COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

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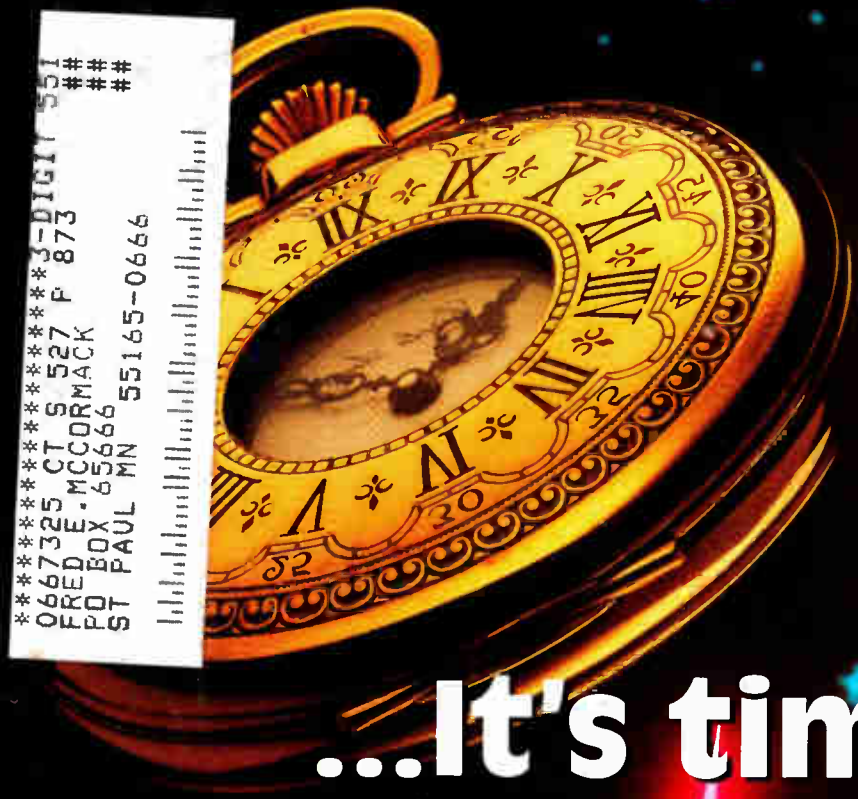

...It's time to act

November 1993

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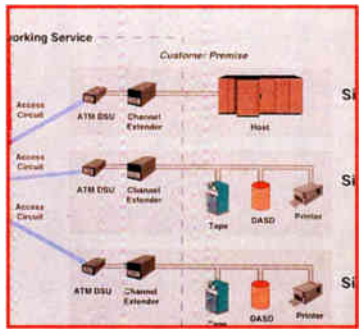

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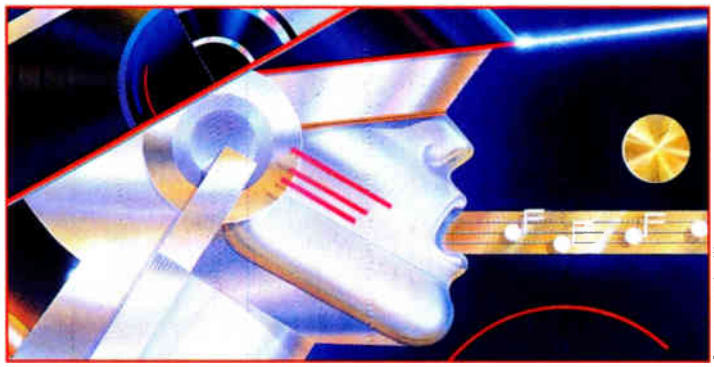

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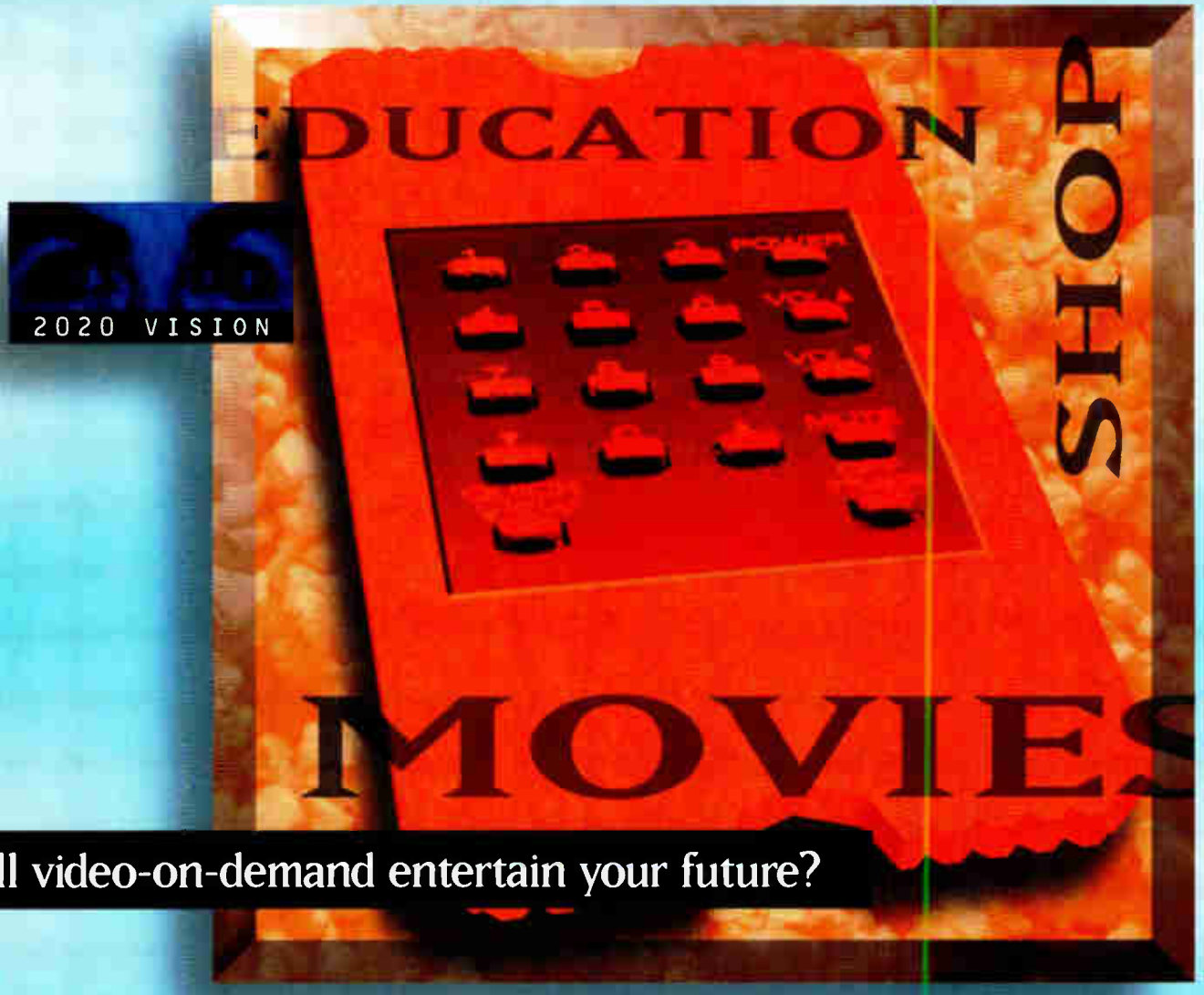

