reading, and limited interactivity. But to be able to handle full-duplex, high speed data transmissions for such services as alternate access or PCS, cable TV will need to have at least 15 MHz to 20 MHz bandwidth, in each direction, at bit error rates comparable to telephone practice. This requires aggressively pursuing the extension of hybrid fiber optics, probably home-run, to serving areas of not more than 1,000 to 5,000 households, and probably much smaller.

The great advantage enjoyed by cable TV is that the bandwidth of coaxial service drops, while not as great as fiber, far exceeds that of copper pairs. Cable TV is already aggressively installing fiber in its distribution network. Telcos are still studying how to use fiber in the local loops.

Cable already has a 1-GHz path to the home; while telco, at best, has no more than 1.5 MHz. For video distribution, *cable TV is the fairest one of all*, hands down. CED

Big goals take teamwork...



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And the beat goes on...

Concerning the "Back to Basics" article in the February issue of *CED* ("Non-interfering method of CTB measurement," p.52), the technique for measuring CTB discussed by Bawdon and Cash should be used with caution.

The statement that worst-case CTB occurs at the highest frequency in a cable system is not generally true. The channel or frequency at which the worst-case CTB occurs is strongly dependent on the total number of channels in use, and their location within the overall system.

For instance, Jerrold's *CATV Reference Guide RD-14* shows that the maximum number of beats occurs at channels 10, 18-22, 11, 28 and 29, and 32 and 33 for fully-loaded 12-, 21-, 35-, 52- and 60-channel systems. However, assuming the CTB level goes as 10 log (number of beats), the maximum error for the aforementioned fully-loaded systems is only 1.7 dB using the Bawdon/Cash technique.

To find the worst case in general, one must compute all possible sums of the form $f_1 + f_2 - f_3$ and $2f_1 - f_2$, where f_1, f_2 and f_3 are the frequencies of channels in use by the system.

The frequency at which the largest number of sums occur is the frequency of the channel at which composite triple beat will be greatest.

Bob Swarts and
Lynn Hurd
Tektronix Inc.

Messrs. Bawdon and Cash reply:

What the people from Tektronix say is true. If you calculate the frequency of every triple beat product, the area where the largest number of beats will fall is somewhere near the middle of the bandwidth used.

There is plenty of literature available showing this. If you have enough time on your hands, you can do the calculations.

But for a technician working in the field, this is useless information.

According to Ronald C. Cotten, in his "Distortion in Cable Television Systems" handbook put out by CableLabs in 1990, even though the number of beats decreases as you go from mid-spectrum to the higher frequencies, the CTB level rises, "peaking somewhere at or near the upper band edge.

"It can be anticipated, therefore, that the composite triple beat distortion will be visible on the upper frequency channels before it is seen on the lower frequency channels."

Regardless of where the most beats fall, if an amplifier has a CTB problem, an increase in CTB might be measured across the spectrum beyond what would be expected.

The entire point in using the method of measurement we wrote about is to get an estimate of what the level of CTB is at any given point. Although it can be a useful troubleshooting technique, it should be understood that this is not an exact measurement.

Maintaining a cable system, out in the real world, rarely requires that we achieve accuracy in our distortion measurement to a hundredth or even a tenth of a decibel. We need effective troubleshooting tools and procedures that minimize customer dissatisfaction. If any part of your system goes out, someone will be watching—no matter what the time of day.

That includes deliberately shutting off single channels. Sometimes this is unavoidable. In our system, we try to avoid this whenever possible.

This single measurement technique is not the answer to all distortion problems, merely a tool that could be useful. Any new techniques can be useful to some extent. The amount of excitement they produce should be proportional to their usefulness.

Although we work for our "engineering" or maintenance department, we are technicians, not engineers. But we are integral in the battle against the composite triple "beast."

Questions? Comments?

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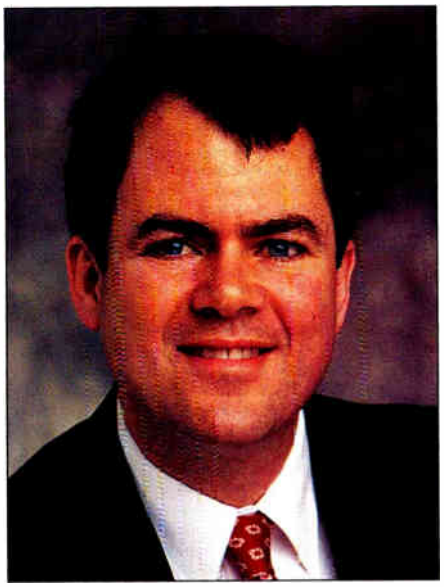

John Vartanian

HBO's space cowboy

Have a question about the upcoming satellite changes in the orbital arc? Ask John Vartanian. As director of engineering for Home Box Office, Vartanian spends a lot of time with his head in the clouds—figuratively, of course. And lately, his concerns in this area have made him highly visible at trade shows and in print.

He's not hard to miss. Although the Texas-born, Massachusetts-bred Vartanian says his surname comes from Armenian descent, he admits to being half-Irish. And it shows. In fact, all he needs is a fisherman's sweater and a foggy morning, and he'd be a shoe-in for an "Irish Spring" commercial.

But alas, most of Vartanian's time has been spent behind the camera, even though he says he dabbled in video production and radio while studying electrical engineering at Renssalear Polytechnic Institute. He earned his E.E. degree in 1979 and immediately scored a job with Warner Cable Communications, who recruited the young engineer during an on-campus career day.

Vartanian's first job at Warner involved work on TVROs and microwave systems. After a year, he relocated to the company's Cincinnati, Ohio system, where he supervised its design department.

In 1984, Vartanian joined HBO. His first post was that of staff engineer, and over the past eight years he worked his way up the ranks to his current post as director of engineering. What that means, Vartanian says, is keeping a finger on the pulse of what's happening in CATV.

"We have a very small corporate engineering department here," Vartanian says (seemingly without remorse). "Because of that, it's real important for us to be aware of a lot of different areas, like cable TV operations, satellite developments, scrambling, new technologies and FCC actions."

Vartanian says his most important function is to "keep conversations going" with HBO affiliates. "A good example of this is the change in the satellites that we're seeing now," Vartanian explains. "We're in a situation where from now until the next year and a half or so, we'll have an entirely new generation of satellites being launched. This will affect every cable system in the country."

And while Vartanian's visibility on this issue is unquestionable, there are a lot of other items on his task list. In fact, Vartanian says that HBO is actively testing multiplexing and is reviewing RFPs on digital compression systems from "all the major players." And, in 1989, HBO rolled out its Spanish audio service for both HBO and sister service Cinemax.

"Pay cable hasn't been growing like it did earlier on," Vartanian says, "So we've turned much of our efforts toward enhancing our core business and looking at new businesses."

Those new businesses include HBO's recent launch into several international markets, including Latin and South America and Hungary. "What's happening is, Time-Warner wants to be a global leader in entertainment. The common thread that will tie all these different international areas together is technology," Vartanian predicts. More international launches are expected.

Scrambling to scramble

In late 1985, HBO launched the nation's first satellite scrambling system. Vartanian calls the launch the "biggest undertaking I've been involved with in cable television."

"It was a massive undertaking," Vartanian recalls. "Because we were the first to do it, we were involved with a number of different areas: Monitoring the quality control of the manufacturer, educating and assisting our affiliates and troubleshooting any problems our affiliates encountered."

The biggest snag, Vartanian recounts, was compatibility with the "dozens and dozens" of older and varying satellite receivers in the field at the time. "We're talking about thousands of headends that were affected (by video scrambling)," Vartanian recalls.

And if Vartanian is right, different but similarly monumental changes will be affecting those thousands of cable systems again—soon. "The growth in our industry won't be linear, but exponential. I think the technical developments going on right now are greater than anything we've seen since 1975, when satellites were first used for delivery of video programming," Vartanian says.

Overall, though, he thinks fiber optics and digital compression will have the greatest effects. Fiber for its obvious reliability features, and compression to enable a "huge increase" in the number of potential channels, both on satellite and on cable systems.

"This huge increase in channels will surely spawn entrepreneurial activities that will result in new channels and ancillary services," like digital audio and other similar services, Vartanian says.

Cool under fire

Vartanian's co-workers describe him as a guy who's "cool under fire" and an "excellent translator" of complex engineering issues to HBO staffers, the industry at large and the media.

He's an active SCTE member and participates on the NCTA's prestigious engineering committee, where he works with the group's satellite practices subcommittee.

At home in Manhattan, Vartanian says most of his spare time is spent with his young sons—Andrew, 4, and David, 2. He just bought a new bike and spends a fair amount of time bicycling with Andrew (who's getting the hang of his training wheels) in nearby Riverside Park. His in-laws live in Colorado, so Vartanian says they try to get out there "once a year or so" to ski.

The ultimate in space management

Interestingly, Vartanian and his wife, Ann, are active gardeners. They have a four-foot by five-foot plot of land on West 89th street where they grow tomatoes, herbs and vegetables.

Gardening in Manhattan? "Don't laugh," Vartanian says. "In Manhattan, that's as big as they come." CED

By Leslie Ellis

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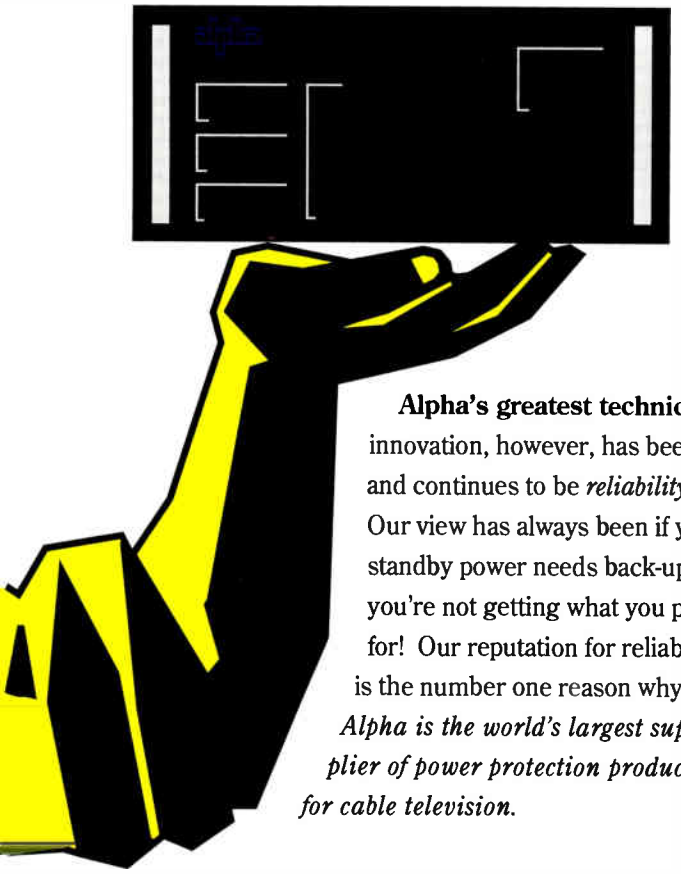

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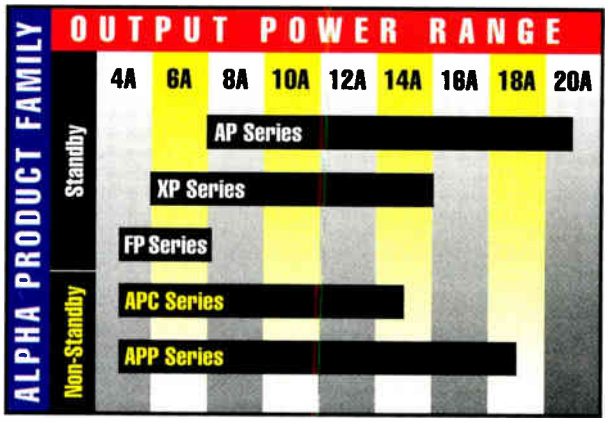

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Proof testing fiber links

This article provides the system level engineer or technician with a basic understanding of the measurements used in proof testing fiber optic links. It also addresses the difficulties we commonly find in making these "high performance" measurements.

The use of fiber optic links in CATV has increased dramatically in the last few years. A substantial number of operators are considering, or have incorporated, fiber links into their systems. The combined advantages of improved reliability and signal quality to the subscriber have made optical transmission very attractive.

It is important for system personnel to become familiar with the skills and knowledge necessary to obtain and maintain the performance specifications promised by their equipment manufacturers.

Performance tests

The following basic measurements are the performance tests necessary to evaluate a fiber optic link's performance:

- The optical transmitter launch power. Typically specified in milliwatts (mW), monitoring the optical transmitter launch power is an indicator of the laser diode's condition.
- The optical receiver input power. Specified in dBm, optical receiver input power is subtracted from the transmitter launch power to determine true link loss.
- The optical receiver carrier-to-noise ratio (C/N). The receiver C/N measurement determines the thermal noise or "graininess" ultimately seen in the subscribers' pictures.
- The optical receiver composite triple beat (CTB) and the optical receiver composite second order (CSO). These measurements indicate the amount of distortion or "lines" seen in the subscribers' pictures.

Transmitter launch power

Measuring a transmitter's optical power output is most commonly done with an optical power meter. The key to accuracy in using this device is matching the input connector of the meter with the output connector of the transmitter. Use of the wrong connector results in a loss of coupled power and a lower-than-actual output reading.

Before measuring the output power, be sure that the meter's range will handle the power coming from the transmitter. Most manufacturers rate their optical transmitters in milliwatts. To convert milliwatts to dBm, use the following formula:

$$dBm = 10 \text{ Log}(mW)$$

When the output power drops below the power specified by the manufacturer, it is a sign that the laser diode is weakening and will need to be replaced soon.

Be very careful when testing optical transmitters. Laser light used in CATV is invisible and can cause permanent eye damage without warning, especially from the higher power transmitters.

By John Koczan, Supervisor Application Engineering, Magnavox CATV Systems Inc.

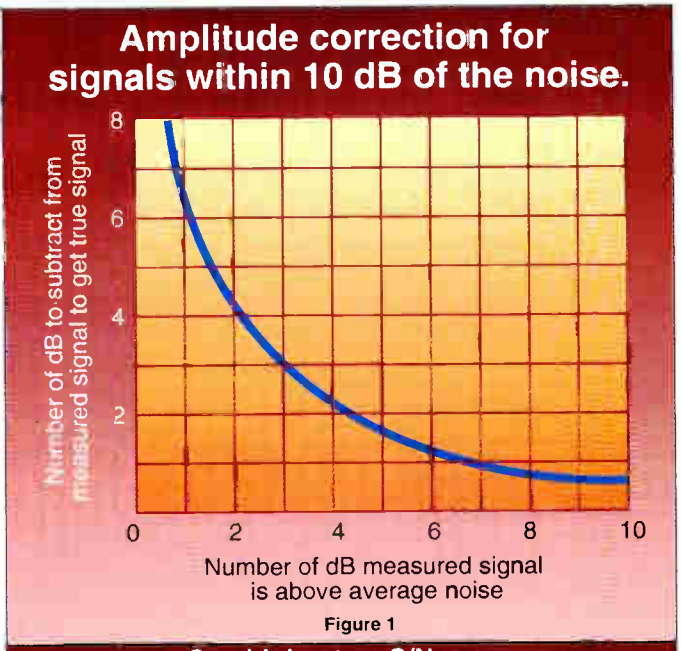
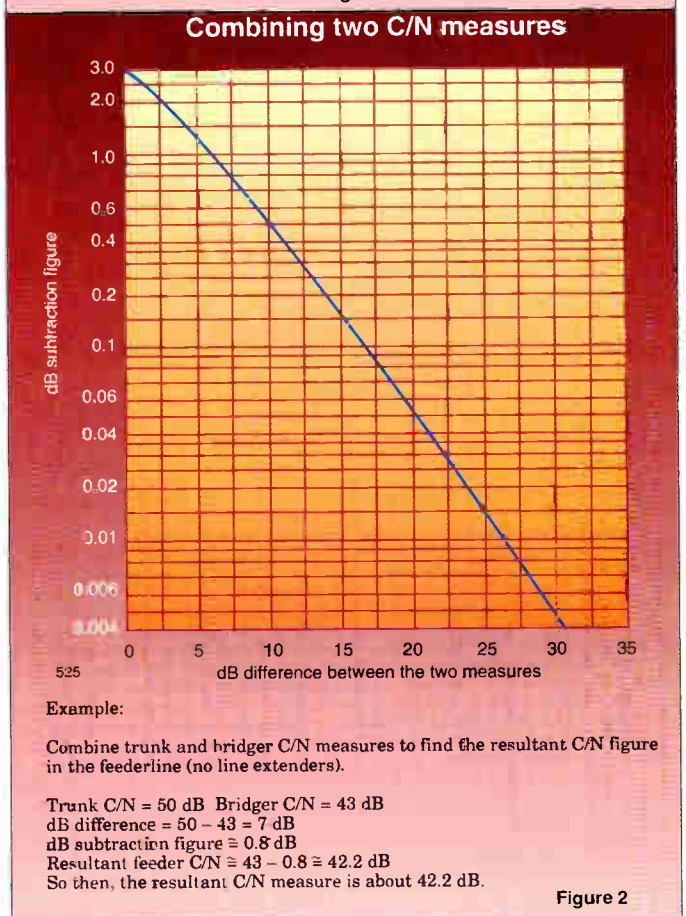


Figure 1



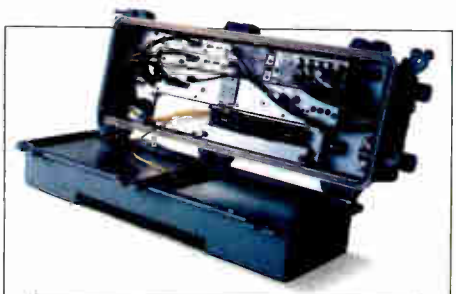
Example:

Combine trunk and bridger C/N measures to find the resultant C/N figure in the feederline (no line extenders).

Trunk C/N = 50 dB Bridger C/N = 43 dB
dB difference = 50 – 43 = 7 dB
dB subtraction figure ≅ 0.8 dB
Resultant feeder C/N ≅ 43 – 0.8 ≅ 42.2 dB.
So then, the resultant C/N measure is about 42.2 dB.

Figure 2

Sumitomo Electric, your light-support system.



VIDEO TRANSMISSION EQUIPMENT

ANALOG

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We manufacture cable with your choice of matched clad or depressed clad fiber. We offer loose-tube cable in fiber counts of 4 to 216, plus our new, economical Lite-Pipe™ cable in counts of 2 to 24. Reel length: up to 12 km. Sumitomo pioneered vapor axial deposition (VAD), the matched clad fiber-making process that set the record for low loss. We offer optical cable sheath construction from all dielectric to double armoured suitable for all installations (lashed aerial, duct and direct buried) and environments.

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We provide any level of service including entire turnkey newbuild or rebuilds. Our in-house experts work closely with your people to evaluate design alternatives, select methods of construction, perform installation, and do turn-up, testing, fusion splicing, repair and maintenance. We offer single-source responsibility, assuring your project gets done right.

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Extreme care should be used when working on active fibers.

Receiver input power

Receiver input power is also measured with an optical power meter. Typical optical receiver input power levels run from -5 dBm to +3 dBm. Maximum input power is limited by the number of channels being carried on a fiber. For example, a single fiber link carrying 80 channels typically has a maximum input power of 0 dBm. A much higher input power will send the receiver into compression. That is, the receiver would generate a large amount of distortion.