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Call for a standard

A few years ago, Roy Ehman and I had an interesting chat about measuring RF field strength. Because of the numerous variables one encounters when attempting to measure field strength — particularly signal leakage — Roy felt that it would be extremely difficult to get a result accurate within several dB. This isn't a problem unique to cable, either. Roy and I are both ham operators and we've seen similar problems in the amateur radio community. (Have you ever tried to measure the gain or radiation pattern of an antenna?)

This was further confirmed in a study performed by United Artists (now part of TCI). It attempted to quantify leakage around the circumference of the strand. From an end-on view, the leakage pattern looked a lot like a fried egg. The pattern was found to be easily affected by other conductors on the pole, nearby buildings and even the ground. The study suggested to me that just because a system passes a ground-based measurement doesn't mean it will automatically pass a flyover, and vise-versa. A low-level leak beneath the cable may well be much stronger above the cable. I have long been an advocate of doing both ground-based and flyover measurements!

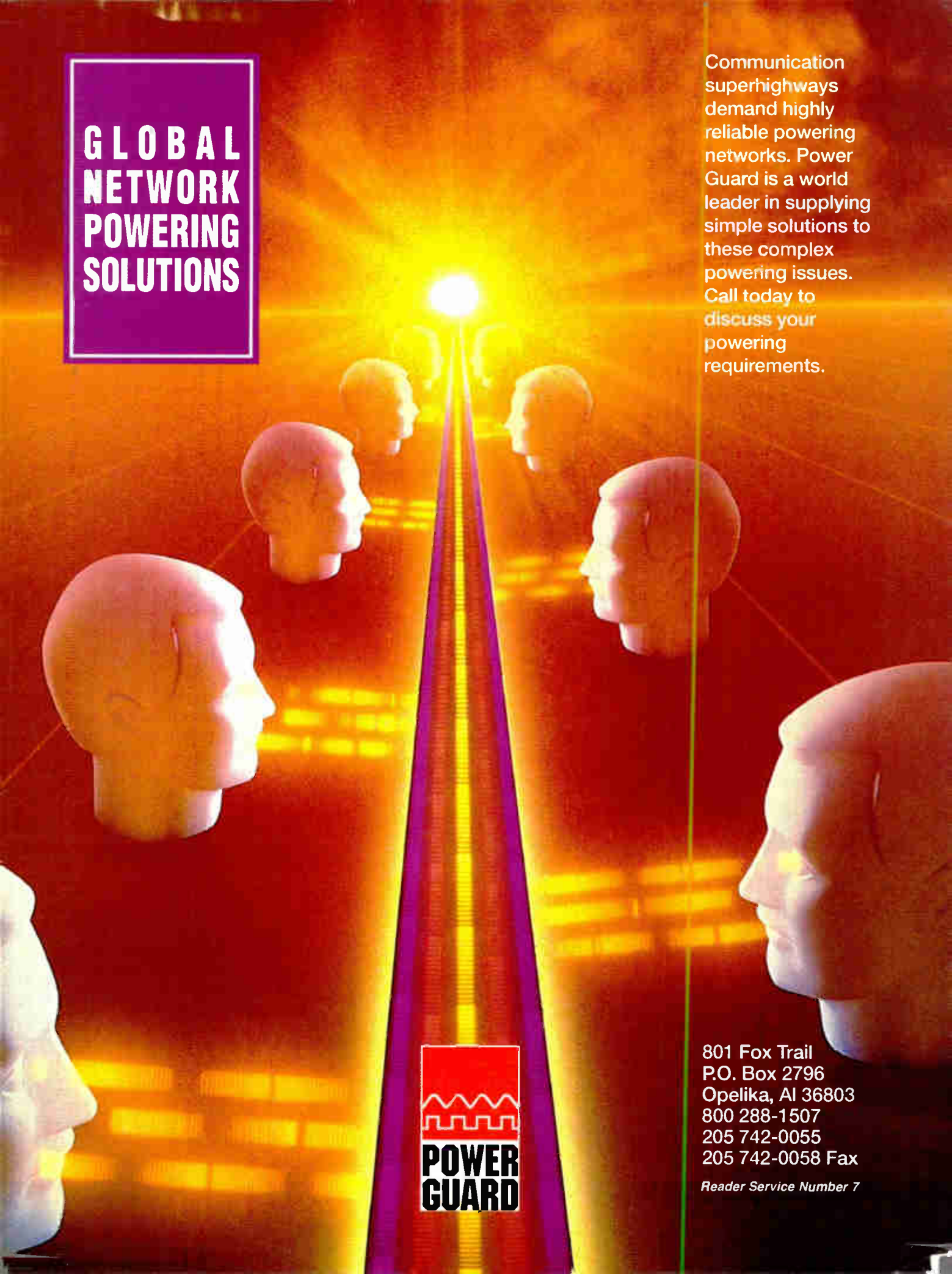
I remember one time when a West Coast cable system had a flyover performed and it indicated leakage over the ocean where there was obviously no cable. This wasn't the fault of the flyover procedure, but rather indicated that leaks don't always go straight up.

Most recently, a large MSO conducted a comprehensive flyover evaluation, where five major flyover companies each were asked to conduct airborne measurements of a calibrated leak on the ground. Not surprisingly, the five companies got five different answers. What was a surprise, though, was the fact that there was an 11 dB spread among the results!

An unmodulated 109.825 MHz RF carrier was fed into a reference crossed dipole located above a ground plane and each of the companies proceeded to perform flyover measurements at 1,500 feet. The results varied from 1.34 dB above the predicted field strength at the measurement altitude to 9.79 dB below it. The discrepancies were attributed primarily to variations in measurement techniques. Some companies are set up for modulated carriers instead of CW carriers and some have their equipment optimized for a different part of the aeronautical spectrum, etc. There also appeared to be a radiation pattern problem with the "reference" ground-based antenna, as well as questions about its gain. (When the MSO contacted the manufacturer, they were given three different gain specs.)

As difficult as accurate field strength measurements are, I think it's time for the industry to establish voluntary standards and recommended practices for both ground-based and flyover measurements. They should include procedures for establishing reference leaks for vehicle equipment calibration, as well as procedures and antenna configurations for flyover calibration and measurement. Any takers?

Ronald J. Hranac
Senior Technical Editor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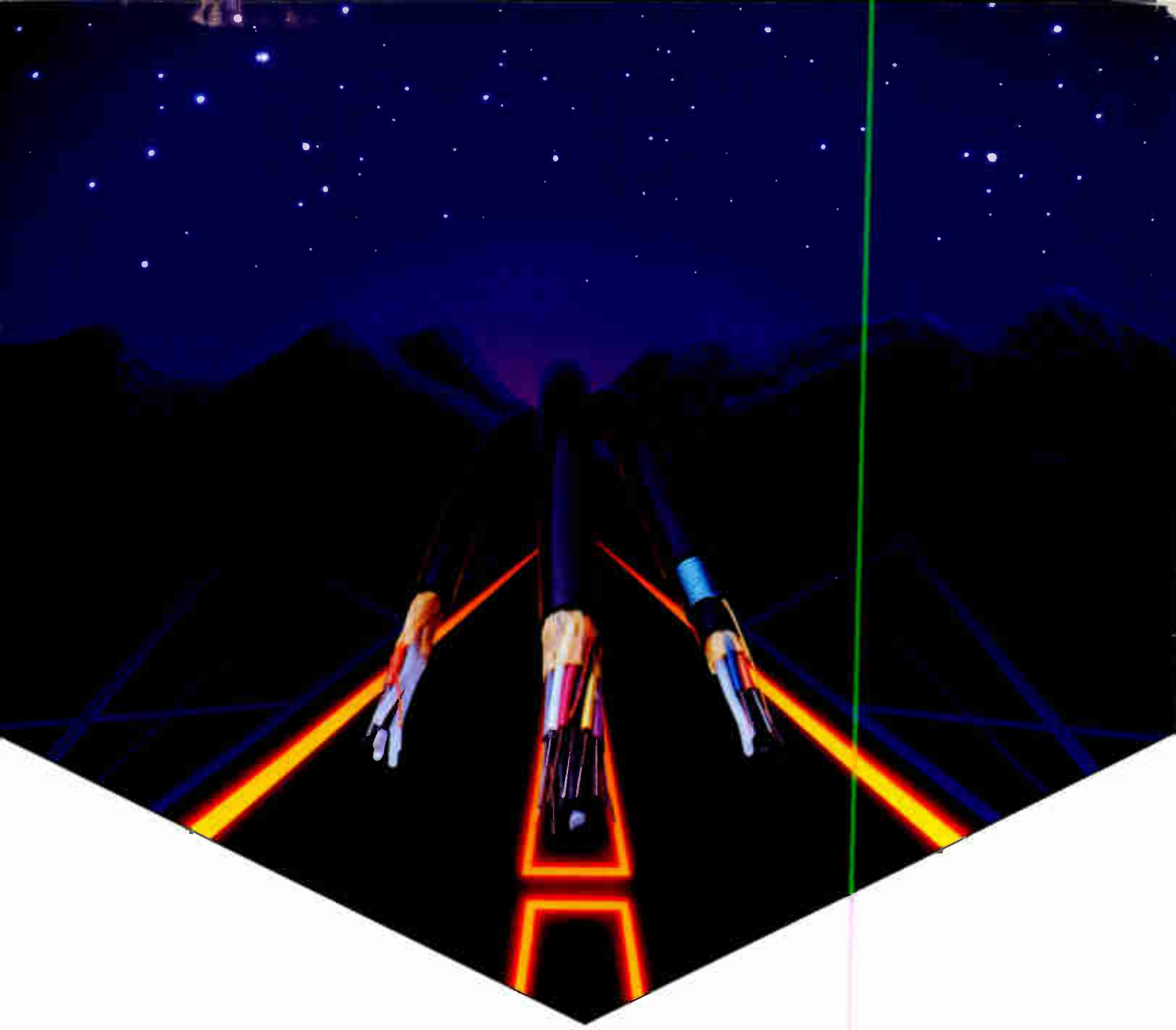

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Tele-Communications Inc. and Bell Atlantic Corp. announced the biggest merger in history, a $33 billion deal that, more than ever, signals the marriage of the cable and telco industries, and paves the way toward the 500-channel information superhighway.

The deal is expected to close late next year, subject to approval by the Federal Communications Commission and regulatory scrutiny of the Justice Department. The deal is to be completed in two stages, the first of which would be worth about $21.4 billion, including assumed debt. In the second stage, Bell Atlantic will purchase programming and other regulated TCI assets.

TCI shareholders will hold approximately one-third of the shares of the merged company, though no single TCI shareholder will own more than 2%.

Bell Atlantic estimated the merger will dilute its earnings per share by 30% to 35% in the first year. It expects earnings per share to grow well over 10% a year in the first five years after completion of the deal, and revenue to build to about 10% a year.

TCI will hold five of the 15 seats on Bell Atlantic's board of directors and TCI President John Malone will preside as vice chairman and a director of the new company. Malone's duties have yet to be announced, but he is expected to play a prominent role in the company's programming and technology developments.