Receiver C/N ratio

The C/N measurement is the difference between the RF carrier peak and the system noise floor. It requires a correction to allow for the bandwidth of the test equipment being used. Measuring the C/N at the optical receiver presents several unique problems. Manufacturers usually specify the C/N performance at the output of the receiver.

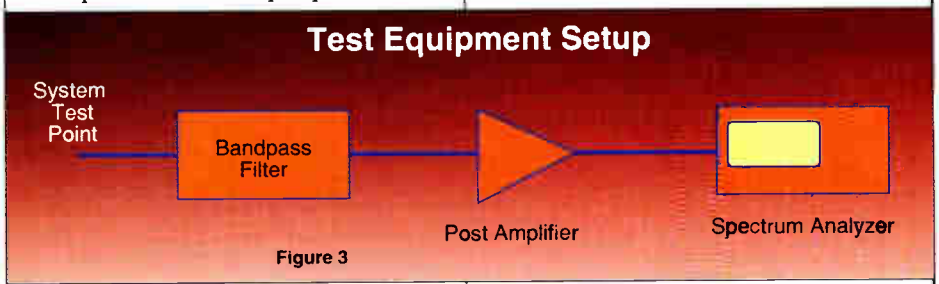


Figure 3

Typical C/N ratios for optical links run between 50 dB and 55 dB. This means that the measuring device, be it a spectrum analyzer or signal level meter, must be able to read a noise floor up to 73 dB below the RF carrier level to allow for noise bandwidth correction. Since the dynamic range of most portable analyzers is 70 dB, it can be seen that the limits of the test equipment are being approached.

At the same time, typical receiver RF output levels run from +10 dBmV to +20 dBmV. When the signal is passed through a length of drop cable from a node to the test equipment and then through a bandpass filter, the resulting input into the test device is in the single digits. This means that, at best, you are reading the system noise floor very close to the noise floor of the test equipment.

A few spectrum analyzers compensate for noise measurements made close to their noise floor. Most do not. Refer to the equipment manual or dealer to determine which type of analyzer you have.

A quick test to see if you are working close to your test equipment's noise floor is to disconnect the test lead from the receiver. If the noise floor drops by less than 10 dB, corrections will need to be made to the readings. Subtract the correction factor in Figure 1 if the analyzer does not automatically make these corrections.

This is a universally accepted correction table, although the analyzer's manufacturer may have a chart for specific models.

A few spectrum analyzers compensate for noise measurements made close to the noise floor. Most do not.

Many people add an amplifier to the input of their analyzer to raise the system noise floor above that of their test equipment. When doing this you should calculate the noise contribution of your amplifier and allow for this in your performance specs. You can use the following formula to calculate the C/N of your amplifier:

C/N = 59 -NF + IN
Where
C/N = carrier to noise of test amplifier
NF = noise figure of test amplifier (from manufacturer)
IN = input level to amplifier

Use Figure 2 to find the correction factor you must subtract from the lowest C/N to get your true link plus test amplifier C/N.

Receiver CTB

The CTB measurement is the difference between the RF carrier level and the undesired distortion. The CTB distortion falls directly under the RF carrier. Link CTB performances run in the 65 dB to 70 dB range. These figures again approach the limits of most spectrum analyzers. Using an amplifier with an input bandpass filter tuned so that the adjacent channels are at least 12 dB below the desired channel will help you to accurately make this measurement. When set up as shown in Figure 3, the amplifier will provide gain and not add additional distortion to your measurements.

You can raise the input levels and trade some of this distortion improvement for a better carrier-to-noise ratio.

Receiver CSO

Second-order distortions are similar to CTB. But, unlike CTB distortions, they fall 0.75 MHz or 1.25 MHz above or below the RF carrier. They run in the 55 dB to 70 dB range. Optical transmitters are very sensitive to reflections. If you measure poor second-order distortions, you should suspect a bad fiber connector or splice, especially near the transmitter.

On a final note, the above distortion numbers are achieved using unmodulated carriers. Tests have shown if you make these measurements with modulated carriers from your headend, you can expect about a 10 dB improvement. Remember, you can raise the input levels to the transmitter and trade some of this distortion improvement for a better carrier-to-noise ratio.

The preceding information was intended to provide a general overview of tests and procedures, as well as certain specific applications and limitations. It should not be regarded as complete. You can obtain a complete description of each measurement from texts and test equipment manuals. CED

Buried cable and technology

Part I: Looking at the life of the cable plant

When one considers that other electric transmission industries having outside distribution plants, such as the telephone and power utility industries, have been around for this entire century, one must admit that the cable television industry is quite young. Cable TV is a youthful forty-something.

Yet, in spite of its youth, constant and dramatic changes in the technology of cable distribution systems has been its history. The imperative of constantly improving picture quality and reducing outages, while continuing to radically expand bandwidth and redesign the architecture, have all driven cable system technology advances. And it is the nature of technology to continue to advance and impact the network unless cable systems are artificially sub-optimized or, simply, the new technology is not cost-effective.

Degradation effects

Sure, degradation of materials requires replacement of equipment. Connectors corrode, insulation bakes and cracks in the sunshine, salt-fog conditions rapidly degrade materials, and outside electronics slide "off spec." But, in cable TV, often sooner than obsolescence of materials, the obsolescence of technology requires plant upgrades and rebuilds.

Granted, most of the time the coaxial cable—trunk, feeder and drop—is not replaced when an upgrade is done, at least not all of it. Usually most of the coax is still serviceable and can handle the incremental increase in bandwidth provided by the new electronics being installed, depending of course on the bandwidth goal of the upgrade.

Many cable systems are on the verge of deciding to move from 300 MHz to 450 MHz or 550 MHz, and some to 750 MHz. If these 300 MHz systems are currently aerial plants, operators may want to consider taking the cable underground. Then the question becomes, "Do we direct bury the cable or place the cable in the ground in conduit?"

More questions

Many systems went to an underground plant with their first rebuild. If a system with underground plant that direct buried its cable must replace the cable, then the question becomes, "Do we direct bury it again or place it in the ground in conduit?"

Or if an upgrade would be insufficient and a rebuild is necessary to take the system to higher capacity or improved picture quality, and the plant is underground, lucky is the operator who buried his or her cable in a conduit. If not, then the question is the same, "Do we direct bury the cable or use cable-in-conduit?"

Those who have been around the cable industry for a while will easily remember that the vast majority of cable systems offered only 12 channels as recently as 10 years ago. The midband channels had become technically available in the previous decade, but it was only in the 1980s that most systems sought higher bandwidths. Franchise renewal pressure and the "franchise wars" meant that owners or new bidders promised the "blue sky" to the municipal officials and, if they won, had to deliver what they promised.

Bandwidth expansion

But once an operator took his system to 220 MHz, often doable with a drop-in upgrade or a mod-kit, he was faced with a major rebuild if he wanted to take it higher. The new pay services, and their potential subscribers, were increasing the pressure to make more channels available.

Certain steps up the bandwidth ladder may require rebuilding no matter how small the increase. For example, to take a 12-channel system and add the midband was fine—but to take that same system to 300 MHz required a significant rebuild.

Having completed that rebuild successfully, taking that same system to 450 MHz would require an expensive upgrade of electronics and maybe some fiber, but much of the coax might still handle it. To then move that same system to 550 MHz would likely require a major rebuild with fiber running deeper into the network and a dramatic redesign of the system architecture.

Most cable systems today are 36-channel, 300 MHz-plus systems. This is actually not much, particularly considering the current state-of-the-art Time-Warner Queens system which will deliver 150 channels when completed.

Fiber optics is what is dictating partial and full rebuilds today, and will over the next decade and beyond. And fiber requires whole new architectural approaches.

Placing underground cable in conduit allows CATV operators to avoid the costly trenching process when replacing cable or upgrading to fiber.

by George C. Sell, Contributing Editor

Since the days when clever TV shopkeepers built antennas on hilltops and ran some cable down the hill to their shop and to friends' houses (thus the name Community Antenna Television or CATV), industry observers have witnessed system architectures improve and advance into today's broadband telecommunications distribution megaplants.

Architecture advancements

In the 1950s, amplifiers were first used to carry signals farther from the headend. The late '50s saw the use of broadband amps and, in the early '60s, aluminum shielded distribution cable with foam dielectric was introduced. A few years later, AML tests showed that distant signals could be received and the first set-top converters were introduced. The '70s saw scrambling schemes made available and solid state amps and convertors capable of handling 300 MHz. Then, mid-decade, of course, came satellites and HBO, and the industry went into high gear.

> Short-term financial and technical planning will provide apparently lower rebuild costs.

The coaxial cable tree-and-branch architecture that had evolved served the industry well. It showed itself to be adaptable, improvable and expandable—and this is still true today. Coaxial tree-and-branch systems, when taken to their potential, can deliver at least 100 channels adequately.

But beyond that, only the addition of fiber optics into the mix will take it farther. And with the obvious fact being that the future of cable television involves channel capacities beyond 100 channels, there is no fiscally sound reason to take coaxial systems to their limits. Instead, the industry has generally decided to progressively add fiber to the network where it can improve distribution networks and pay for itself in a reasonable timeframe.

Various new fiber architectural approaches have been proposed for taking CATV to the next phase, all of which make extensive use of existing coaxial plant. Nevertheless, a wholesale change-out of cable in major portions of the plant will often be necessary; and coaxial sections that are retained will need rebuilding because of degradation and to improve signal-to-noise ratios.

Fundamental fiber network topologies such as fiber-to-the-feeder and fiber backbone retain feeder and drop coax in the architecture but call for fiber to replace most existing trunk and some feeder cable.

Specialized fiber architectures, such as Rogers Cablesystems's multi-service platform, Jones Intercable's Cable Area Network, and proprietary architectures such as Scientific-Atlanta's fiber-to-the-serving-area, Jerrold's Starburst, ONI's communications infrastructure, and Magnavox CATV's Diamond architecture are all either extensions of the fiber backbone concept or encompass backbone and FTF topologies. They all retain some portion of the coaxial cable in the scheme.

But for how long? And will the fiber placed today be made obsolete before it's useful life has ended? Today, the fiber wavelength of choice is 1330 nanometers. However, many are touting the benefits and future applications of 1550-nm fiber wavelengths.

Who, today, can tell when buried cable, whether coax or fiber, will need to be dug up again, changed out and reburied?

First-costs

As a young industry, cable tended to look at the bottom line of construction budgets. Operators looked at first-costs as the only costs—and there were several reasons for this. Cable systems were built as quickly as possible in order to bring them on-line and start generating revenues. Also, many owners and their financial supporters built systems knowing that they would be selling them in the near term. They simply were unconcerned about future costs. Those costs would be borne by the new owners, whoever they might be.

This is, of course, not true for all system owners. But even those who have owned their cable systems since the franchise was first obtained have only recently prepared their upgrade or rebuild budgets with future capacities and lifetime costs figured in. Upgrades or rebuilds had to pay for themselves within the shortest time possible. But many owners, or those acquiring older

systems, have been sad to learn that, if the system had been constructed or rebuilt with not only future capacity in mind but also with longer life materials and equipment, they would have saved capital over time.

If "construction and installation" builds it and walks away, "maintenance and repair" must live with it. And the cost of the next rebuild will be much higher than necessary.

Of course, short-term financial and technical planning will provide apparently lower rebuild costs. If a rebuild is planned and budgeted with the goal of keeping construction first-costs to a minimum and immediately capturing revenues that are today's "sure thing," yet ignores the need to have additional capacity for new opportunities and services, a better signal-to-noise ratio than is necessary today, and positioning for future competition, an operator will find him or herself paying a far greater price over time. It's kind of like the old saying, "Penny wise but pound foolish."

Lifetime costs

As the cable television industry matures and consolidates, cable systems will remain in the hands of the same owners over a longer timeframe. Short-term financial and technical planning must be replaced with long-term strategies and preparation for competition.

Long-term strategies imply cost analyses that look at lifetime costs rather than first-costs. In looking at lifetime costs, any incremental price figure anywhere on the timeline is less significant than the total cost savings over time.

> Not looking at long-term needs when planning a rebuild is like the old saying, "Penny wise but pound foolish."

For example, if widget "A" costs less than widget "B", short-term planning would stop there. Widget A would be purchased and installed. However, long-term planning would further ask, "What will be the costs after installation for the lifetime of widget A versus widget B? What impacts will each widget have on other cost factors? What, indeed, is the lifetime of these two widgets and what will it cost me to remove them when they need to be replaced?"

It may turn out that while widget A has a lower first-cost, widget B has a much lower lifetime cost. In fact, widget B's lifetime costs may be so much lower that its higher first-cost constitutes a meaningful investment.

Long-term modelling

In the next part of this two-part article, a method of modelling lifetime costs of direct buried cable versus cable-in-conduit will be examined, complete with real-world, system-level lifetime costs. The model will also look at the dollars typically invested in each approach and compare them with the cost of money to see if there is a return on investment with one or the other approach that would favorably compare with investing

those dollars, instead, in some low-risk stock or, perhaps, a new programming service.

In anticipation of that, let's take a look at the general assumptions and incremental costs that will become factors in our model.

The objective of the model is to weigh the decision to spend money today to install a conduit system and have lower replacement costs, against a directly buried cable system with a comparatively high replacement cost. The model is shaped by certain assumptions and incremental costs, some directly associated with the installation of direct buried cable and cable-in-conduit and some related impacts of each on other operational cost factors over the lifetime of the cable and the evolution of the technology.

Cable-in-conduit can reduce the amount of dig-in damage from pick and shovel digging and light machinery.

Among the costs that would be different between these two approaches, there is:

- the cost of 1.25-inch conduit per foot;
- the number of installation vehicles necessary to install a certain footage over a fixed period of time;
- the cost per foot of trenching and restoration for future replacement of direct buried cable;
- the cost per foot of pulling cable for future replacement of cable-in-conduit.

Costs that are common to both direct buried cable and cable-in-conduit are such factors as:

- the same type of cable would be involved;
- the same reel trailers could be used for both (as long as the width of the conduit and length of the continuous run are within standard parameters)[1];
- the first-cost of trenching;
- the direct labor first-costs would be the same;
- an inflation rate of 4.5 percent for labor and equipment is assumed;
- the annual cost of capital is assumed to be 8.0 percent.

Also, no additional cable life from conduit protection is assumed, although there would probably be some extended life to cable-in-conduit because it may protect cable from freezing and crushing. In fact, cable-in-conduit can reduce the amount of dig-in damage, especially from pick and shovel digging and light machinery.

Certainly, if the buried cable is hit by a backhoe, it's likely that neither direct buried nor cable-in-conduit will survive, although the chances are better with cable-in-conduit. But this cost savings is intangible and therefore will not fit into the model, which requires actual dollar amounts.

Other real factors that will not be included in the model are the ease of plowins of cable-in-conduit due to the ruggedness of the conduit and since all the pulling tension is on the conduit and not on the coax or fiber cable. Probably the hardest day in the life of cable is the day it is installed. Cable-in-conduit promises to make its first day easier. This might have a profound effect on construction labor costs.

Fiber optic installation may be made easier if conduit already exists in the ground. When fiber is installed, its continuous runs are significantly longer than coax because there's no need for an amplifier station every 2,200 feet. At those locations the unspliced fiber could be pulled and simply patched together in another piece of conduit. Provisions should be made, however, for later access at those points.

Also, gophers have been found to eat direct buried cable but not cable-in-conduit. And in many franchises, the public relations benefit of not having to dig up people's lawns during the next rebuild can be significant.

However, leaving these intuitive factors out of the life-cycle cost modelling will not skew the results because the significant numbers are those that will be factored in, namely, the tangible costs that are different between direct buried cable and cable-in-conduit. **CED**

Reference

1. If conduit wider than 1-1/2 inches is used, the necessary reels will be larger than typical trailers can handle. Also, a reel for fiber-in-conduit or empty duct for fiber installation may be at lengths of 2,500 feet per reel or longer and may require a larger reel than standard. When this is the case, most cable operators will contract with a construction contractor experienced in fiber who will likely already have the trailers appropriate for non-standard reel sizes.

The following companies have paid a fee to have their listing appear in the Construction callbook.

Contractors

Kennedy Cable .....(912) 557-4751
Construction, Inc.
WATS.....(800) 673-7322
FAX .....(912) 557-6545
Hwy. 280 W
PO Box 760
Reidsville, GA 30453
PERSONNEL: Roger Kennedy Jr., President; Deno Jones, Operations Manager; Thomas Heath, Marketing Manager
DESCRIPTION: Aerial and underground line construction of CATV, LANs, telecommunications and fiber optic systems. Strand mapping, design, splicing, upgrades, rebuild, new extensions of system, balance, sweep and proof system. Over 20 years of experience.

LINE TECHS
CATV RE-BUILDS - NEW BUILD - SPLICING

Line Techs, Inc. .....(313) 688-3057
FAX .....(313) 688-3336
PO Box 386
North Branch, MI 48461
PERSONNEL: J. David Giesy, President; Ken A. Gasper, Vice President Construction Services; Carol Davis, Vice President
DESCRIPTION: Rebuild/upgrade of aerial and underground CATV systems, either turnkey or labor. Includes coaxial, fiber optic installation, as-built mapping. Fiber to feeder design, splicing, retrofit, engineering analysis, sweep, CLI, proof. Also auditing and installation service. Consulting on project analysis and cost management. 15 years experience in all facets of CATV.

Schenck construction

Schenck Construction ...(206) 668-1300
FAX .....(206) 668-1400
8602 Maltby Rd.
PO Box 1530
Woodinville, WA 98072
PERSONNEL: Edward A. Schenck, President; Bud Longnecker, VP/Aerial; Imel L. Wheat, Jr., VP/Underground
DESCRIPTION: Aerial and underground cable TV construction; turnkey, fiber optic construction.

Installation Services

RTK CORPORATION

RTK Corporation.....(908) 665-0133
WATS.....(800) 527-2705
FAX .....(908) 665-0990
120 Floral Avenue
New Providence, NJ 07974
PERSONNEL: Richard Thomas, COO; James MacGeorge, President
DESCRIPTION: Installation services: full/modified turnkey residential and commercial installations, audits, rebuilds, converter changeouts and upgrades; MDU pre- and post-wiring, survey and design.

CAD and Design

METRONET INC.

Metronet Inc. .....(404) 475-9956
FAX .....(404) 475-9944
1111 Alderman Dr., Ste. 210
Alpharetta, GA 30202
PERSONNEL: James P. Worthen, President; Frank Walker, Director of Sales
DESCRIPTION: CAD fiber optic and coaxial system design (Lode Data). On site project management; turnkey services; mapping services—strand and as-builts; drafting services—base, strand and electronics; AutoCAD conversion to lynx; Auto LISP programming-client specific; CAD training and set up; marketing services (dark fiber).

RTS Value Engineering

Rahmer Technical .....(800) 779-2074
Services, Inc.
FAX .....(404) 920-2410
6280 Senior Circle
Suite A
Douglasville, GA 30134
PERSONNEL: Bob Rahmer, President
DESCRIPTION: RTS provides value engineered services to the cable industry in the areas of: All phases of CAD design and mapping services, fiber optic architecture custom to client, fiber feasibility studies and cost analysis, FCC testing, certification, sweeping and CLI, headend testing and alignent, and on-site project and engineering management.