H-P makes interactive plans

Santa Cruz, CA — At the recent Hewlett-Packard test and measurement seminar held here, there was a lot of hype about the company's line of test products. There ought to be. After all, H-P is a key supplier of test equipment to nearly a dozen industries ranging from aerospace to manufacturing and cable TV. But what was new and truly interesting was the announcement that the company is planning to hop into the interactive entertainment industry in a big way.

And it's not just test equipment. The company is talking about video servers, set-top boxes and other video accessories. Laurie Frick, marketing director for the interactive TV appliances division, expects that the company will be earning over a billion dollars from interactive TV by the year 2000.

H-P's set-top box division has been in existence for a year and a half, and has created a prototype (in look at least) of the future set-top box. Frick said H-P has talked to every telephone company and the top 20 MSOs in order to prepare for this opportunity.

But selling these services to the consumer will be a battle fraught with obstacles, explains Frick. For starters, consumers are concerned with privacy. They don't want their name, address, viewing and shopping habits broadcast to the universe of potential marketers. And they are more concerned that their credit card numbers will fall prey to hackers as they drift across these networks. Consumers want security that this type of information will remain private.

Another consumer fear, according to company research, is that after a month of heavy playing on the TV set, they will receive a bill for $1,000. Consumers want to be able to set a limit on how much they spend, perhaps a cutoff after a certain dollar amount.

Price also is an issue. Frick said the next generation of fancy set-top boxes will have to cost less than $300.

Of course, people fear the next generation of television will turn kids into couch potatoes. Who will want to play outside when they have access to terabytes of the hottest video games in their living room? However, Frick believes the advent of interactive video will enable kids to use television

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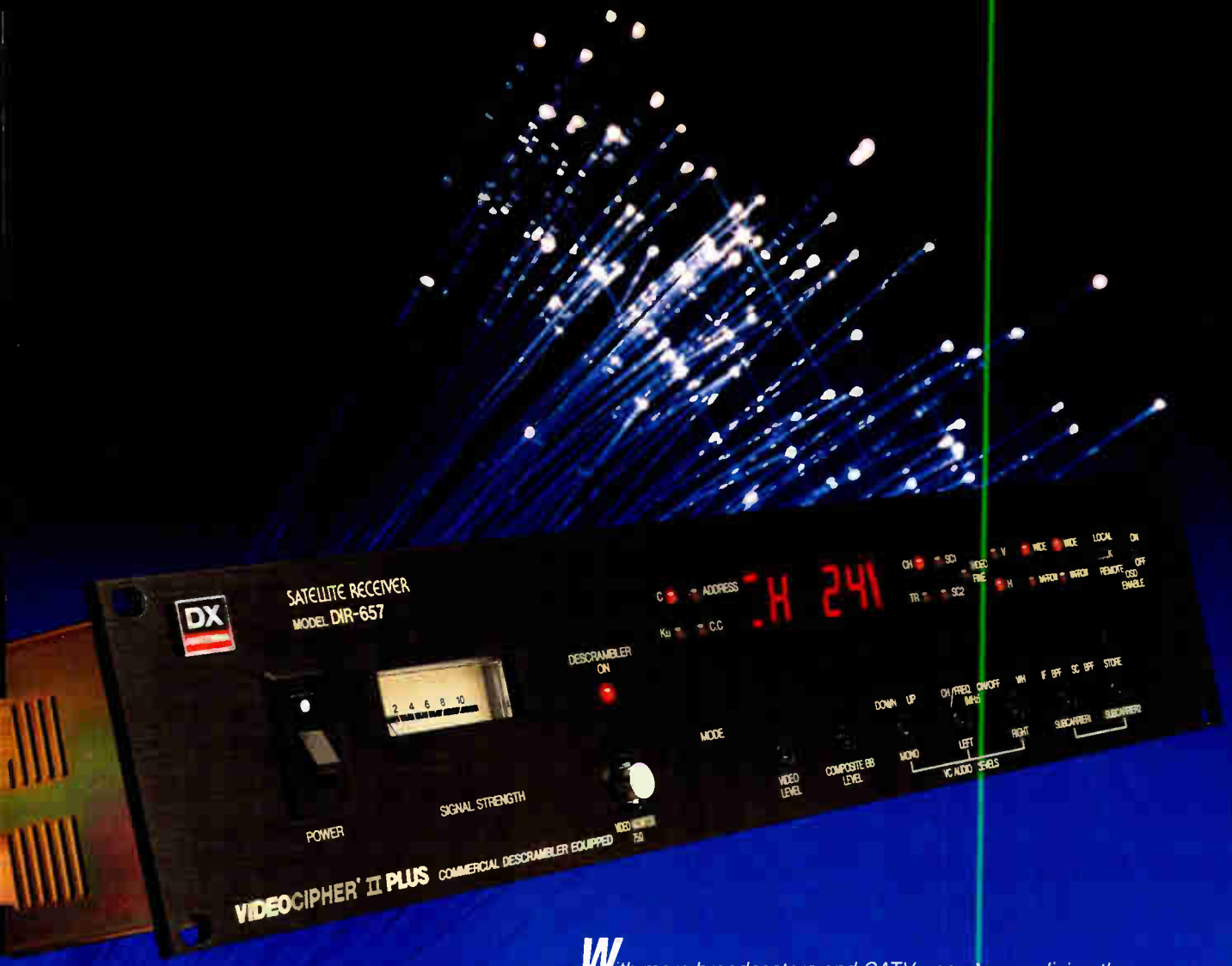

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Call for papers: Cable-Tec Expo '94

The SCTE is soliciting proposals for technical papers and/or workshops to be presented at Cable-Tec Expo '94, June 15-18, 1994, in St. Louis. Technical papers accepted will be presented at the Society's 18th Annual Engineering Conference. Workshops should accommodate hands-on sessions to provide in-depth instruction on technical procedures used in everyday practice. Submissions, which should include a brief abstract of the paper or workshop, should be sent to: Bill Riker, SCTE, 669 Exton Commons, Exton, PA 19341, no later than Nov. 22. For more information, contact SCTE at (215) 363-6888 or FAX (215) 363-5898.

Emerging Technologies set for Jan. 4-6

The Program Subcommittee for the Society of Cable Television Engineers' 1994 Conference on Emerging Technologies is currently finalizing the papers to be presented at its upcoming seminar. The program will include:

- **Tuesday, Jan. 4**
  Pre-conference tutorials
  Tours of local manufacturing facilities
- **Wednesday, Jan. 5**
  "Digital compression and transmission techniques"
  "Advances in fiber-optic technology"
- **Thursday, Jan. 6**
  "Networks of the future"
  "Advances in semiconductor technology"
  "Wrap-up panel: Economic considerations"

The conference will be held at The Pointe Hilton Resort on South Mountain in Phoenix, AZ. This is an all-suite resort with a sports club, 10 tennis courts, horseback riding stables and an 18-hole golf course on the property. Suite rates for the conference are $130 per night for single or double occupancy. For reservations, call (800) 876-4683.

SCTE member registration for the entire program will be $225. Conference registration packages will be mailed to all members by Nov. 1. Nonmembers should contact SCTE at (215) 363-6888 to request a package.

SCTE sets seminar calendar

The SCTE has determined the dates for its Technology for Technicians II and OSHA/Safety seminars for 1994.

Technology for Technicians (TFT) seminars, held over a three-day period, are advanced technical programs covering broadband test equipment and its usage. Offered especially for maintenance technicians, chief technicians and system engineers, the program includes a hands-on lab for spectrum analysis, signal leakage tests and measurements and system signal level meters. Subjects covered in the sessions are: mathematics and measurement, amplifier systems, powering, coaxial cable, common cable system faults, system operation and maintenance concepts, and cumulative leakage index (CLI) tests and mea-

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surements. The registration fee, which includes all materials (technical manual, scientific calculator and note pad), is $195 for SCTE members and $235 for nonmembers (includes SCTE membership). Seating for this seminar is limited to 40 attendees.

OSHA/Safety seminars are one-day presentations designed especially for system managers and safety coordinators. The programs offer a comprehensive look at safety, including guidelines for designating a system safety coordinator, OSHA resources and compliance factors, the HAZCOM program, and the application of items specific to cable TV. The registration fee, including the safety manual, is $145 for SCTE members and $195 for nonmembers (includes SCTE membership). Seating for the OSHA program is limited to 50 attendees.

The schedule of months and locations for 1994 is as follows: January — Orlando, FL; February — Anaheim, CA; March — Minneapolis; April — Cherry Hill, NJ; May — Columbus, OH; July— Springfield, MA; August — Chicago; September — Seattle; October — Columbia, SC; November — Nashville, TN; December — Albuquerque, NM.

Western Show tech sessions

The Society will sponsor several technical sessions during the Western Cable Show in December in Anaheim, CA. These sessions will be:

• **Dec. 1**

1-2:15 p.m.: "FCC/Washington update" — This panel will discuss current activities in Washington regarding technical reregulation and consumer equipment compatibility as well as other legislation impacting the cable TV industry.

2:30-3:45 p.m.: "Proof-of-performance — A report card (one year later)" — Discussion will focus on efforts from the operators' side to implement procedures and reporting structures, the role regulators play in the examination of results and the effects on subscribers in terms of quality improvements. In addition, the FCC will comment on the feedback and effect the rules have had on complaints or customer service and their impact on further legislation or technical standards.

• **Dec. 2**

10:15 -11:30 a.m.: "Multimedia/interactive services and applications" — The widespread introduction of interactive services is just around the corner. The first batch of these are likely to be interactive versions of existing program services. Specifically, there will be interactive versions of conventional TV programs, video and computer games, and on-line computer services.

1:45-3 p.m.: "Intelligent converters vs. intelligent networks" — This panel will discuss switched-cellular broadband digital networks, advanced multimedia interactive home terminals, video servers and intelligent decompression set-top converters.

3:15-4:30 p.m.: "Fiber architecture in an interactive world" — This panel will discuss intelligent fiber-optic architectures, node sizes and two-way interactive-ready fiber systems.

• **Dec. 3**

9-11 a.m.: "BCT/E and installer certification testing" — Exams in the Broadband Communications Technician/Engineer (BCT/E) Certification Program will be conducted in all categories. Installer Certification Program written examinations also will be available.

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Artificial intelligence/ knowledge-based systems

The operational support powers of artificial intelligence/knowledge-based (AI/KB) systems may be coming soon to a cable system near you.

At a CableLabs-sponsored demonstration held at Time Warner's Columbus, OH, system in mid-August, an AI/KB system was used to answer a dozen of the kinds of questions that might ordinarily leave a customer service representative (CSR) telling a frustrated customer, "Gee, I don't know."

This is the power of AI/KB:

- The ability to pull together an expert's insights about some subject and make them easily accessible to someone less savvy.
- To evaluate raw data and draw conclusions not from pat rules (which computerists would call a "linear programming" model) but from inference and past examples (so-called "rules-based algorithms"). This is much as humans do.

In Columbus, AI/KB researchers from Ohio State University's Laboratory for Artificial Intelligence Research took experiential data provided by Time Warner and structured it into a knowledge-based system residing on an off-the-shelf notebook computer.

Uses expert-engine shells

A key piece of enabling technology, just now becoming available, is new generations of "expert-engine shells," which are software packages that provide a framework for holding the data about a specific field of knowledge.

In commissioning the Ohio State researchers, CableLabs specified the use of such shells, and said the entire package must be able to run on a standard office PC. A package called KBMS, by Trinzic Systems, provided the shell used in Columbus.

A KB system to expand the wisdom of CSRs was chosen for the demonstration both because the knowledge building blocks were readily available and because the value of such a system would be readily evident to cable executives, said Scott Bachman, CableLabs vice president, operations technologies projects.

Artificial intelligence/knowledge-based systems

Type I: Closed-form algorithm
Information needed to run the algorithm is available and time to solution is tractable.
Example: Routine computer sorting or "number crunching."

Type II: Less solvable
Single definite answer elusive, but human problem solvers solve such problems "well enough" using deliberation or recognition process
Example: Medical diagnosis, business planning.

Type III: Too large for human solution
Humans cannot accomplish due to complexity or data and heuristic rules.
Example: Develop daily routings for all of Delta's airplanes.

Source: CableLabs

For example, Bachman said such a system, if implemented, could contain a cache of wiring diagrams for attaching all major models of TV sets with major models of VCRs. CSRs could summon the diagrams up on their screen to help customers solve wiring problems immediately, making for happier customers and fewer truck rolls.