Drop Material & Cable

COOPER
Belden

Belden Wire and Cable .(800) 235-3362
FAX .....(317) 983-5503
2200 U.S. Highway 27 South
Richmond, IN 47375
PERSONNEL: Nish Teshoian, President; Mike Murphy, Director, Sales; John Valentine, Director, Marketing; Jim Hughes, National CATV Sales Manager; Craig Snyder, CATV Product Manager; Doris Nichols, Customer Service Administrator
DESCRIPTION: Quality manufacturer of CATV coaxial drop cables including Belden Super Drop™ 1 GHz drop cable. Products include RG-59, RG-6, RG-7 and RG-11 in aerial, burial and indoor designs with UL/NEC ratings. Fiber optic trunk cable available in multi-fiber per tube design in armored and all dielectric products. Other cables include head end, plenu, riser and audio products.

Comm/Scope, Inc.
THE Cable in Cable TV.

Comm/Scope, Inc. .....(704) 324-2200
WATS.....(800) 982-1708
FAX .....(704) 328-3400
PO Box 1729
Hickory, NC 28603

PERSONNEL: Frank Drendel, President; Larry Nelson, EVP/General Manager; Stan Lindsay, VP/Sales; Gene Swithenbank, VP/Sales; Frank Logan, VP/International Sales & Marketing
DESCRIPTION: Manufacturer and supplier of quality fiber optic cable and 1- GHz coaxial cables featuring Quantum Reach, PIII, CableGuard jacketed PIII, and a full line of drop cables including cables that meet the NEC requirements.

TFC TIMES FIBER COMMUNICATIONS, INC. an LPL company
358 Hall Ave • P.O. Box 384 • Wallingford, CT 06492

Times Fiber .....(203) 265-8500
Communications, Inc.
WATS.....(800) 677-CATV
FAX .....(203) 265-8422
358 Hall Avenue
Wallingford, CT 06492
PERSONNEL: John P. Forde, President and COO; Sanford D. Lyons, Director, Sales and Marketing; Frederic N. Wikenloh, Director, Engineering
DESCRIPTION: Times Fiber Communications, the only coaxial cable supplier standardized on GHz bandwidth for trunk feeder and drop cables, is committed to: Quality, service and technology. With over 40 years of experience we continue to lead the industry in product advancement and innovation. Times Fiber Communications is proud to be a part of bringing information and entertainment into the homes of your customers in the United States and in over 30 countries around the world. Times Fiber Communications...where technology meets the bottom line.

Trilogy COMMUNICATIONS INC.

Trilogy Comm., Inc. .....(800) 874-5649
FAX .....(601) 939-6637
2910 Highway 80 E.
Pearl, MS 39211
PERSONNEL: Daryl Gambrell, Sales/Service Manager
DESCRIPTION: Manufacturer of the high quality MC² air dielectric coaxial cables. Also offer full line of drop cables, including X and V UL ratings along with corrosion resistant compound.

Tools

cable prep® BEN HUGHES COMMUNICATION PRODUCTS CO.

Cable Prep® .....(203) 526-4337
Ben Hughes Communication Prods. Co.
FAX .....(203) 526-2291
207 Middlesex Ave.
PO Box 373
Chester, CT 06412-0373
PERSONNEL: Deborah Morrow, President; David Morrow, Vice President; Eric Smith, Sales Manager; Patricia Anderson, Inside Sales
DESCRIPTION: Manufacturer of CABLE PREP tools. Product line includes hex crimp tools for CATV, MATV, STV and standard RF connector applications; coring and stripping/coring tools for all major cables (Times Fiber, Comm/Scope and Quantum Reach); the CPT series tools for stripping 59 & 6 series cables; EZ Squeeze tools for Raychem connectors; ratchet handles for all coring and stripping/coring tools; jacket stripper tools and other accessory tool items. Special tools made to order. Products are sold through major distributors. Call or write for information.

Dist./Suppliers/Reps

ANIXTER CABLE TV

Anixter Cable TV .....(708) 677-2600
WATS.....(800) 323-8166
FAX .....(708) 677-1092
4711 Golf Road
One Concourse Plaza
Skokie, IL 60076
PERSONNEL: Marty Ingram, President; Peter Wagener, Vice President/Product Management and Marketing
DESCRIPTION: Anixter Cable TV is a full line supplier of products for the CATV industry. With stocking locations throughout the country, Anixter Cable TV provides 24-hour delivery and after-hours service for emergencies. Anixter Cable TV stocks products required to build, operate, and maintain a cable system, including satellite receiving equipment, headend equipment, fiber optics, subscriber devices, distribution electronics, coaxial cable and connectors, aerial and undergroud construction material, system passives, drop and installation material, tools and safety equipment, and test equipment.

JCA

Jerry Conn Associates, Inc.
Corporate Office .....(800) 233-7600
IN PA.....(800) 692-7370
FAX .....(717) 263-1547
130 Industrial Drive
PO Box 444
Chambersburg, PA 17201-0444
REGIONAL OFFICES: Bob Sollenberger, 6117 55th Terrace East, Bradenton, FL 34203, 813-739-1856, Fax 813-753-5127; D.J. Bos, Route 1, Box 264A, Waverly, AL 36879, 205-826-2818
PERSONNEL: Dave Showalter, Vice President/General Manager; Trav Neumann, Director of Sales and Marketing
DESCRIPTION: JERRY CONN ASSOCIATES, INC. is an East Coast based distributor and manufacturer's representative. JCA has a very diverse product line to meet all your needs from construction to test equipment. We are a stocking distributor of Trilogy's MC² and drop cable, as well as carrying Fitel General's line of fiber optic cable. JCA is also a stocking distributor of the following vendors: LRC, Diamond, Sachs, Lemco, Klein, Cablematic, Cable Prep, and Augat. JCA has just expanded its coverage to include the entire eastern seaboard.

The digitization of commercial insertion

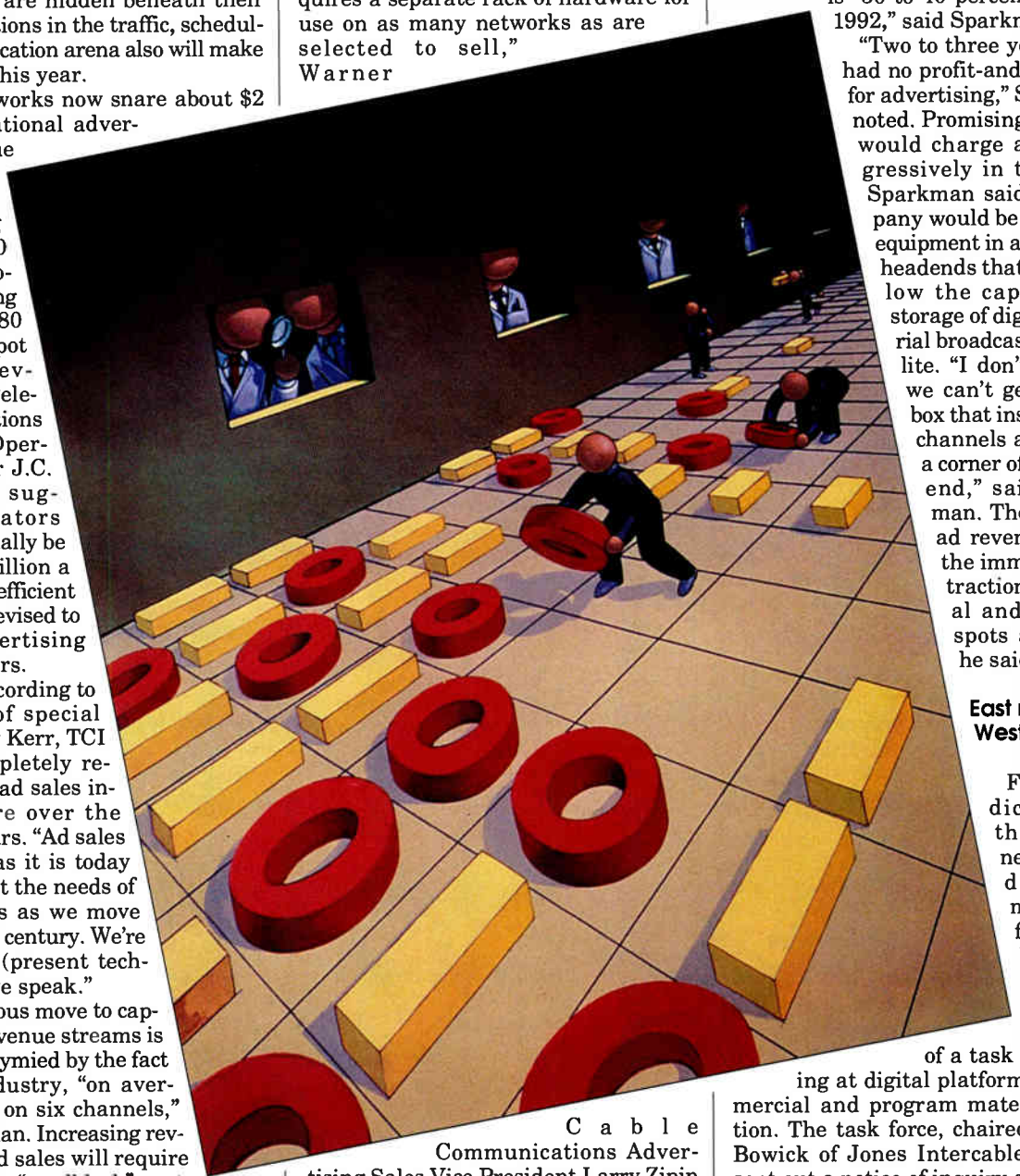
Necessity being the mother of invention, watch for dramatic breakthroughs in commercial insertion technology and software over the next year or two as rapidly-developing signal compression and storage technology is pushed by frenetic operators eager to mine rich advertising ores they believe are hidden beneath their feet. New options in the traffic, scheduling and verification arena also will make their debut this year.

Cable networks now snare about $2 billion in national advertising revenue while operators manage to snag about $580 million in local advertising and about $80 million in "spot market" revenues. But Tele-Communications Inc. Chief Operating Officer J.C. Sparkman suggests operators could potentially be netting $6 billion a year if more efficient ways were devised to bid for advertising agency dollars.

In fact, according to TCI's GM of special project Gary Kerr, TCI will be completely rebuilding its ad sales infrastructure over the next few years. "Ad sales equipment as it is today will not meet the needs of the business as we move into the next century. We're outgrowing (present technology) as we speak."

But a serious move to capture such revenue streams is at present stymied by the fact that the industry, "on average, inserts on six channels," said Sparkman. Increasing revenue from ad sales will require the ability to "roadblock" spots and insert on 22 channels, he said. Granted, that could be done today, using standard insertion gear and 30 to 40 tape machines, Sparkman noted. But in practical terms, "that's impossible," in part because of the space and maintenance demands placed on headends by tape decks that suffer from high failure rates.

"For all practical purposes, this requires a separate rack of hardware for use on as many networks as are selected to sell," Warner Cable Communications Advertising Sales Vice President Larry Zipin has said.



More cash, please

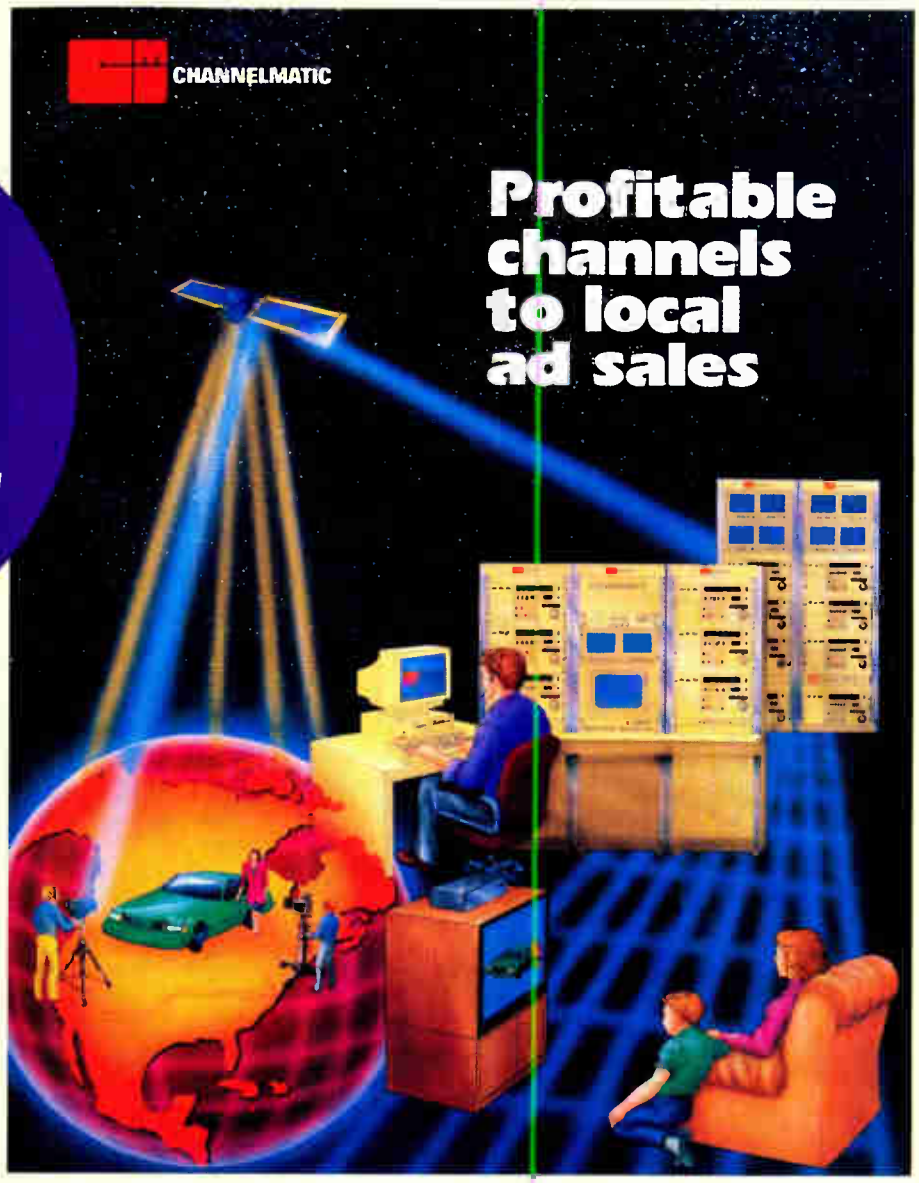
The search for new revenues to drive growth is especially frenzied now that caps on basic revenues—driven by government fiat or customer price sensitivity—seem to be headed the industry's way. At TCI, which booked $100 million last year in ad revenue, the goal is "30 to 40 percent more in 1992," said Sparkman.

"Two to three years ago I had no profit-and-loss item for advertising," Sparkman noted. Promising that TCI would charge ahead aggressively in this area, Sparkman said his company would be installing equipment in at least 500 headends that would allow the capture and storage of digital material broadcast by satellite. "I don't see why we can't get a small box that inserts on 22 channels and sits in a corner of the headend," said Sparkman. Though local ad revenues seem the immediate attraction, "regional and national spots are next," he said.

East meets West

Further indication of the breakneck pace of development is the formation by Cable Television Laboratories of a task force looking at digital platforms for commercial and program material insertion. The task force, chaired by Chris Bowick of Jones Intercable, recently sent out a notice of inquiry on the subject. The aim of the task force is to establish voluntary guidelines (*not* stan-

NEW Guide to Commercial Insertion Success



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dards, as Bowick is quick to point out) for compressed digital commercial insertion systems.

The Cable Television Advertising Bureau, for its part, also has formed a new committee to look at the whole issue. And according to CAB President Thom McKinney, those two groups will be working together to establish answers to the growing pains that plague ad sales operations.

"This project will be real challenge," says Scott Bachman, director for technical operations projects, CableLabs. "There are so many forces at play. Frankly, if hardware were the only issue, it would be solved quickly. But that's just not the case."

And although CableLabs is obviously well-equipped with engineers to deal with topics like digital compression and platforms for national spot delivery, the CAB is no stranger to engineering issues, either. Back in the early '80s, the group was instrumental in establishing uniform VCR pre-roll times and cue tone standards for the ad sales biz, says McKinney.

This time around the engineering block is not much different, according to McKinney. "Last year, a bunch of us sales guys were sitting around discussing all these problems," McKinney admits. "So in December, we made the trip out to Boulder to talk with the guys who know: the engineers."

So far, CableLabs has received responses to its NOI from 43 companies with interests in the area. And though commercial insertion systems were once considered a niche technology, both Scientific-Atlanta and Jerrold, among others, submitted their thoughts on the subject to CableLabs, joining the well-known bunch of ad sales hardware and software players like Texscan MSI, Channelmatic, Arvis and TPC.

Bachman says three common elements have surfaced in most of the responses: architecture, the need for an evolutionary approach to the problem and software—or, as Bachman puts it, "how to put it all together to overcome barriers."

"Architecturally, operators are moving from a 'connectionless' environment to a 'connectivity' environment—we have to try to interconnect all these headends," Bachman explains. And, he explains, the industry has to move gently from a video cassette player-based environment to digital-based insertion. "I see (digital commercial insertion) used initially as an expansion device," Bachman predicts. "It needs to be an evolutionary move that allows for the gradual phase-out of VCPs."

The CAB's McKinney wholeheartedly agrees. "There are people out there who have dropped a lot of money into new VCPs", he says. "For that reason, it has to be a gradual move (to digital storage technologies).

But none of this will mean "squat," Bachman says, if the industry can't get hardware and software to talk together in a uniform format. "To me, that's the critical component," Bachman says.

Indeed, one analogy that seems to keep popping up in these software discussions is the reservation systems used by all the major airlines. "What's the difference between an open ad avail, wanted by local, regional and national markets, and a seat on an airplane? Certainly, in the beginning, (the airline industry) didn't have travel agencies out there able to access all available flights, regardless of carrier, instantaneously. That's where ad sales software needs to be," Bachman explains.

Loudest software grumble

The biggest complaint from operators about their ad sales software seems to be inventory management, says McKinney. (Inventory in the ad sales side of things is not something one can see; it consists of the lists of avail space in which cable ads can be inserted.)

Ed Dowd, a consultant for Compulink, the market leader in ad sales software installations, says his clients are looking for "dynamic and accessible inventory control."

"Salespeople at any level—whether they're local, regional, whatever—need accessibility to open inventory from multiple sources," Dowd says. "That's the main thing we're hearing. Using the airline analogy, if you picture each potential buy source like an individual travel agent's office, then I need to be able to call up and know if I can clear an order at that moment."

And although Dowd didn't commit his company to any particular product, he feels that within the next 24 months there should be "no reason not to expect" that a local ad sales rep sitting at an agency's desk could open a notebook computer, build a proposal with the client and be able to glean, real-time, whether the desired air times are available. "We're looking in that direction," Dowd says.

Jerry Ware, director of advertising sales for Metrovision's properties, says that cable ad sales is, quite simply, "growing up."

"The various media agencies want to use us, but they're getting frustrated with our processes. We need to streamline several of the processes in order to make us more appealing to the big agency buyers," Ware says.

New players

Those ad sales "growing pains" have spurred new ideas—and hence, new companies. Salt Lake City-based Unibase is one example. This software group, made up primarily of ex-Texscan employees, has been hiding in bushes, so to speak, for more than two years. During that time, the company's staff of seven software engineers has been busily developing a multi-faceted ad sales traffic and billing system, designed from the input of "several MSOs," says Cory Fabiano, software project manager for Unibase. Times Mirror and Cox Cable are currently licensed to receive the product and will be involved in beta tests in May. Also, TCI's Gary Kerr admits that TCI is a "silent partner" in the Unibase project, and will be alpha testing the product in its corporate office this month. Beta tests will follow in its Rock Island, Ill. system.