In fact, however, CableLabs has not yet selected the best targets for putting AI/KB to work in cable systems. That's one of the tasks of a CableLabs-formed Artificial Intelligence/Knowledge-Based Systems Advocacy Group that held its first meeting in September.

See the accompanying table for the different types of AI/KB systems.

Which application areas?

That meeting focused on the group gaining a common understanding of AI technology and terminology, and on identifying and characterizing the various potential cable applications for the technology.

The group also will analyze benefits vs. costs of AI/KB systems and (should the prognosis for AI/KB use look good) help CableLabs establish its work plan for getting the technology out into the hands of MSOs.

Bachman stressed that CableLabs is not funding any basic software development, it's just looking for ways to apply the recent outpouring of AI/KB software innovation to cable's operational problems.

Any system that is implemented will probably need regular updating by a skilled "knowledge engineer" whose role is to debrief system personnel for the necessary knowledge, then build that knowledge into the program, Bachman noted. A crucial choice will be whether to customize a knowledge-based system for an individual MSO's operations or to develop more generalized models that can be used industrywide.

In either case, Bachman said, implementing AI/KB will not require installing a new computer on anyone's desk. Rather, CableLabs would work with cable industry vendors to see that AI/KB functionality is added to operations support systems that are already part of a cable system.

Starting on time?

AI/KB, while much ballyhooed in the 1980s, has had fairly limited use in the corporate world, Bachman said. Why? Because the computers to support it were too expensive and the necessary software building blocks didn't yet exist.

Still, companies like IBM, American Express and Nippon Life have been pioneers in demonstrating its potential value, as have some regional telcos, Bachman said.

In all, Bachman thinks the time may be just about right for AI/KB. CableLabs' MSO-member board of directors agreed, putting the explorations into AI/KB on CableLabs' work plan for the first time this year. Besides CableLabs' effort, Rogers Cablesystems in Canada and Times Mirror are pursuing AI research work on their own.

The coming months should yield insights about how far the cable industry will run with AI/KB, and how fast. **CT**

system was cheaper. Whereas he believes he may have paid about $20,000 each for four lasers or $80,000, he only paid $70,000 for the laser amplifier system he bought from Synchronous.

In the field

Jones has plans to eventually deploy optical amplifiers in the field and in a regional hub network connecting headends. He is waiting for a field deployable unit that has a cooling mechanism built in. When it arrives, Jones believes he will not only cut costs but improve the reliability of his network.

Jones will design his network so that each amplifier is operating at saturation. This will enable the network to continue amplifying even if the power goes out. Each signal will only drop by 3 to 5 dB. This is because the optical amplifier is able to maintain continuity and can use the pumping energy from the previous amplifier in the powered-down amplifier.

The amplifier works by using a laser at one wavelength, typically 1,060 or 880 nm to energize the erbium-doped fiber, which emits energy in response to an incoming signal. When the energy from the pump laser is carried down the fiber, it can be used by the next amplifier to regenerate the signal. When Jones is designing the network, he not only considers the cost of the amplifier, but the fact that it does away with the need to build redundancy into the network.

In some ways, SEC was lucky. It decided to go with fiber after 1,550 nm technology became available to the cable TV industry. This enabled SEC to build a fiber network with a lower attenuation. But for those systems that have already invested in 1,310 nm equipment, fiber amplifiers are not yet an option. Some systems based on neodymium and praseodymium are beginning to show promise in the lab, but commercial deployment is still a ways off.

Jones said, "If I had made a big investment in 1,310, then I would be hoping that the optical amplifiers would become good at 1,310. That capability is very nice because you don't have to make the conversion from light to RF and RF back to light. You get distortion and then you need a receiver and a transmitter in the same housing. With optical amplifiers, the noise is so low and amplifiers are so linear that we see very little distortion at all.

"When the demand for super-high bandwidth to the home and office really explodes, amplifiers will become an enabling tool in making this happen."

Going the distance

For long distance fiber-optic connection, such as between headends, fiber-optic amplifiers are proving an attractive alternative to traditional electrical regenerators. For starters they have far fewer active components. For example, AT&T's SL2000 optical amplifier only has two integrated circuits, while the SL560 electrical regenerator has 22, plus eight electrical relays and a few other components. In fact about the only truly "active" components in AT&T's amplifier are two laser modules, used to do the pumping.

AT&T has begun deploying amplifiers in a few test beds, as well as in its underwater cable system that spans the globe. In XUNET, a test bed that spans this country, AT&T just installed 40 optical amplifiers in a 500-mile section between Madison, WI, Chicago and Urbana, IL. Subu Subramanian, the district manager for the National Information Infrastructure, said the purpose of the experiment was to determine the performance of optical amplifiers in the field, to assess their ability to multiplex wavelengths, and to determine if the optical amplifiers cause a wavelength change.

The reliability of the optical amplifiers was extraordinary, the network experienced errors of less than one part in 10^{-13}. Success also was experienced with multiplexing a 1,550 nm optically amplified signal with a 1,310 nm signal with no problems. Eventually optical amplifiers may be used to amplify tens or even hundreds of signals multiplexed onto the same fiber. But these signals would have to be closely spaced in wavelength. In this experiment, the 1,310 nm signal was regenerated independently of the 1,550 nm signal.

The experiment also demonstrated that it is possible to amplify an optical signal through different amplifiers without a change in wavelength.

In this experiment, the amplifiers were only spaced 25 miles apart and this was partly because the service huts were already in place and being used by the electrical regenerators. In new-builds, it should be possible to space them out two to three times that.

In the local plant

Although optical amplifiers are proving their worth over long distances and between headends, many doubt their widespread application in cable systems. Jerrold was at one time really excited about them. It had developed a system for the cable plant with BT&D three years ago. Bob Young, director of distribution of product marketing at Jerrold, said, "The problem we ran into was that people would not use it for the fiber backbone. It was good in a niche basis for replacing headends."

Jerrold believes the industry is moving away from a broadcast mode in which a single source of information can feed everything. Young said that the new trend is to build narrowcasting and video-on-demand (VOD) applications into the network. But this implies that each laser should be able to address fewer homes. Optical amplifiers, on the other hand, maximize the number of homes that can be addressed by a single laser.

Young said, "You have to limit the number of splits on each amplifier to have reason to go after narrowcasting. One of the tremendous selling points of optical amplifiers is that you can get a lot of splits, but that runs counter to narrowcasting. They are technically capable of doing it, but they do not have widespread applications. If all we saw was the continuation of broadcast we would have gone after it, but in a broader scale of multimedia, and VOD, the bulk of connection to specific nodes can not be done with optical amplifiers."

Bellcore (the telephone industry's version of CableLabs) is beginning to doubt the efficacy of optical amplifiers in the local loop as well. John Scirabba, a researcher at Bellcore, points out that one of the telco industry's hopes was that the laser power could be boosted enough so that it could be split several ways. But now that lasers with powers in the 10 to 15 mW range

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are emerging, this need is less apparent.

Edmund Smith, vice president of technology at Optel International who is working on a marketing report on fiber-optic amplifiers, believes that we ing to 1,550 networks, Smith believes that if a 1,310 nm amplifier does not come out in time, there may never be a market for it.

Wither semiconductor

Amoco is selling this 24 dBm laser for only $78,600. That's only $262 per mW of power. That compares quite favorably to a DFB laser, which may cost $1,000 per mW or more. Kevin Sweeney, a researcher at Amoco

Conditional access for compression

(Continued from page 19)

ponents should be much greater than the deferred service cost.

Functionality issues

As compared with most analog addressable systems, some of the primary issues affecting functionality for conditional access with digital compression are:

- The much larger numbers and variety of channels/program choices/tiers/program packages and other digital services to be controlled. Control of high-speed data services for personal computers also should be considered.
- Need for multiple operator/programmer control.
- Provision for interactive program requests.
- Requirements for high-speed authorization and deauthorization.
- Control of delivery of encryption keys.
- Logistics of using exchangeable security components such as smart cards. (Smart cards are certain to be an element of conditional access systems. But smart cards on their own are not the total answer to secure conditional access. Cards must be designed to be totally immune to outside probing. This is a requirement not to be taken lightly. Program code and data storage memories within smart cards should be encrypted and any attempt to discover the value of the keys used should result in erasure of the card's contents. Operational security requires a lock interaction between the smart card and the device into which it is connected. The card should be locked using an algorithm from the first unit into which it is plugged, causing the smart card to be unusable in any other unit.)

Compatibility issues

Bringing 500-plus cable channels into a subscriber's home introduces new challenges for the configuration of conditional access terminal equipment. When first introduced (projected to be in 1994), digitally compressed signals will be decompressed and restored to analog NTSC format for connection to existing TV receivers and recorders.

Configurations to achieve this will include set-top tuner/decompression boxes, point-of-entry devices and decompression devices at a node removed from the subscribers' premises.

Compatibility provisions of the Cable Act of 1992 constitute a serious challenge to the industry's use of analog addressability. Some of the unique characteristics of digitally compressed programming provide both a new set of potential problems, and also an opportunity (with careful planning) to try to "do things right." Rather than a set of suggested attributes, the following are some of the compatibility issues to be confronted:

- Availability of a large number of channels (perhaps greater than 500) is likely to lead to provision of programs at multiple time slots. The process for the subscriber to select a program/time slot is likely to be menu-driven and will not likely resemble channel selection as mostly used today. Universal remote control program selections will likely need to accommodate such new ways of perceiving digital program selection, and additionally, control TV sets and VCRs.
- Digitally delivered programming will be almost artifact-free (certainly free of cable system analog distortions such as cross-modulation, beats, etc.). Putting the digitally delivered image into a TV screen free from the noise and distortion inherent in TV tuners will be a challenge.
- Anticipation of digitally compressed program delivery is bound to affect consideration of solutions to the industry's present issues of compatibility in delivering analog signals. There is, for example, no digital equivalent of clear signal delivery with interdiction. Some form of set-top device is certain to be required for delivery of digitally compressed programming for many years.
- Compatibility with digitally compressed high definition TV (HDTV) programs also will be an issue, once a U.S. standard for HDTV is selected.

Evaluation methodology

Evaluation of proposed conditional access technologies should give first priority to security. If security is compromised early, it is difficult and expensive to patch it later. It is essential that a conditional access technology survive security challenges over the entire life of the technology (meaning longer than the expected service life of the subscriber terminal). It is important that security can be assured for as long as the compressed signal format remains in use.

In order to achieve the maximum confidence in security, the process of evaluation and selection of a secure conditional

access system should start with the assertion that "this is a decision completely separate from the selection of compression technology (or the selection of compression system vendors)." [2]

Similarly, the evaluation of functionality and compatibility should be separated from decisions regarding compression algorithms, transport layers and vendors. It is important that the evaluation process include independent outside expertise including individuals and companies with insight into the unconventional methods favored by signal pirates in the past. The industry's 20-year experience with scrambling and encryption reveals that systems have almost always been circumvented by employing shortcuts in ways never imagined by the original system engineers. Security of encryption algorithms or of smart cards is only a part of the equation. Total system security is the only thing that ultimately matters. It also is essential to the evaluation process that would-be suppliers provide complete disclosure (including all details of systems, the results of their own and independent security analyses, and their own knowledge of potential threats).

Conclusion

Conditional access objectives for security, functionality and compatibility need to be established now by the operators and programmers who will commit their businesses to the use of digital compression technology in coming years. An industry process can and should be initiated to specify desirable features and attributes and to communicate these requirements to industry vendors. As digital compression systems are proposed by vendors for introduction, the industry needs to be satisfied that security and other goals have been met by independent and exhaustive evaluation. **CT**

References

[1] ATSC Document T3/180, "ATV Conditional Access System Characteristics," Sept. 18, 1992.

[2] "Conditional access via digital compression" by Graham Stubbs, *Communications Technology*, March 1993.

Acknowledgment

The Advanced Television Systems Committee developed and published in 1992 a list of conditional access system characteristics appropriate to advance TV (HDTV) systems. The approach taken in this article is based in part upon the work reported by ATSC.

Encryption options for digital

(Continued from page 22)

control of the conditional access system (sending end).

• Access control — The function of the conditional access control at the sending end is to generate the scrambling control signals, and the provision of information to enable authorized users to descramble the program or service. The availability of this information is controlled by the conditional access system, between the transmitter and receiver(s). Thus, information is structured in secure messages multiplexed with the signal itself.