The package, called Traffic Pro 2000, uses an OS-2 operating system and is specified to run on a Novell network with a 386 server and several intelligent, 386-based workstations. It can also run on a standalone computer with an OS-2 operating system.

The networked system was designed to enable, as Fabiano puts it, "spontaneous scheduling" of contracted spots. Once a contract is entered and approved, the workstations immediately start building an air schedule. The scheduling process does not interrupt users from performing any other functions on their workstations.

"Typically, scheduling functions tie up the ad sales computer for long periods of time," Fabiano says. "Because of that gripe, we designed the background processing function. If an operator has 50, heavily loaded contracts to enter, chances are the traffic logs are already built when the user finishes entering the last contract."

Compulink's Ed Dowd, however, begs to differ. "Scheduling has to be a real-time deal," he says. "It can't be that the host computer is accepting an order, then passing it to a background scheduler."

Another unique feature of the Unibase system is its method of communicating with various types of insertion hardware. According to Fabiano, the entire upload, download and verification process is "transparent" to the user. Times for sending and retrieving air schedules to insertion machines are set up in a parameters module, then acted out when the specified time comes.

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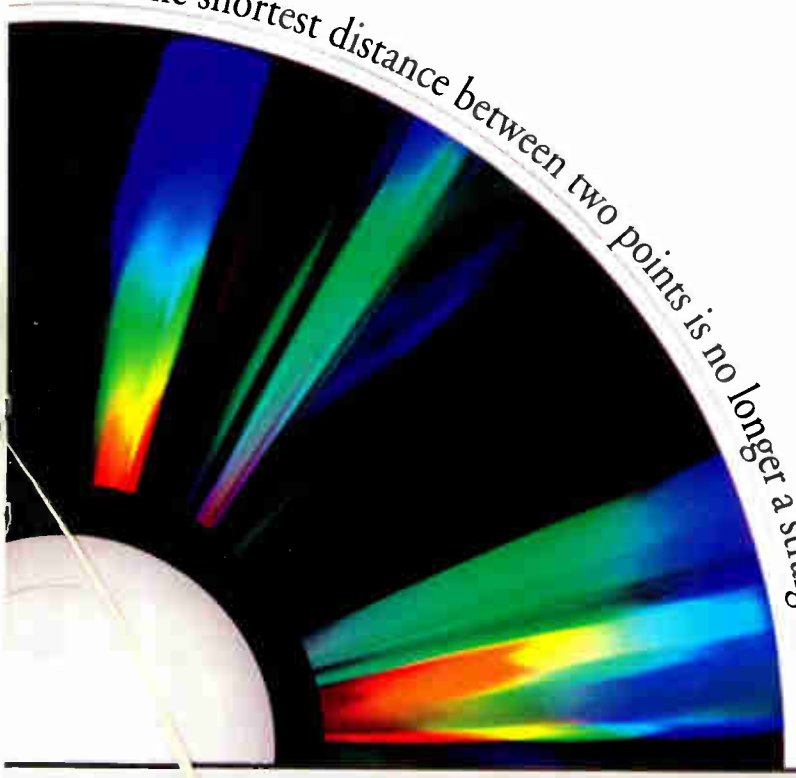

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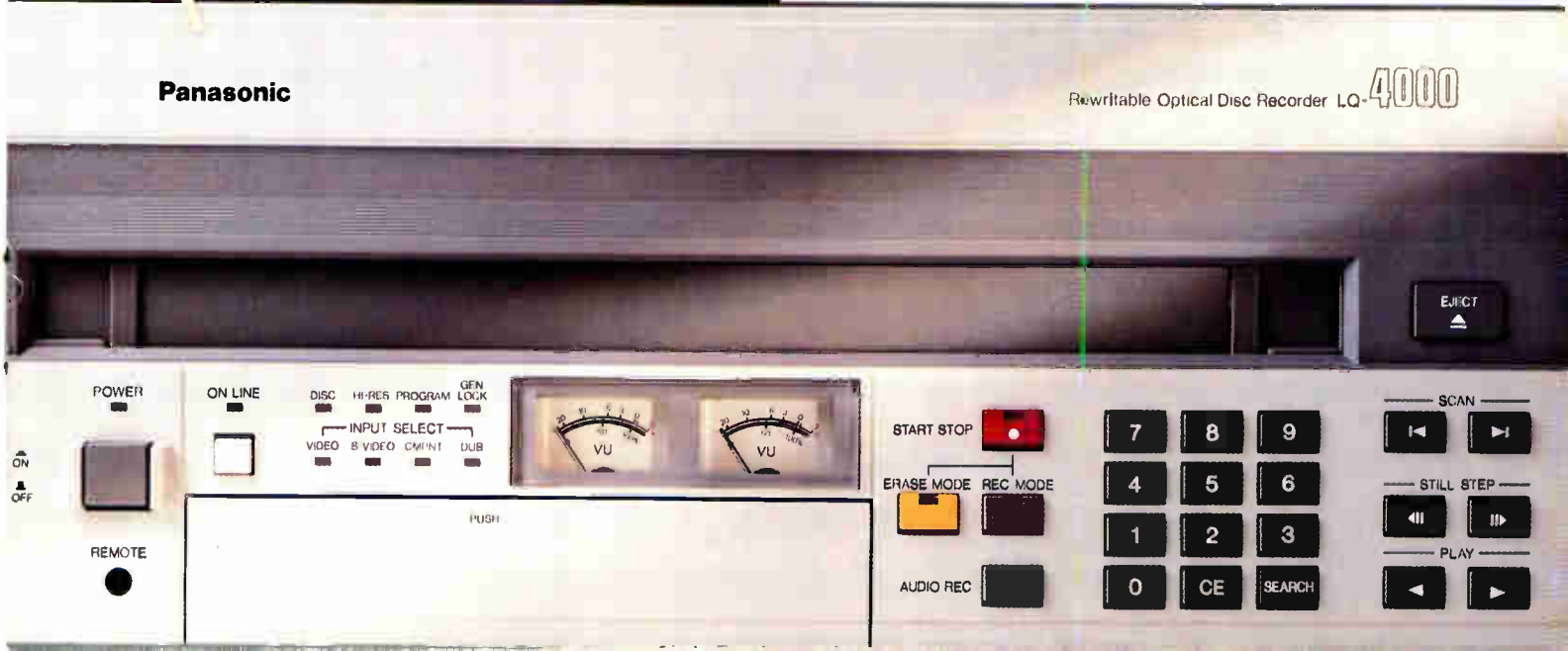

"We've tried to close the loop," says Fabiano. "In traditional systems, you've got three elements: Traffic, communication software and hardware. The communication between the traffic system and the insertion hardware is enabled via the ad software. And some poor little traffic operator is trying to learn all these divergent technologies.

"We deal with the inserters; the traffic people don't. Verification, uploading, downloading—it's all unattended," Fabiano boasts.

Another new startup company is Broadcast Data Systems, which six months ago released a patent-pending "passive pattern recognition system" which essentially verifies that scheduled spots are airing.

The system works like this: An advertising client sends off a cut of its commercial to BDS. BDS then reads the audio from the tape, digitizes it, and transmits that data to monitors in specific markets, specified by the advertiser. When BDS monitors see a match between the reference audio and a commercial that's airing, the match is time-stamped and saved.

What makes the system passive, says Terry Meacock, VP/GM of the company's electronic media division, is that no encoding is required on the commercial tape. Essentially, he says, it's a "reassurance" to the advertisers. "It's proof from an independent source of where and when their ads ran." The system is currently being used by Prime Sports Network.

Meanwhile, the established ad sales software companies are scrambling to come up with enhancements to their existing products. On the list for Compulink is a data export module, which will enable existing Compulink data fields to be queried by external, commercial software packages. Also, Dowd says the company plans to roll out an improved inventory utilization report.

Telecommuniacation Products Corp. says its next release will also be heavy on avail management. One main feature, says Mark Maslanik, senior software engineer, is a "make-good" function which will essentially reschedule any failed spots *before* it's too late (i.e. before the billing process). Also, the company will take the wraps off a feature that automatically fills in daily air schedules, based on contracted spots that fit into the open avail parameters.

Hardware developments

On the hardware side of the equation, two major developments are underway. First is the advent of service bureaus offering the equivalent of Federal Express-type delivery of compressed video material by satellite to headend receivers mated with digital or optical disc storage media. Among the new players in this arena is West Chester, Pa.-based Starnet, which is expected to be in beta testing this summer, according to company President Alan McGlade. A full launch as early as this fall is envisioned.

As some indication of the interest commercial insertion is drawing from firms that haven't historically focused on cable industry needs, note that Salt Lake City-based Dynatech Cable Products Group, a newly-formed business unit, will be the lead integrator of the headend hardware platform.

Some observers say the local storage system should be capable of storing 70 minutes of high-quality video, or about 15 minutes worth on a 1.2-gigabyte hard disk drive. The key management software, including scheduling and verification functions, is provided by Unibase.

Other contenders

Other announced contenders for satellite delivery of compressed material include Dublin, Calif.-based Ad Express Co. and Miami-based Multivail Inc. Though it hasn't yet formally tossed its hat into the ring, Prevue Networks Inc. also has been investigating its own satellite delivery system. At least one additional firm, yet to make its existence known, will go public this month.

The more challenging hardware trend, though, is the development of the actual local storage system. Satellite delivery of digital video is technologically a simple matter. But the development of systems that compress, decompress and store high-quality video at reasonable cost while manipulating video in real-time represents a major technical challenge, most observers say.

So far, attention has tended to center on digital storage media and secondarily on compression and decompression methods. So far, vector quantization; MPEG (Motion Picture Experts Group); and the General Instrument Corp. MPEG-like compression engines have surfaced as likely compression contenders. Talk about suitable storage options has ranged from analog storage on erasable optical disc to standard Winchester hard disk drive technology. There also has been some exploration of Digital Audio Tape, CD-ROM (compact disc read-only memory), ROM (read-only memory) and RAM (random access memory) as possible storage options.

To date, optical disc and hard disk drive technology seem to be getting most of the attention, though long-term, most observers assume that RAM storage methods will be most desirable and feasible. At least one contender, Multivail, believes it can use a two-tier RAM-based storage system in which a central server holds up to 200 30-second spots and downloads material to local storage units that hold about 18 commercials at any one time.

Interface options

The contenders in the digital arena have offered a range of interface options. Some, such as Ad Express Co. and Starnet, have developed new scheduling, traffic and verification software in conjunction with their hardware platforms. Others, such as Multivail, say they'll interface with existing industry-standard traffic, billing and verification packages. Many companies, which have not talked about their plans in public, will probably also seek to provide interfaces to standard analog insertion systems built by Texscan and Channelmatic, for example.

For its part, Scientific-Atlanta, for example, looked at the whole matter of digital insertion and ascertained that it "had about 98 percent of the elements needed to put such a system together," said Bob Luff, S-A vice president, strategic operations. "Scheduling software is about the only place we don't have the basics in place," he said.

Jerrold Communications is interested not necessarily because of the potential size of the market for hardware digital compression, but more importantly because it is strategic. With its engineers having already developed or presently working on all the components required for a full digital headend and digital signal delivery to and from customer homes, the commercial and program insertion pieces can't be left out, said Jerrold president Hal Krisbergh.

Bowick, who chairs the CableLabs digital commercial insertion task force, suggested that "People are a lot further along than we've been led to believe. By the end of the year, we should see some striking demonstrations."

Bowick said that price is the issue where storage media is concerned. There's no question high-quality video can be compressed and stored in digital fashion in relatively well-understood ways. What's really not so clear right now is what such capability will cost, he said. **CED**

By Leslie Ellis and Gary Kim

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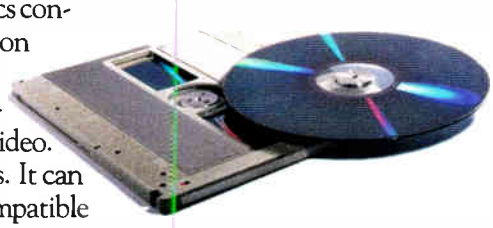

The VDR-V1000 can record audio and video simultaneously or separately, so you can dub PCM stereo audio onto video. Access is available through the RS-422A or RS-232C ports. It can read and write SMPTE time codes, and transmit signals compatible with component, composite and RGB formats.

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Multi-satellite feed system for 2-degree satellite spacing

Several years ago, cable operators observed with considerable interest plans to move two major cable satellites to a three-degree orbit spacing. Now, a few years later, operators are contemplating the ramifications of several satellites being spaced just two degrees apart.

By the middle of 1993, virtually all cable systems in the continental United States will have to have the capability of picking up a minimum of five satellites, plus others being used for regional sports, pay-per-view and other special events. Four of the satellites that many cable systems will be using are to be lined up with 2-degree spacing from 131 degrees to 137 degrees (see Figure 1).

Due to space limitations caused by surrounding trees, buildings and low elevation angles found in the northeastern part of the United States, many earth station headend sites have severe restrictions on the satellite viewing arc. As more and more satellites come on line, the earth station space crunch at the headends has come to the point where many headends simply do not have any more room to add even just one more dish.

Figure 1

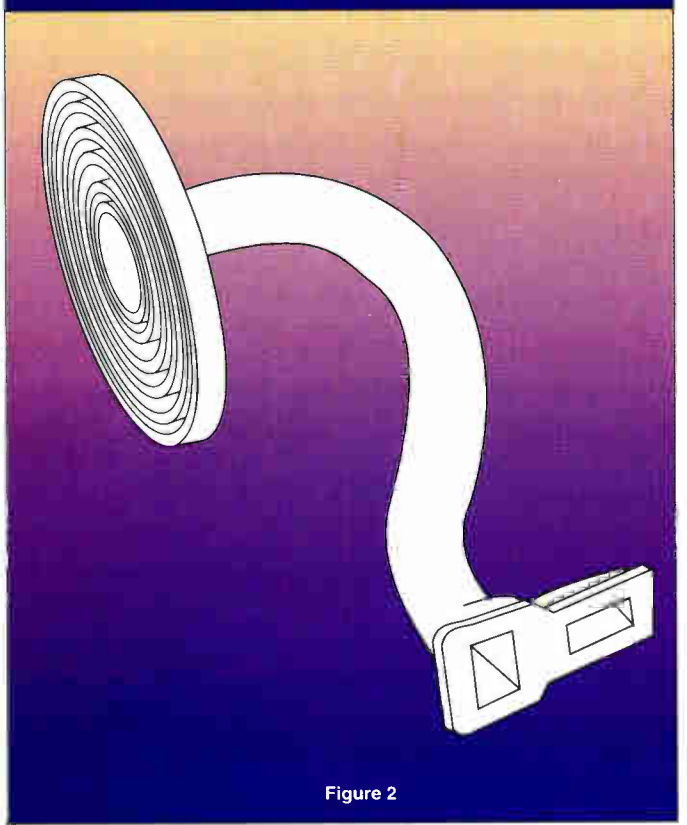
Figure 2

Space crunch solutions

There are alternative solutions to the space crunch problem: buy or lease additional adjacent property or move the headend. Both options are expensive, even if the cable operator could find suitable property and satisfy all of the local zoning requirements. A better solution is to create more value from current antenna space resources by finding a way to pick up multiple satellites with existing antennas. Many cable systems have one or more 4.5- to 7-meter antennas already in use, which are ideal for retrofitting to a multi-satellite feed (MSF) system.

While MSF systems have been explored since the 3-degree satellite orbital move, a 2-degree solution has evaded an engineering solution. Mechanical constraints alone pose nearly an insurmountable problem. Feed scaler plates overlap. Horizontal and vertical orthomode couplers, low noise amplifiers or block converters interfere as they compete for the same space.

By Thomas G. Hill and Bob G. Haney, Sammons Communications Inc., and Tore N. Anderson, Steven Galagan and Dr. Ronald S. Posner, Antennas for Communications

Brute force won't work

Brute force attempts to literally bend feed assemblies away from the same interference volume have led to feeds with large, 3-dB to 10-dB power suck-outs (see Figure 2). The power suck-outs appear randomly over the entire C-band (3.7 GHz to 4.2 GHz frequency range). To make matters even more complicated, the power suck-outs are accompanied by random polarization twists of horizontal and vertical transponders. Often no orthomode cross-polarization nulls are measured or a pea soup chaotic mixture of polarized signals are encountered over the band.

This article investigates the criterion for activating higher order waveguide/feed modes, which suck-out satellite energy and examines the significance of bending the feed pipe (variation of propagation direction) in destroying polarization purity.

The Antennas for Communications (AFC) MSF 2-degree satellite feed extension is proposed along with expected antenna performance. Measured MSF results are reported on the Sammons Communications 5-meter Scientific-Atlanta dish located at Newport, Tenn.

Higher order waveguide/feed modes

Ordinary rectangular waveguide, such as WR229 for 4 GHz operation, will not support microwave energy in two polarizations as required for "Frequency Reuse Satellite Systems." To solve the two polarization obstacle, it becomes necessary to go to either square or circular waveguide. (See Figure 3)

Microwave energy, propagating in rectangular or circular tubes, have electromagnetic field patterns which depend on frequency and waveguide shape. The lowest frequency mode is called the fundamental mode. Other

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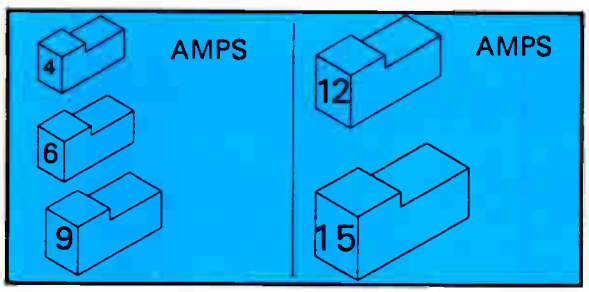

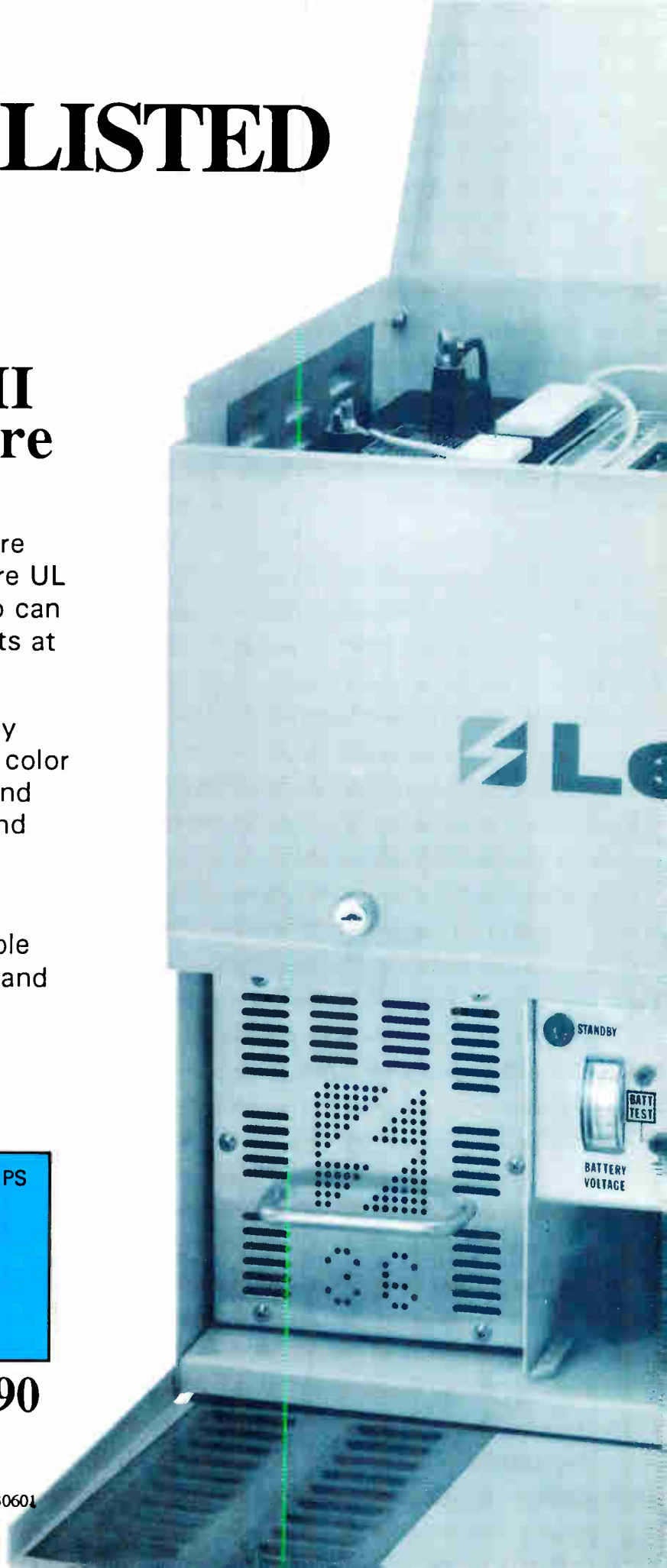

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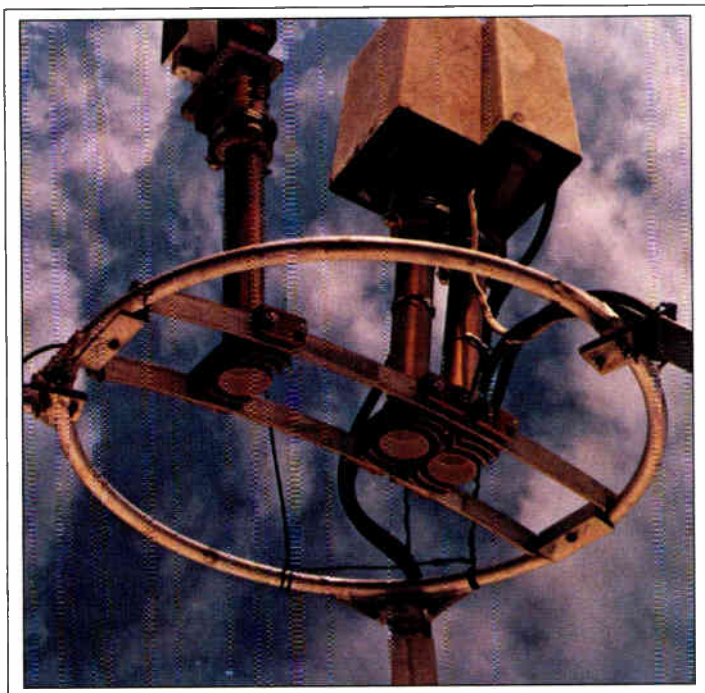

Close-up of multi-sat feed system in Newport, Tenn.

fundamental waveguide mode. In general, larger waveguide dimensions promote lower frequencies for higher-order mode propagation.

Square waveguide is difficult to build and design feed structures for parabolic dishes. Circular waveguide, on the other hand, lends itself naturally to feed design, providing optimum performance and supporting continuous polarization rotation adjustment. Circular waveguide, however, has a much reduced frequency range for mode free operation in the fundamental TE_{11} mode. Also, any change in waveguide diameter acts as a higher-order mode converter.

Indeed, signal energy is transferred out of the fundamental mode into the higher-order modes. The most important higher-order mode is the TM_{01}. For an abrupt diameter change, energy is coupled into the TM_{01} mode at a rate $(4S/D_1)^2$. (See Figure 4)

From a feed designer's point of view, multi-mode operation is very desirable. A larger diameter is required to impedance match the circular waveguide to free space over the 3.7- to 4.2-GHz frequency band. More too, the correct amount of TM_{01} and TE_{11} energy

Multi-sat system on 5-meter dish.

will better shape the primary feed radiation pattern to optimize the dish far field antenna radiation pattern (achieve high gain and low sidelobe level).

For 2-degree satellites, it is necessary to space the feeds closer together. Mechanically, the simplest way to perform this task is bend circular waveguide to a shape where the orthomode junctions no longer interfere with each other. Mounting the existing feed and scaler plate directly against the bent circular waveguide, however, causes two problems for "Frequency Reuse" cross-polarized signals.

Circular waveguide is continuously symmetric over 360 degrees. What this means is that circular waveguide may be rotated around any axial angle without any change in shape. Without any means of identifying specific direction, circular waveguide modes may be polarized at any rotation angle. When circular waveguide is bent though, the complications really start. For one signal polarization, the bend lies in the magnetic field plane.

For the other polarization at 90 degrees, the bend lies in the electric field

modes, which begin to carry energy at higher frequencies, are termed "higher-order" modes. As is often the case, several higher-order modes often turn up over a frequency band along with the

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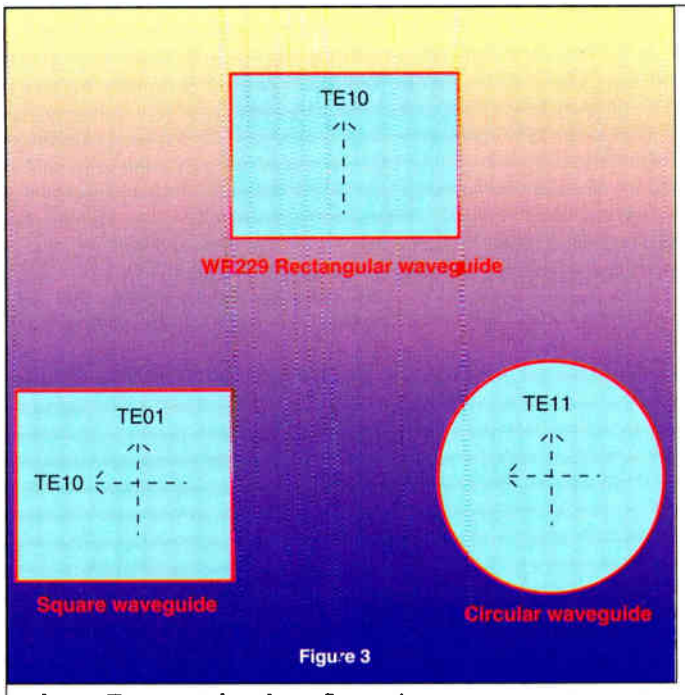


Figure 3

plane. For most bend configurations, the actual signal polarization is some crazy combination of the two. These opposite polarizations, as they traverse the bend, have different phase velocities. They result in an elliptical polarized wave, seriously impairing cross polarization discrimination and increasing adjacent channel interference. Further aggravating the problem, the elliptical polarization rotates continuously over the frequency band guaranteeing no unique polarization solution.

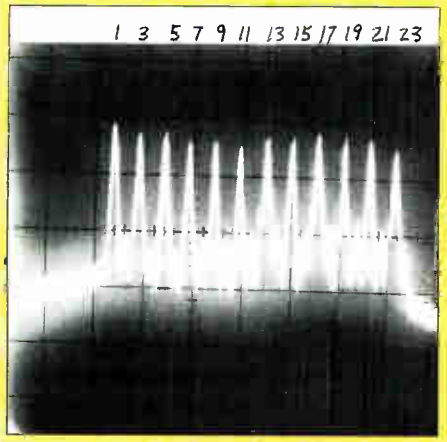
The second problem again arises from clamping an oversized feed, scaler plate assembly directly against the bent circular waveguide. At certain frequencies, a resonant cavity is formed, where the trapped TM_{01} mode is exactly a multiple of a half wavelength long. The trapped TM_{01} energy bounces back and forth causing suck-outs at these resonant frequencies as well as introducing time and phase delay distortion.

Suck-outs as large as 20 dB have been measured at certain frequencies within the 3.7- to 4.2-GHz band. Between resonant frequencies, good fortune sometimes admits reasonable carrier-to-noise ratios on some transponders but other adjacent ones disappear into the noise level. These same between frequencies have a VSWR of 1.9 to 1 (-10 dB return loss). This VSWR increases transmission loss by 0.5 dB and noise temperature by 29 degrees K. For a 80-degree K LNA/LNB, the antenna system performance is degraded by another 1.5 dB.

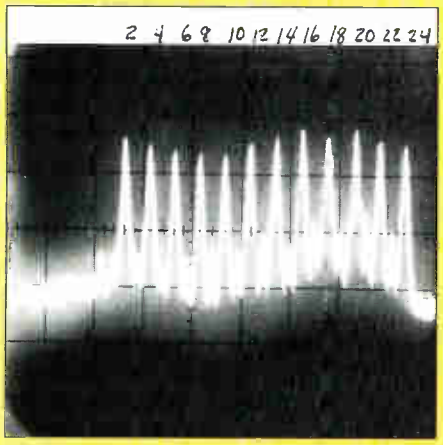
In all cases, the action of circular waveguide bends on dual-polarized signals is serious cross-pol interference (see Figure 5). As those who have worked on telephone network microwave repeater link installations know, circular waveguide is frequently used to reduce transmission line loss. During installation, the circular waveguide is very carefully and precisely aligned in a straight line to avoid the slightest hint of misdirection. Bends in circular waveguide have big consequences.

Mimicking the communications industry, the best feed approach for 2-degree satellite operation is to use a straight, "spurious free" high-performance extension. The extension length is chosen to simultaneously remove the

Spectrum analyzer picture of Galaxy G1 at 133 degrees.



MSF-ext G-1 odd Transponder 133 degrees (10 dB/div.)



MSF-ext G-1 even Transponder 133 degrees (10 dB/div.)

orthomode junction interference conflict, maintain the higher-order TM_{01} to TE_{11} mode ratio and preserve the phase relationships between these same modes.

Multi-sat antenna scanning

When the feed of a parabolic antenna is displaced at an offset angle from the focal point, the main beam of the radiation pattern moves in the opposite direction. For practical antenna parameters, the main beam scanning angle is nearly equal to the feed offset angle.

As the feed horn is moved off axis, the scanned beam will show a decrease in gain, δG. At the same time, sidelobes in the direction of the scan are suppressed and the trailing sidelobes tend to increase. The term "coma lobe" is used to describe the largest trailing sidelobe.

Practically speaking, the scanning process can continue until the gain loss and comma lobe interference produces objectionable results. One of the authors has experimented with scan angles as large as 10 degrees with acceptable picture quality. Other higher order aberrations, such as astigmatism, filling in of pattern nulls and beam broadening, are associated with large scan angles.

For 2-degree spaced satellites, scan angle are confined to a narrow ±8-degree or less range. Over this range the decrease is gain can be approximated by $\delta G = -0.045 \cdot \Theta_s^2$, where Θ_s is the scan angle.

Experimental results

At Sammons Communications' Newport, Tenn. headend, there was absolutely no space for an additional earth station. The Multi-satellite feed was the obvious solution. The existing 5-meter earth station had already been retrofitted for a competitive dual-satellite feed, but the 2-degree feeds had a poor frequency response across all

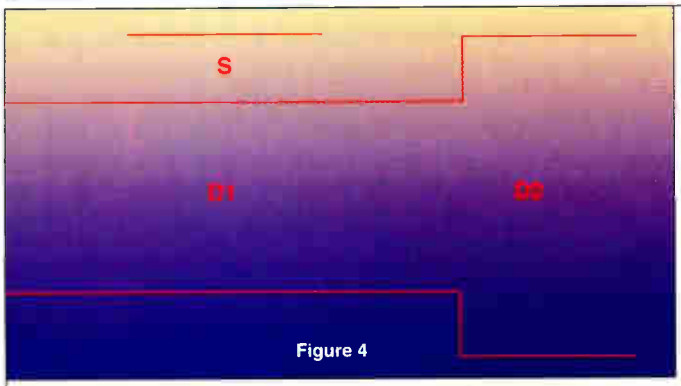


Figure 4

transponders on a given polarity.

Adjusting the feeds for optimum polarization on this system was virtually impossible. The AFC feed, on the other hand, exhibited a more linear frequency response and allowed precise polarization nulls.

The Sammons' field test was laid out to determine expected performance on existing satellites located around 133 degrees over to where Galaxy G5 will be positioned at 125 degrees. Consequently, three feed extensions were installed to receive the three satellites:

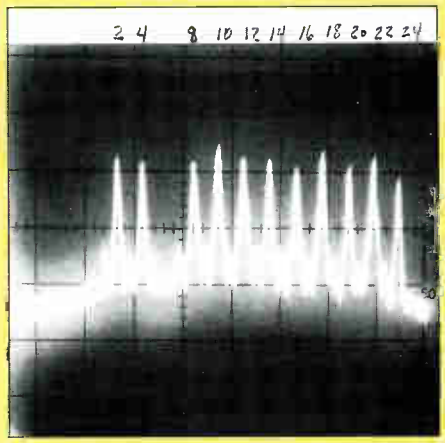
- Galaxy G1, located at 133 degrees;
- Satcom F1R, 131 degrees; and
- Telstar 303, 125 degrees (future G5 location).

After the feed extensions were peaked on the satellites, signal level readings were taken and receive pictures were evaluated. The evaluation made comparison between picture quality and signal levels measured off a single satellite dish. With the antenna bore-sighted at 129 degrees, a feed was moved from one end of the feed tray to the other.

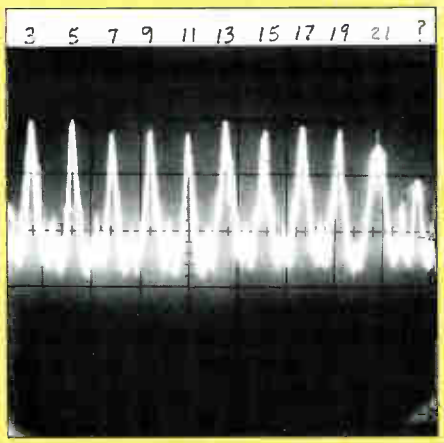
Indications are that the MSF-16 is capable of looking at as many as seven satellites spaced 2 degrees apart. The five feed positions set in the middle would have losses (over a single feed) of 0 to 0.5 dB. It appears that the two end feeds would have losses of about 1.75 to 2 dB. Most cable operators are satisfied with the pictures they are receiving from 3.7-meter antennas—which have a receive energy 3 dB to 4 dB less gain than the 5-meter dish.

Sammons' judgment is the 1.75- to 2-dB loss off boresight does not seem excessive. The Sammons' tests indicate that the MSF-16 should perform satisfactorily from the G5 location at 125 degrees to the future Satcom C4 (replacement for Satcom F4) at 135 degrees. (See spectrum analyzer photos

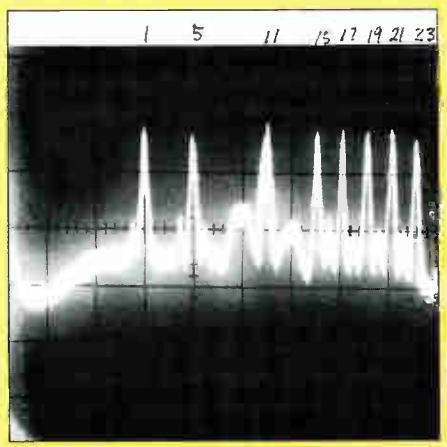
Spectrum analyzer picture of Satcom F1R and Telstar 303



MSF-ext F1R even Transponder 131 degrees (10 dB/div.)



MSF-ext F1R odd Transponder 131 degrees (10dB/div.)



MSF-ext Telstar 303 (future G-5) odd Transponder 125 degrees (10dB/div.)

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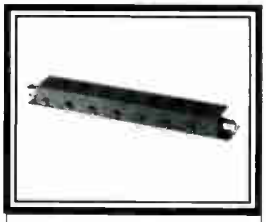

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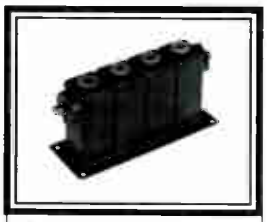
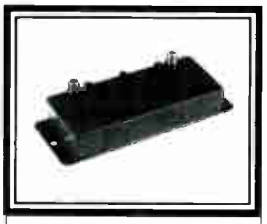
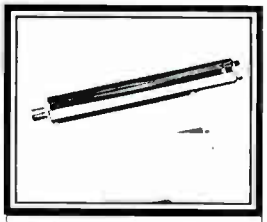


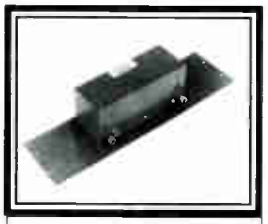
Types 4930 and 3278 for Hyper and UHF Channels.



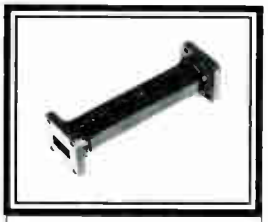
3328 BPF for Leakage Receivers.



Pay -TV BPF is Pole Mounted.



Sharp BPF Selects FM Channel.



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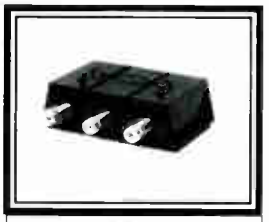

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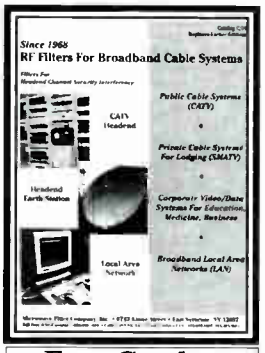

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and Figure 7.)

MSF installation

When installing the multi-sat feed kit, it is important to verify that the feeds are positioned at the proper focal point for each particular dish. Operators will probably have to call the manufacturer for this dimension. A typical 5-meter dish will be about 74 inches, whereas some 4.5-meter dishes may require about 60 inches from the center of the reflector to a point slightly inside the feed. This measurement should be the same on each end of the feed tray.

The next step is to establish the "role," or declination angle of the feed tray. This angle determines the amount by which the feed tray is rotated to correspond with the way the satellites are lined up in the arc. When the feed tray is properly aligned to the correct declination angle, the maximum signal from each satellite is found in the center of the tray.

The declination angle for the East Coast can be determined by the following technique:

- Set one feed in the center of the feed tray and point the antenna at the satellite (for example at 131 degrees).
- Rotate the feed tray approximately 40 degrees counterclockwise as you face the dish.
- Peak the dish and polarize the feed for maximum receive signal.
- Install LNA/LNB on one orthomode coupler and connect to a satellite receiver.
- Connect a power meter or spectrum analyzer to the IF output of the receiver (receiver should be in a manual mode with AGC off).
- Move the feed to each end of the feed tray and while monitoring the signal, rotate the feed tray slowly until maximum signal is achieved down the middle of the feed tray at each end.
- Secure the feed tray bolts and position each feed to pick up the desired satellites, peaking and polarizing in turn.

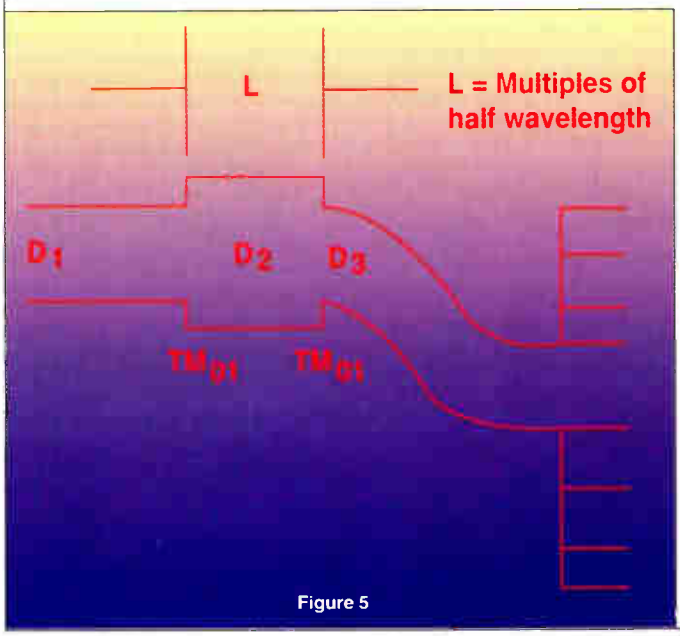

Figure 5

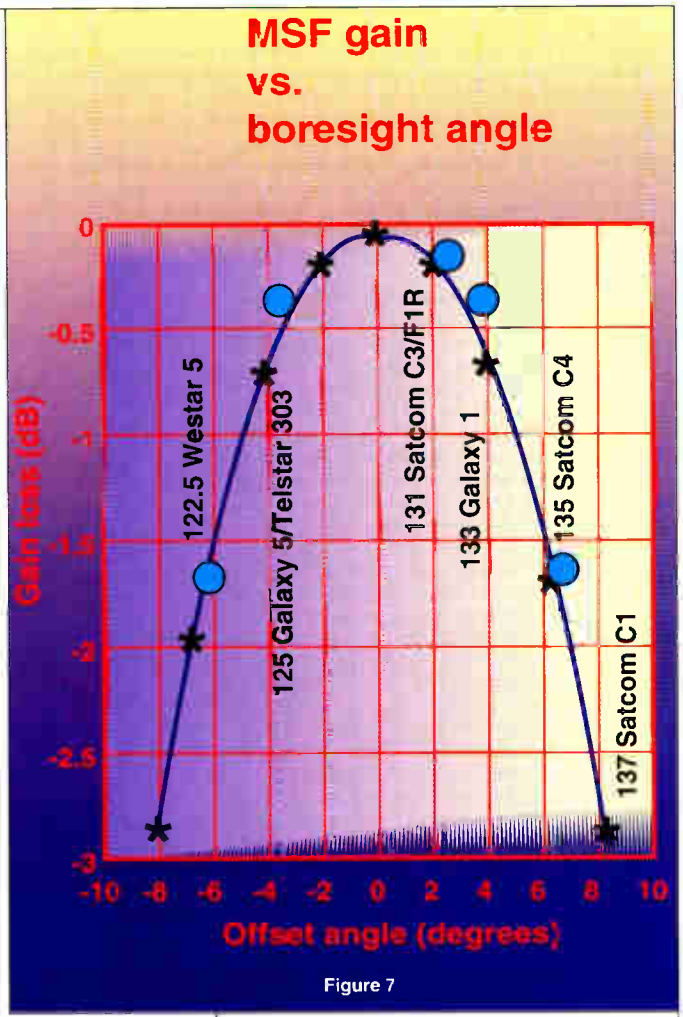

Figure 7

Summary and conclusions

To accommodate the number of satellites required by the communications industry, new cable satellites are being clustered into tight 2-degree parking orbits. Cable operators, compelled to deliver these new satellite program services, are obligated to upgrade or increase their antenna system number.

Sammons Communications' site space and viewing arc limitations, similar to the cable community at large, are forcing headends to better use their antenna resources. This has led to the need for multi-satellite feed (MSF) systems that work in a 2-degree environment.

In order to make a MSF system work for 2-degree satellite spacing, the physical proximity of the multiple feed, orthomode structures must be moved out of the way. Several ways to make the MSF modifications were reviewed.

Such simple techniques as bending the circular waveguide was shown to

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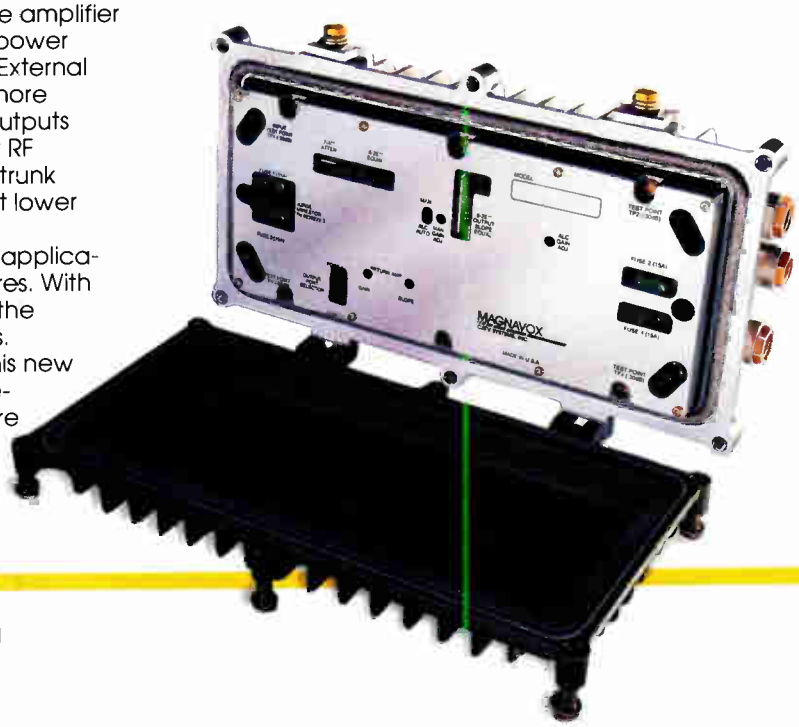

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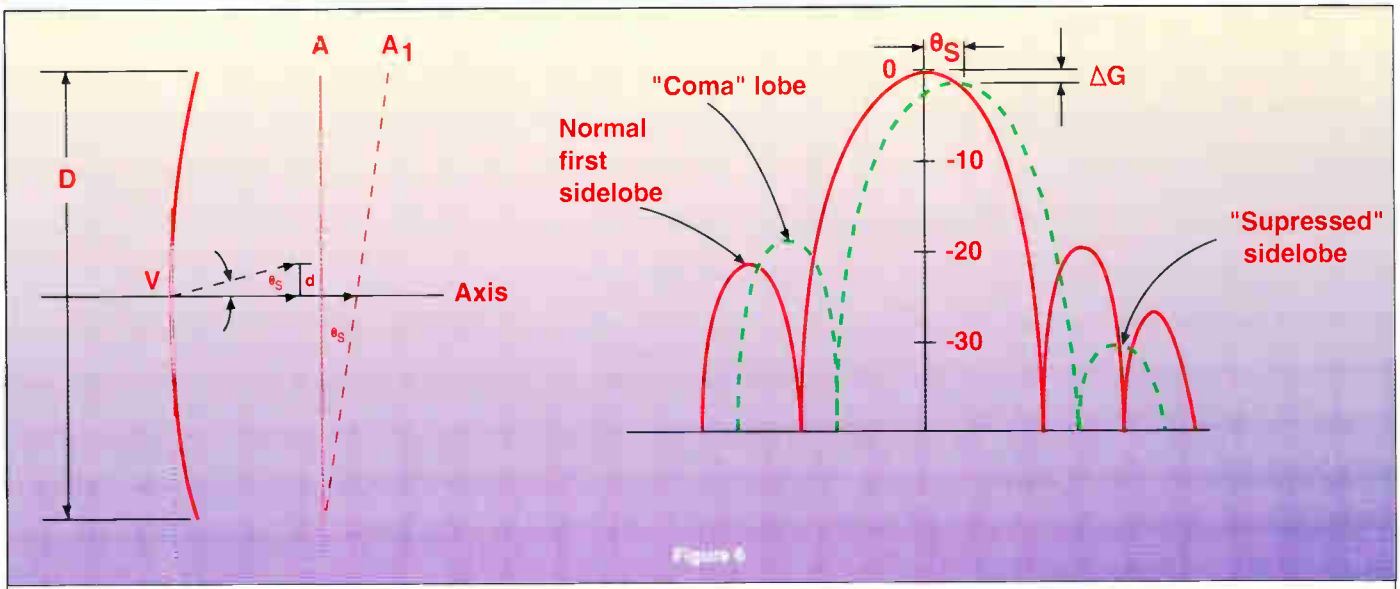

lead to large power suck-outs and severe polarization distortions. The straight feed extension solution was shown to have spurious free operation for frequency re-use satellites. Equally as important, the MSF extension maintains the proper amplitude and phase relationships between higher-order and fundamental waveguide modes for optimum antenna gain and sidelobe performance.

A three-feed extension, 2-degree MSF system was tested by Sammons Communications on a 5-meter headend antenna in Newport, Tenn. Less than 0.5-dB gain loss was observed on both polarization for simultaneous reception of Galaxy G1, Satcom F1R and Telstar 303. Moving the feed to the end of the MSF tray, approximately 1.75-dB loss was found. Making installation routine, the MSF extension was easy to use, preserved polarization purity and demonstrated precise polarization nulls.

Acknowledgments

The authors wish to thank Mike Coulter and Wes Hudson for performing the MSF measurements. CED

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NCTA SHOW TECHNICAL SESSIONS/SEMINARS - Monday-Wednesday - May 4-6

MONDAY

HDTV/ATV—The big picture
Location & time: West Ballroom B, Noon-1:15 p.m.
Moderator: Dan Pike. *Speakers*: Bronwen Jones, CableLabs; Brian James, CableLabs; Graham Stubbs, Eidak; Bernard Lechner, consultant.
Description: What quality will ATV subscribers expect? Will the systems and cable networks satisfy them? Will all the equipment work together?

Optimizing fiber technology for cable
Location & time: West Ballroom A, Noon-1:15 p.m.
Moderator: Tom Elliot. *Speakers*: Doug Wolfe, Corning; Nigel Watson, Magnavox; John Chamberlain, Comm/Scope; Curt Weinstein, Corning; Larry Brown, Magnavox.
Description: Getting peak performance from optical fiber-based plant? Product designers review components, merits and technical performance specifics.

Advances in fiber technology
Location & time: West Ballroom A, 1:30-3 p.m.
Moderator: Louis Williamson. *Speakers*: Henry Blauvelt, Ortel; Rezin Pidgeon, Scientific-Atlanta; T.E. Darcie, AT&T; David Huber, Jerrold; Dr. Swanenburg, Philips.
Description: What obstacles lurk in the next-generation deployment of video transmission via fiber? State-of-the-art components, methods and performance are examined.

Flexible network architectures—safeguarding cable's future
Location & time: West Ballroom A, 3:15-4:45 p.m.
Moderator: Nick Hamilton-Piercy. *Speakers*: Carl McGrath, AT&T; Lawrence Gitten, AT&T; Andy Paff, ONI; George Hart, Rogers Engineering.
Description: Issues and challenges in planning for potential and emerging service opportunities. What's the best way to ensure cable's victory in the PCN and alternate access race?

TUESDAY

Digital techniques and applications—audio and data
Location & time: West Ballroom A, 10:30-noon
Moderator: Alex Best. *Speakers*: Craig Todd, Dolby; Edwin Gunn, Scientific-Atlanta; Jeffrey Cox, Magnavox; James Wendorf, Philips.
Description: Meet the future armed with the latest technical intelligence on digital audio and intriguing data channel possibilities.

Real-world solutions to outage problems
Location & time: West Ballroom B, Noon-1:30 p.m.
Moderator: Tom Jokerst. *Speakers*: Peter Deierlein, Magnavox; David Hevey, Warner; Brian Bauer, Raychem; Scott Bachman, CableLabs.
Description: When subscribers demand round-the-clock perfection, system reliability is a top priority. Vendors and operators who have tackled outage issues share their findings.

Improving the cable/consumer electronics interface—issues and hardware
Location & time: West Ballroom A, Noon-1:30 p.m.
Moderator: David Large. *Speakers*: Walt Ciciora, ATC; Jay Vaughn, ATC; Robert Burroughs, Panasonic; Daniel Moloney, Jerrold; Rich Annibaldi, Pioneer.
Description: Veterans of "consumer friendliness" campaigns address cable's responsiveness to subscribers' whims, needs and ever-changing video equipment.

Digital systems: techniques and performance
Location & time: West Ballroom A, 2:30-4 p.m.
Moderator: Bob Luff. *Speakers*: J. Hamilton, Jerrold; Mahesh Balakrishnan, Philips Labs; Lamar West, Scientific-Atlanta; Arun Netravali, AT&T.
Description: An overview of what digital video compression promises and the data on what experts predict it can deliver.

High-speed digital transmission for CATV
Location & time: West Ballroom A, 4:15-5:45 p.m.
Moderator: Chuck Merk. *Speakers*: M. Freeling, GE American; Joe Waltrich, Jerrold; Rich Prodan, CableLabs; Kamilo Feher, DIGCOM; Monisha Ghosh, Philips Labs.
Description: The ability of satellite and cable to support high-speed digital transmission is explored. Problems and solutions for cable systems are discussed.

WEDNESDAY

Cable systems or networks—what are you building?
Location & time: West Ballroom A, 9-10:30 a.m.
Moderator: Mike Angi. *Speakers*: Don Raskin, Texscan; John Caezza, Magnavox; Ed Callahan, Antec; C. Holborow, AT&T.
Description: An exercise in system network architecture and how different transmissions affect it. What is the right mix for the network of the future?

Advances in conditional access and consumer electronics compatibility
Location & time: West Ballroom B, 10:30-noon
Moderator: Bob Zitter. *Speakers*: Claude Baggett, CableLabs; Aleksander Futro, CableLabs; Aravanan Gurusami, Magnavox; D. Pellerin, Philips.
Description: New ideas and new systems to control program access. Can program security and subscriber satisfaction coexist?

Headend operations
Location & time: West Ballroom A, 10:30-noon
Moderator: Hank Cicconi. *Speakers*: Gary Chan, Rogers; Quintin Williams, Pioneer; Blair Schodowski, Scientific-Atlanta; Uwe Trode, Magnavox; Scott Bachman, CableLabs.
Description: Steady advancements in headend technologies have led to improved video signal measurement, storage and overall quality.

A basic introduction to digital applications
Location & time: Lower north meeting room, 3 p.m.
Presenter: Walt Ciciora, ATC.
Description: This workshop will introduce the cable technologist to the world of digital technology. The nature of digital signals, circuits and systems will be covered and contrasted with their analog counterparts. A brief discussion of the role of HDTV and compressed NTSC will also take place.

Implementation of the new technical standards
Location & time: Lower north meeting room, 3 p.m.
Presenter: Ted Hartson, Post-Newsweek Cable
Description: This workshop will examine the new FCC technical standards for cable television. Specifically, it will address the new rules, what procedures they might require and answer questions about how they'll be dealt with by operators and franchise authorities.

SCTE®

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

April 8 *Southern California Chapter* BCT/E exams to be administered. To be held at Cencom Cable, Alhambra, Calif. Contact Tom Colegrove, (805) 251-8054.

April 8-9 *Dakota Territories Chapter* Consecutive meetings to be held April 8 at the Ramkota Inn in Pierre, S.D. and April 9 at the Radisson Inn in Bismarck, N.D. Topic: "Distribution Basics and Concepts" with Richard Covell of Texscan. Contact Kent Binkerd, (605) 339-3339.

April 9 *Chesapeake Chapter* "System Sweep" and "Distribution Systems." To be held at the Holiday Inn, Columbia, Md. Contact Mike Manz, (301) 662-7734.

April 11 *Cascade Range Chapter* BCT/E exams to be administered in all categories. To be held at Paragon Cable, Portland, Ore. Contact Cynthia Stokes, (503) 230-2099.

April 12 *Old Dominion Chapter* BCT/E and installer exams to be administered at both levels in all categories. To be held in conjunction with the Virginia Cable Television Association convention at the Jefferson Hotel, Richmond, Va. Contact Margaret Davison, (703) 248-3400.

April 14 *Central Illinois Chapter* BCT/E exams to be administered. To be held at Continental Cablevision, Pekin, Ill. Contact Chuck Prosser, (309) 347-7071.

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Optical Networks International has announced the formation of a five-day, comprehensive optical training course. **Fiberworks '92** is designed for those technical personnel desiring a hands-on, interactive approach to acquiring in-depth knowledge of optical technology. Topics include:

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- Transmission path electronics.

April classes held at ONI's Englewood, Colo. facility will take place April 6-10 and April 20-24 and will be repeated regularly throughout the year. Or, consider ONI's **"Taking it to the Streets"** program, which can be conducted at your site. This training includes two separate courses on splicing and construction. Contact Russ Eldore at (800) 342-3763 for more information.

HUGHES

Hughes Aircraft Co. has announced its 1992 schedule of technical training seminars on its AML microwave equipment for local signal distribution. Four full seminars are offered throughout the year covering both the new family of AML broadband transmitters, amplifiers and repeaters, as well as traditional AML products.

System design, installation, operations and maintenance will be covered. The schedule is as follows:

May 18-20
September 21-25
November 9-13

For more information call Hughes Aircraft officials at (310) 517-5633.

Roping 'em in at the Texas Show

SCTE subcommittees make progress; digital TV discussed

This year's Texas Show served up a full plate of engineering meetings and SCTE subcommittee meetings. Following are excerpts from the two-day meeting schedule:

• The SCTE's drop interface committee, after months of grueling meetings, reached a final vote on the female port of the F-interface. What this means, says committee chairman Dave Franklin, is that the female port of the F-interface is now "set," so that anyone who wants to build a male port can count on a firm specification.

"Mostly what the specification involved were mechanical ceilings and techniques," Franklin says. "This is not a drastic change to what exists today; it simply prevents future incompatibility problems and short ports."

Franklin is quick to point out that the group is still "working feverishly" on three other specifications: The male port of the F-interface; flexible drop cable and a 5/8-inch entry port for amplifiers and taps.

"We are still actively soliciting input on these three areas," Franklin emphasizes. "I would encourage anyone involved in these areas to either attend the meetings or send their comments directly to me." Franklin can be reached at (303) 799-1200.

• In two separate technical sessions, officials from Scientific-Atlanta and Jerrold Communications agreed that the "first phase" of digital compression will happen later this summer. Geoff Roman of Jerrold said the satellite-delivered portion of digitally compressed video is "well underway," and Bob Luff of S-A confirmed this news on S-A's behalf.

Also, Roman said problems that would be considered "not so major" in today's analog cable systems may have a larger impact when digital signals are introduced. Specifically, he said, phase noise and reflections will be "much more of an issue."

"Reflections occurring in today's analog systems, which manifest themselves as ghosts, are annoying but not disastrous to the signal itself," Roman explained. "But in a digitally compressed world, reflections could be a disabling factor."

The least predictable area where reflections are found is typically in the drop, Roman said, where operators have little control over such variables as consumer-installed equipment and television tuners. The solution, Roman said, is "some form of adaptive equalization installed within the subscriber terminal."

S-A's Bob Luff, in a separate technical session, predicted that "compression promises to have a bigger impact on cable television than fiber did, simply because compression starts at the studio, lowers transponder costs and simply changes the economics of the headend and virtually every aspect of the cable system."

Commenting on why the world is turning digital, Luff said the major reason is digital's lack of signal deterioration. New chip technology, Luff said, is making possible features like error correction, unsurpassable security and a more robust signal output.

"Before we meet here (at the Texas Show) next year," Luff quipped, "there will be hybrid digital/analog devices on the market."

• Look for the SCTE's emergency broadcast subcommittee to file its response to the FCC's Notice of Inquiry regarding cable EBS on or before the SCTE Cable-Tec Expo, to be held in San Antonio in June. During a Texas Show meeting, the group resolved to form three working groups: One to examine existing emergency alert hardware; one to formalize goals for cable television's participation in the cable EBS project; and one to draft a response to the NOI.

William Browning, chief of the FCC's EBS department and an executive on loan from the White House, spoke at the meeting to ensure cable participants that President George Bush, Congress and the FCC will strongly back the SCTE's efforts to get cable operators to participate in emergency broadcast transmissions. "The Commission backs cable's efforts 100 percent," Browning said.

According to Ken Wright, chairman of the SCTE subcommittee, volunteers to serve on the working groups are still needed. To get involved, call Ken at (303) 792-3111.

• Just because the FCC has issued its new technical standards for the cable industry doesn't mean operators have to fork over huge sums of money for new test equipment, emphasized Prime Cable's Dan Pike, a panelist at an FCC-related technical session at the Show. "The standards were carefully developed so that operators can use existing

CableLabs president Richard Green, right, accepts the CTPAA's 1992 President's Award from James Ewalt, executive VP of CATA and president of the CTPAA. CableLabs was recognized at this year's Crystal Awards ceremony in Denver for its ongoing effort to educate the industry on the potential of current and future technological developments.

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Premature coax cable failure in the Sudbury, Ontario area used to be commonplace because of the weather extremes. Abrupt 12-hour 60°F temperature swings in the Spring and Fall. Winter lows to -40°F and Summer highs in the 90's. Blizzards, freezing rain and average daily winds of 16 mph with gusts exceeding 50 mph. These severe conditions kept maintenance crews busy repairing or replacing sections of cable that may have been installed only months before.

Denis Coté, Service/Plant Maintenance Supervisor for Northern Cable Services, and lineman, Wayne Minor, knew these problems firsthand. But, since they installed their first section of Quantum Reach back in 1984, they have been smiling from ear to ear. That's because QR cured their cable failure problems. They've seen how QR's unique design makes it lightweight and easy to handle yet strong enough to outperform any other cable. "Nothing works like Quantum Reach," they say with good reason.

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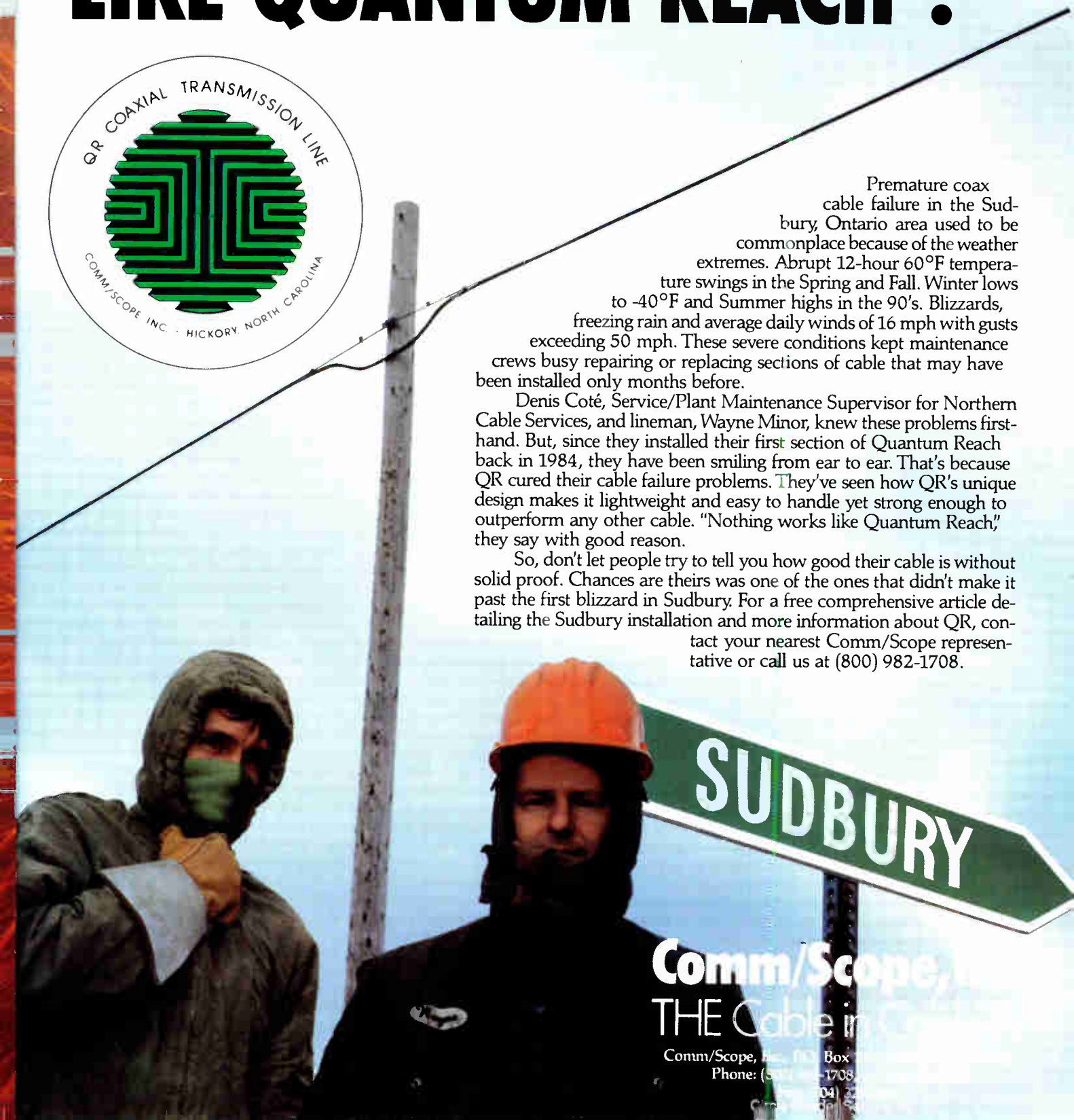

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equipment in most cases, except for color testing," Pike said.

In the same session, the FCC's John Wong said that the Commission is shutting down aeronautical frequencies at an average of one cable system every two months because of excessive signal leakage, and emphasized that "enforcement is still strong." Generally, during an FCC ride-out, staffers will evaluate a portion of the cable plant (usually five to 10 miles) to look at leakage conditions and "the general state of the cable plant." If any major problems are found, Commission employees huddle with the cable engineer in charge to determine whether or not the channels should be immediately shut down.

• Yes, compression looks cost-effective in the beginning, but over the long run the high cost of subscriber terminals may make compression an expensive endeavor, according to Colin Horton of C-Cor Electronics, who spoke at a technical session at the Show. Hortin's platform is that extended bandwidth and digital compression are "complementary" technologies, just as fiber deployment has supplemented coax and FTF designs haven't replaced the traditional backbone architecture.

"What I see is a co-existence of com-

Digital TV

The coming decade will be characterized by fundamental changes in cable technology and business, according to Tom Elliot, VP of engineering at TCI. Those changes include high definition television, home storage, an era of increased competition and a move toward a transaction-based operation instead of a simple subscription service. Another key transition replaces analog modulation with digital signal delivery.

Speaking during the annual Raychem CATV Symposium in San Francisco, Elliot said research has shown digital signals to be more robust than was originally thought, but the cable industry is at a "huge risk" because of the large number of connectors and fittings that exist in a cable network.

For example, the cable industry collectively accounts for 32 million taps, 64 million tap fittings, 100 million aluminum cable connectors and 450 million F-connectors, according to Elliot. In addition, there are 1 million feeder amplifiers and another 500,000 active trunk amps connected to 1 million miles of aluminum cable.

"When you look at the number of mechanical interfaces, it's frightening," said Elliot. With the advent of digital transmission, every interface will have to be "functionally perfect" because of the traits of digital television signals.

Unlike analog signals, which degrade "softly" when connections become loose or corroded, digital signals fail catastrophically, Elliot said. As a result, consumers see a complete loss of picture or perhaps a frozen frame of an image for several seconds before the digital signal is recaptured and delivered. "These interruptions will be painful and extremely irritating," warned Elliot.

Indeed, the industry as a whole "spends too much money wrecking and rebuilding drops for reasons that are actually related to service and security," said Joe Lemaire, a Raychem business unit manager.

Lemaire provided details of a joint Raychem-Comm/Scope study of a non-addressable Midwestern cable system that was designed to determine how and why drop materials are used in day-to-day operations. It's been said that the cable industry as a whole purchases enough drop material to completely rewire every drop in the country every three years.

The reason for this seems to be largely based on the assumption that the drop system is an expendable commodity, said Lemaire. The study of this one system showed that at least 35 percent of the drop material used was for repeated installations. That is, drop systems were being replaced, perhaps unnecessarily, during disconnects, reconnects and other service changes. Also, it was found that the drop system is often replaced when trouble is reported simply because the technician suspects it could be the problem.

The study also discovered that the system was suffering higher than anticipated theft of service problems. While penetration was high—65 percent—Lemaire said it was unlikely to grow much higher because a majority of the remaining households were enjoying either free cable service or an unauthorized level of service.

The study determined that the weak point of the system was the tap port, which made it easy for homeowners to literally tap into the system without paying. CED

pression and extended bandwidth," Hortin, C-Cor's product manager for extended bandwidth and new products, said. "One-gigahertz technology is available and can be added to a system. But operators should allow for both technologies in their future plans."

Along the same lines, Regal Technologies president Steve Necessary said the deployment of 1-GHz passives is nothing more than "cheap insurance." To justify his argument, Necessary used an economic model showing the current premium for 1-GHz passives at $2 and a future upgrade cost of $17 (where the faceplate costs $7 and the labor costs $10).

"So the question is, would you spend $2 now to save $17 later?" Necessary asked in closing. "I contend it's a bargain."

• Watch for major changes in the orbital arc over the next year and a half, said HBO's John Vartanian (please see Spotlight, p.20). Of the Hughes fleet, Galaxy V will slide into its new parking place at 125 degrees on May 8, and will carry all the current Turner networks, HBO east, ESPN, USA east, Disney east and "some other services for SMATV and hotels." Galaxy IR, Hughes' other main bird, will launch in late 1993 to replace Galaxy I. It will reside at 133 degrees and will carry HBO, Cinemax, the Disney Channel and USA. Galaxy VI was launched as a backup in October 1990, at 99 degrees. And, Vartanian said, Galaxy III will reach its end of life in 1995. It's programming will be transferred to GE's C-3 and C-4 birds in 1993.

Of the GE fleet, satellite C-3 will be launched in December and will be operational at 131 degrees in the first quarter of next year. C-4 will be the first to go up, in October, and will also be operational at 135 degrees in the first quarter of 1993.

"What operators need to know is that between 131 degrees and 139 degrees, there will be five satellites. So it's getting pretty crowded up there," Vartanian noted.

New products

Messenger drop clamp

Sachs Communications has announced an improvement to its messenger drop clamp. In the new version of the SC02MFA clamp, coaxial cable is installed into the body of the clamp. This both preserves the cable's coaxial configuration and characteristic impedance, Sachs officials say. Also, a new slot design enables installation of the messenger cable from the side, which makes it easier to apply, officials submit. For more information, call (800) 929-7224.

Fiber optic equipment

Fiber optic power meter

Laser Precision Corp has a new, hand-held optical power meter, dubbed LP-5150. The new meter tests both multimode and singlemode fibers at 780 nm, 850 nm, 1300 nm and 1550 nm wavelengths. Its three-button op-

Laser Precision's LP-5150

eration facilitates applications including FDDI testing, cable acceptance testing, splicing, connectorization and end-to-end testing of installed links. Officials say the unit is accurate to within ±0.3 dB and has a measurement range of -65 dBm to +5 dBm. Other features include 20 hours of continuous operation on rechargeable batteries (AC power also included), a backlit display, an automatic-off battery save and a universal connector optical interface that accepts adaptors for all multimode and single-mode connector types. For more information, call Laser Precision at (315) 797-4449 or fax inquiries to (315) 798-4038.

Splice closure bracket

New from **Siecor Corp.** is an aerial mount bracket to assist in the installation of fiber optic splice closures on aerial messenger cable. The bracket is designed for use with Siecor's SCN series splice closures. Because of an offset design of the bracket, other cables can pass between the Siecor closure and the messenger cable without interference. The bracket is constructed of non-corrosive galvanized steel. For more information, call Siecor at (704) 327-5000.

Also new from **Siecor** is its OptiTest portable loss test set for singlemode fiber systems. The unit performs attenuation testing of mechanical or fusion splices or passive optical components without access to fiber end faces. OptiTest uses a bi-directional transmission and receiving system to measure component loss within a fiber system. Light is launched on both sides of the splice to be measured by clipping on to the fiber. The signal crosses through the splice and is detected on the other side. A receiver provides power ratio measurements on each side of the object. For more information, call Siecor at (704) 327-5000.

Broadband photodiode receiver

Ortel Corp. has unveiled its 2609B broadband photodiode receiver for European CATV applications. The unit uses a unique broadband RF impedance matching circuit to maximize delivered power and achieve 5 dB higher RF gain than an unmatched photodiode, officials say. Features of the 2609B photodiode include a 14-pin DIP package, compatibility with 75-ohm CATV amplifier, 1300 nm singlemode pigtail and greater than 0.9 mA/mW responsivity. For more information, call Ortel at (818) 281-3636.

AT&T acquires Sumitomo technology

AT&T Network Cable Systems has reached an agreement with **Sumitomo Electric Industries** whereby Sumitomo will transfer its vapor-phase axial deposition (VAD) technology to AT&T. The VAP technology is used in manufacturing glass preforms for optical fibers. AT&T says it is acquiring the technology to complement its present manufacturing process for optical fiber. Next, the company plans to construct a new VAD production area in its manufacturing plant in Norcross, Ga. The new facility will enable AT&T to manufacture an additional several hundred thousand kilometers of optical fiber per year.

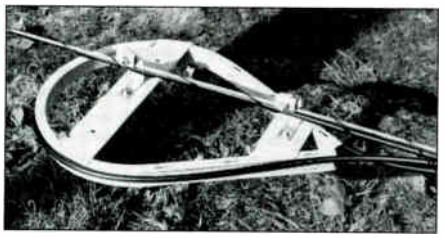
Corning couplers reduce costs

Corning reports saving ATC's Capital Cablevision "more than $400,000" in a cable newbuild of 800 miles of plant in the Albany, N.Y. area. They did this,

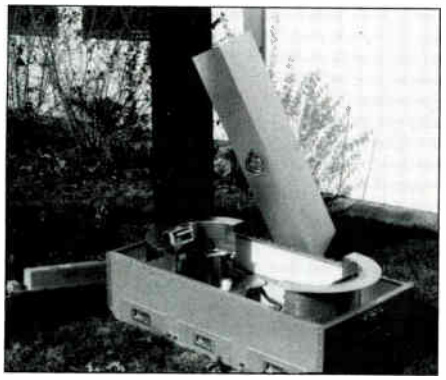
they say, by allowing the shared use of opto-electronics and by eliminating the need for construction of a new headend.

The original design for the build included three nodes, each with a laser transmitter/receiver combination, and extended coaxial RF cascades. The design was later changed to a 17-node fiber-trunk-feeder architecture, with coax RF cascades limited to four amplifiers. By using 13 of Corning's directional fiber optic couplers in the revised design, the number of required lasers remained at three, instead of increasing to 17. That saved ATC around $155,000, says ATC system engineer William Kosek. The other $245,000 in savings came from not having to build another headend and from being able to place the couplers throughout the plant, instead of in a single location.

Slack rack, trunk enclosure



Moore's optical Cable Slack rack



Moore's optical trunk enclosure

Moore Diversified Products has debuted its optical cable slack rack, designed to be used when storing loops of optical cable on strand. The racks protect the fiber by ensuring that the cable is not bent beyond the minimum recommended bend radius. Each rack accommodates up to three wraps of cable. If more than three wraps are needed, guide tabs facilitate stacking of the racks.

Also new from Moore is an optical trunk enclosure designed to contain, protect and organize the tools, equipment and materials needed to perform an emergency fiber optic splice. The trunk includes three lockable drawers and a removable tray for storing fiber and splice enclosures. The tray can be pole- or strand-mounted. The trunk lid serves as a large and sturdy work table, and is detachable with retractable legs.

IFR acquires Photon Kinetics

Photon Kinetics has signed an agreement in which IFR Systems of Wichita, Kan. will acquire 100 percent of the outstanding stock of the privately-held Photon Kinetics. In exchange, Photon Kinetics will give IFR a combination of cash and registered convertible notes.

Optical power meter

Tektronix has taken the wraps off its new FiberChamp handheld optical power meter, designed to measure the optical power in fiber installation, troubleshooting, restoration and R&D. The FiberChamp weighs in at less than a

Alan Gerry, left, reminisces with Hal Krisbergh.

People in the news

Alan Gerry, founder, chairman and CEO of **Cablevision Industries**, was recently honored by **Jerrold Communications** for his "unstinting devotion to the cable television industry." Jerrold president **Hal Krisbergh** presented a plaque to Gerry during the ceremonies recognizing the founder's accomplishments.

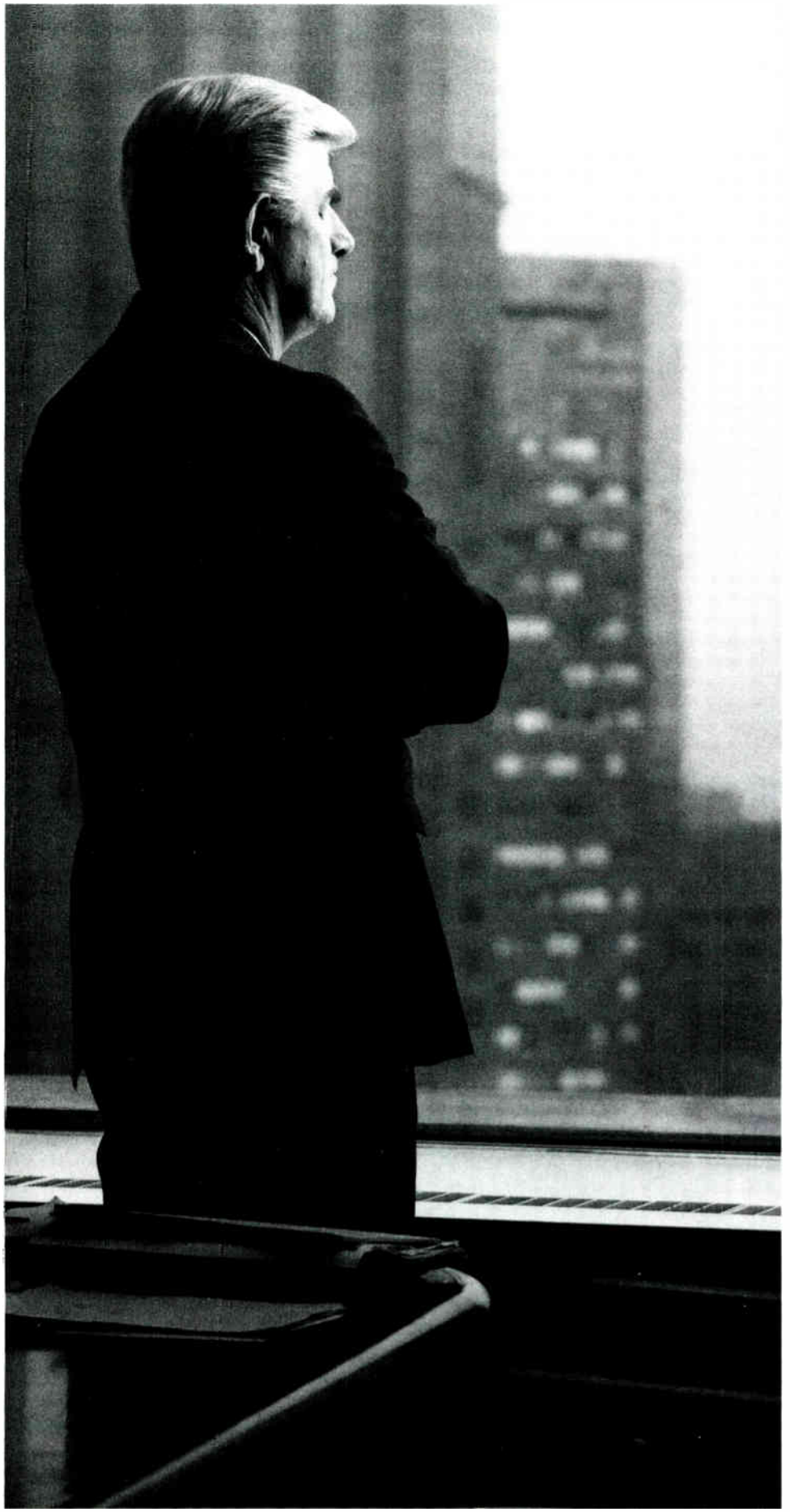
Krisbergh pointed out that Gerry's initial purpose—to bring cable signals to rural areas northwest of New York City—quickly mushroomed to the point where Cablevision Industries now serves more than a million subscribers in 18 states and urban areas. "Alan Gerry has never been content to sit back and offer just ordinary cable service," Krisbergh said, "And because of that, I consider Cablevision Industries subscribers to be among the luckiest in the world. They get things first."

Richard A. Mueller has been promoted to VP of engineering for **Cox Cable Communications**. Most recently, he was director of operations engineering for the company.

Mueller joined Cox in 1979 as plant manager of the company's Santa Barbara, Calif. system. After transferring to Atlanta, he progressed through a series of corporate engineering positions, including responsibilities for the technical assessment and proposal preparation for Cox franchising activities, the development of technical and construction plans for newly acquired Cox franchises and the development and implementation of plans to rebuild and upgrade existing Cox Cable systems.

Also, **Cox** has promoted **Paul R. Workman** to director of technical services for the company. Workman was most recently responsible for the development and deployment of a company-wide technical training program designed for each level of field technical personnel.

Hamid Heidary has been promoted to VP-engineering for **C-Cor Electronics**. In his new role, Heidary will be responsible for C-Cor's world-wide R&D efforts as well as product development, product support, mechanical design and documentation. Prior to his promotion, Heidary was director of engineering for the company. **CED**



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Tektronix's FiberChamp

pound and features a large, backlit LCD display and calibration to 780 nm, 820 nm, 850 nm, 1060 nm, 1300 nm, 1310 nm and 1550 nm wavelengths. The unit can make measurements in either a logarithmic scale (dBm) or a linear scale (watts) on either single or multimode fiber. The measurements are unaffected by ambient light, officials say. For more information, call Tek at (800) 833-9200.

ONI lands order, shows new product

Optical Networks International landed a $1 million fiber order from TCI for TCI's State College, Pa. system. In the deal, TCI will use approximately 70 miles of AT&T's LXE fiber cable, 21 Laser Link II transmitters and 28 receivers to reduce its current 47-amplifier cascade to approximately 15 amplifiers in cascade. The 400-MHz system is relying on optical technology to reduce S/N problems associated with second- and third-order beats.

Also, ONI has announced availability of a new fiber optic splice enclosure manufactured by Reliable Electric. Designed for most fiber optic node sites, the OPFO-TV8 houses both a splice closure and a fiber optic receiver. The closure has 360 degree access and will house three fiber pigtails of up to 50 feet each. ONI says an important feature of the closure is its divider/mounting plate which separates the interior into two separate compartments: one for coax and one for the optical fiber and receiver node. Both compartments can be locked separately to prevent tampering. The closure was designed aesthetically because "community leaders are demanding less visibility of cable TV equipment." For more information on ONI products, call (800) 342-3763 or fax inquiries to (303) 694-0127.

Low loss amplitude modulator

Ramar Corp. has introduced a low loss, high bandwidth lithium niobate amplitude modulator, designed specifically for advanced cable TV applications.

The fiber-to-fiber insertion loss, officials say, has been reduced to 3.5 dB maximum for both 1300 nm and 1550 nm, while the bandwidth has been extended to 1.0 GHz. Gain ripple remains at ±0.5 dB, and the deviation from linear phase remains at ±2 degrees, officials say. The modulators have dual outputs, which allows two CATV systems to operate while using a single transmitter. For more information, call Ramar officials at (508) 392-0952 or fax inquiries to (508) 392-9455.

Deals

Midwest inks new deals

Several announcements have been made by **Midwest CATV**. First, the company has signed an agreement with Scientific-Atlanta in which Midwest will inventory and sell S-A's full line of headend equipment.

A similar agreement has been made between Midwest and Arcom Labs, wherein Midwest will stock and sell Arcom's complete line of traps, including Arcom's guassian filter.

Finally, Midwest has announced a new drop material program in conjunction with Sachs Communications. In the deal, called the "budget drop system," operators will be able to purchase a "specifically priced" system of drop products from the tap to the home. The package will "meet the cost conscious concerns of our industry," Midwest officials said.

Contec gets shot in the arm

Contec International (formerly Brad PTS) has announced increased financial commitments from Westinghouse Credit Corp. Neither party would disclose the dollar amount of the financing arrangement.

Tektronix appoints Spectrum CATV

Tektronix has signed an agreement with **Spectrum CATV** of Bedford, Texas to market Tek's current and future CATV product line to customers in Arkansas, Oklahoma and Texas. Spectrum joins Pennsylvania-based Jerry Conn Associates, which sells Tek's products in the Mid-Atlantic and southeastern U.S. CED

Compiled by Leslie Ellis

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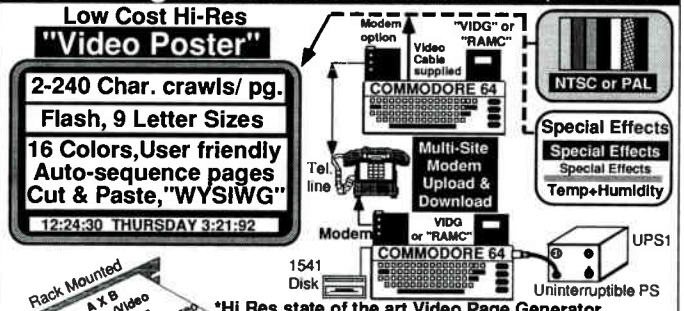

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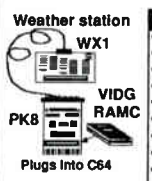

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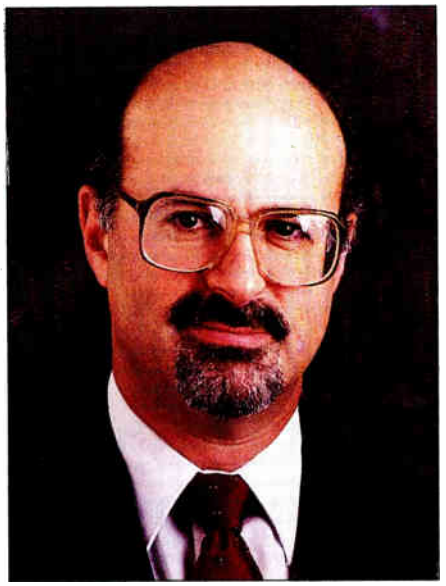


HDTV decision & implementation schedule

Now that half of the six HDTV formats have been tested, and the test plan finally seems to have stabilized, the projected decision and implementation dates are becoming a little clearer. The bottom line is that a June 1993 FCC decision on a standard is agressive but still possible, and HDTV broadcasting could start about three and a half to four years later. I'm betting on June 1997 for the start of HDTV broadcasting.

Schedule for a decision

Up until recently, the "official" schedule called for the FCC's Advisory Committee on Advanced Television Service to review the test results for the six HDTV formats, and to make a recommendation by the end of September 1992. The Advisory Committee would most likely recommend one of the six formats to be the winning U.S. standard for HDTV broadcasting in the U.S. (There is always the possibility that the Advisory Committee could recommend that none of the six be chosen, or that several are equally acceptable, but everyone hopes that won't happen.)

However, September 1992 is no longer feasible, for the following reasons. First, because four of the six proponent systems are now digital, the test plans had to be extended to test additional features. New tests had to be designed, and incorporated into the computer software at the Advanced Television Test Center in Alexandria, Va.

Second, there have been a number of minor delays attributable to breakdowns in the test equipment. In retrospect, this is understandable, because some of the test equipment is prototype equipment in much the same way the proponents' HDTV encoders and decoders are prototypes. But these delays were not anticipated in the schedule.

Third, there is now a recognition that the test data must be compiled and analyzed and reduced to a format that is understandable. Then it must be reviewed by several working parties of the Advisory Committee, including one looking at picture quality and robustness criteria and another looking at interference and signal coverage.

So instead of the testing of the sixth system ending in July 1992, it is now planned to end in September. The working parties will analyze the data in October and November. Another panel will convene, probably in late December or early January 1993, to compare the test results of the six proponents and prepare a preliminary recommendation.

This means that the Advisory Committee can't meet to decide on its recommendation until sometime in January 1993.

At this point, the FCC would most likely release the Advisory Committee's report and ask for public comment. The FCC may at the same time issue a channel allottment plan, which lists the TV channels in each city that can be used for HDTV, and a channel assignment plan, which is a matchup between each broadcaster and the new HDTV channel he will get.

If this FCC rulemaking process starts in the spring of 1993, it could possibly end with an FCC decision on a standard as early as June 1993, but based on what I know about FCC processes, December 1993 seems more likely to me.

Schedule for implementation

Once the FCC makes a selection of a new HDTV standard, there are several factors that will affect implementation. The word "implementation" here means that HDTV receivers will be available for sale to consumers, and HDTV transmission equipment will be available for installation by broadcasters. (What about cable operators, you ask? More about that later.)

Another working party within the Advisory Committee has been evaluating how long it will take receiver and transmitter manufacturers to design new HDTV equipment and get it on the market. The conclusion of this working party is that both receiver manufacturers and transmitter manufacturers will need about three and a half years to design these products and get them to market. The working party believes that manufacturers will need the full technical details of the winning standard, and it assumes the winner will make this available at the time the FCC makes its final decision on a winner.

Based on these assumptions, the equipment would become available, both to broadcasters and to consumers, during the first half of 1997. So a pretty good guess for the start of HDTV broadcasting might be June 1997.

What about cable TV?

Now, let's look at cable TV implementation. Unlike a broadcaster, a cable operator doesn't need a new transmitter or antenna. Tests by CableLabs seem to indicate that at least some cable systems will not need major modification to carry HDTV signals. So why wait for the broadcasters? If Home Box Office or Showtime decides to start carrying HDTV programming (using, perhaps, motion pictures that have been scan-converted to HD video format), cable can get a head start.

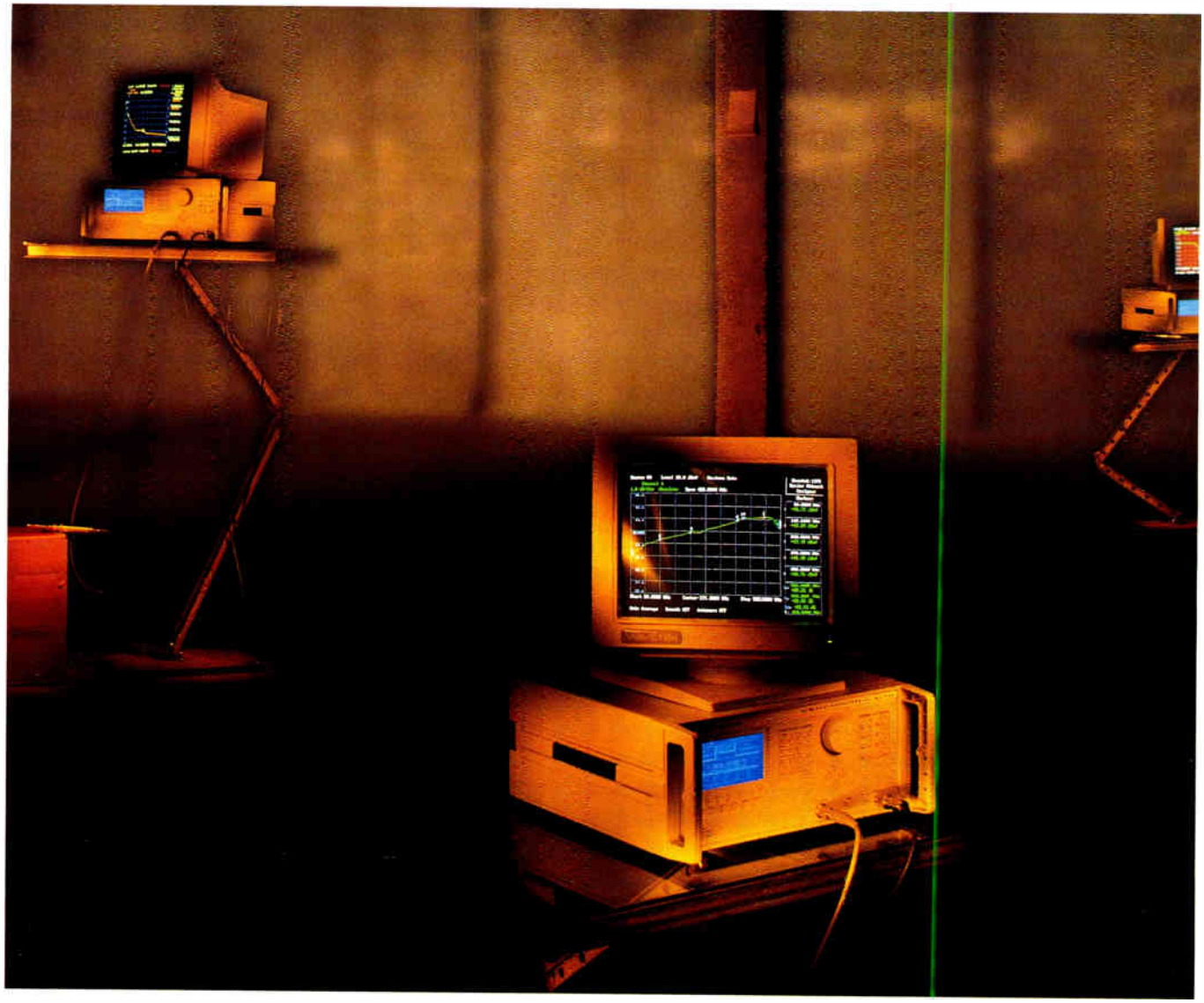
But who is going to watch it? The bottleneck here is the unavailability of receivers. Even though cable programmers and operators could start HDTV delivery earlier than broadcasters, this doesn't make economic sense if there are no home viewers.

In spite of this, the cable industry still has a potential advantage over broadcasters in the delivery of HDTV, once receivers do become available. Motion picture programming could be available quickly, and cable operators may not need to make major system changes.

Conclusion

No, you won't get to see HDTV in U.S. homes before 1997. But that's only five years from now. How accurate is this projection? It's about as accurate as any other projection you see in telecommunications trade publications. But it does seem more plausible to me than some others I've heard. CED

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



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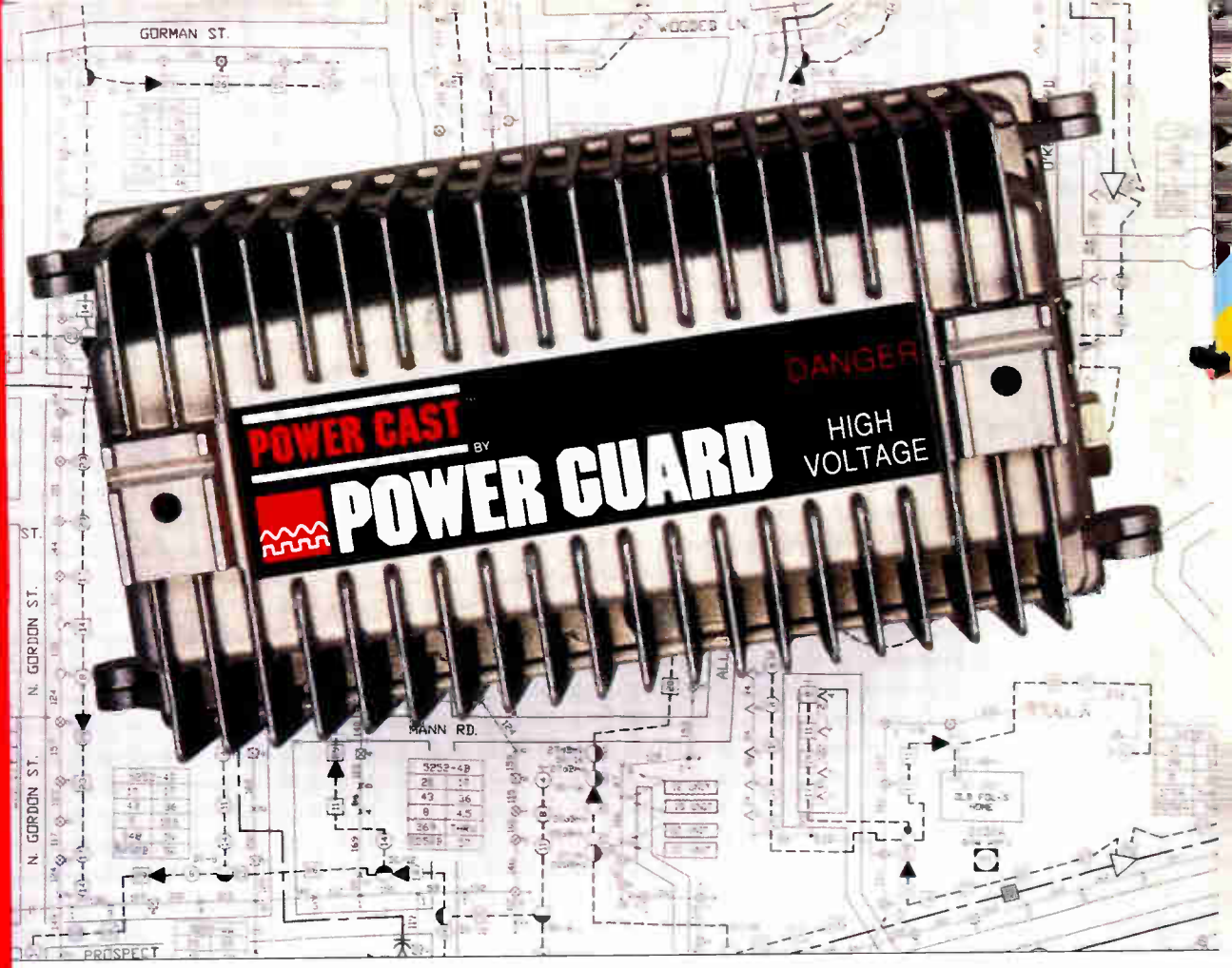

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