So, conditional access is the total envelope of mechanisms that are responsible for delivering information to selected receivers only.

In the context of system implementations and the previous definitions, one notes that there is a natural segmentation between the requirements of a system's transport layer hardware-level scrambling elements and the addressing/authorization access control elements of almost any proto-typical system. In fact, the previous distinct processes have become systemic to modern broadband system security approaches.

The information (programming) to be transmitted is secured by scrambling (encrypting) the data during transit.

The access control delivers to the decoder commands and procedures associated with who, where and when a decoder is allowed to unscramble the information and deliver the program.

In practice, systems get very complex and many factors must be considered. Assuming the scrambling process is done correctly from a cryptographic standpoint, it can be made very straightforward: essentially mechanical or generic. Access control is an area, however, where one finds much of the distinction between systems: how fast, how often, how user-friendly and how operator-friendly. It is in this domain that we find many of the processes that define a system's "personality" as well as those that control program access such as pay-per-view/impulse pay-per-view (PPV/IPPV) procedures, cryptographic key distribution, all addressability processes, latency/synchronization factors, etc. Subscriber management systems, headend control systems and system data channel(s) are dedicated to these functions, and they are all unique to different system implementations.

"In order for the digital TV market to fully and freely develop, it is very important not only that specific audio and video compression techniques be codified, but this transport area as well."

But what can be thought of as common are system services, especially if one considers that an MPEG-2 compressed version of a movie can be universally coded (the program stream), no matter what system is carrying it, or digital storage device is saving it. The scrambling of the signal is what has been recommended by the ATSC and CCIR as a factor that can be standardized on. The access control remains unique to each respective system, responsible for providing enabling parametric information (keys, etc.) to common descramblers.

Scramblers

The most straightforward method to secure a digital signal when presented in a bit serial fashion is simple modulo 2 EXOR of the data with a stream of random data. Of course, the random stream cannot literally be random or the information will be thoroughly and permanently encrypted forever. For this reason, pseudo-random binary streams (PRBS) are utilized. They look random to anyone not having certain "key" information. This approach is commonly used with a "private key" or symmetrical encryption approach that works well for high-speed encryption and decryption.

There are other techniques for encrypting information. The access control channels of most systems typically use other/additional techniques (e.g., public key cryptosystem attributes) to ensure that factors such as message authentication, message replay and other kinds of spoofing, etc., are appropriately handled. These techniques are system-unique.

The basic premise that a pseudo-random stream employed to scramble data can be essentially as secure as a truly random stream is a fundamental notion of modern cryptographic doctrine. When cryptographic systems are compromised, it is not that this doctrine is at fault, it is that the design or the use of the PRBS generator is flawed, or (more often) that the other conditional access element ("access control") has broken down.

The basic argument that it is possible to standardize on

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Figure 3

shoot the signal, not the box.

There could be loose fittings, bad crimps, water damage or typical drop-related problems. Technicians should be trained on the proper diagnostics tools built into the tuners.

Train the customer service representative (CSR) about the typical steps on qualifying the call ahead of time. Converters are no longer volatile, so that eliminates one area of diagnosis. Today's digital boxes hold their memory for five to 10 years.

Train the installation technician on the importance of quality when using this area of spectrum. Bad or loose fittings can cause major problems. The best method of training should be in a controlled environment, preferably a training room, before the technicians are sent into the field. Allow them to work with stereo to overcome any potential concerns they might have.

Train the headend engineer on the headend equipment and its procedures. Verify a full understanding of all its components and how they operate. Understand any procedures for maintenance and troubleshooting. A good stereo and headphones are needed to verify headend performance questions.

Conclusion

Basically, digital audio is a good way to make use of the roll-off part of the cable spectrum and attract the extra revenues it can provide to a system. Follow the rules of proper setup in the beginning or when moving these signals to other frequencies. Make sure adequate time is provided to take advantage of training on these products. And, most of all, remember: digital video is coming. By learning about the support and impact of digital signals on your plant now, you have prepared yourself for the future. **CT**

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Interoperating cable

(Continued from page 27)

someone's lips flapping. You need to see body language and facial expression."

Too much information

At the moment multimedia connections across the network flow across a subnetwork called the MBONE, or multimedia backbone. This is a network of special routers that are capable of sending the same video, audio and data streams to multiple recipients. But these are all limited by the 45 Mb/s speed limit on the Internet today.

And at the local level, the limitations are even more stringent. The networks and connections being proposed by PSI, Hybrid and Zenith are all based on shared bandwidth. That works fine when they are only downloading an occasional file at high-speeds. But if too many people are trying to watch different video or audio over the same cable plant, it could bring service to a crawl.

The Holy Grail for controlling this may lie in ATM. Richard Green, president of CableLabs, gave the keynote address at the ATM Forum meeting held during Interop. Addressing the collection of present and potential ATM equipment vendors he said, "I come here as an emissary from the cable industry, suggesting that the deliberations of the ATM Forum can and should play an important role in the cable industry's efforts to participate in the digitalization of communications in America ... I want you to know that the cable industry pledges to participate with you in the effort to refine and coordinate interindustry technical standards."

Currently, the equipment and services on the market are tailored to large businesses piping massive quantities of data around the corporate network. Already nationwide networks are coming into existence. In early August, San Jose-based MFS Datanet announced the availability of commercial ATM service in 14 cities. At the show, Sprint announced the availability of commercial ATM to over 300 network locations throughout the country. Tulsa, OK-based WilTel announced its commercial ATM service will be available in October.

One of the prime targets of these networks lies in connecting up company LANs across a wide area at a better price-to-performance ratio than other technologies. A three-location T3 ATM network from Sprint will cost only $55,000 to $75,000 per month vs. $126,000 for standard data services from AT&T.

Other targets include video conferencing, high-speed fax, interactive computer-aided design and computer-aided manufacturing, medical imaging, and video production. In fact, Spielberg's latest hit, *Jurassic Park*, was passed back and forth over WilTel's network for fast editing turnaround time.

Al Fenn, president of MFS Datanet said, "We saw getting into ATM as an opportunity to influence the vendors."

When MFS first cased the ATM market, it found only one vendor developing equipment that could operate at DS-3 45 Mb/s rates.

ATM is relatively inexpensive. Fenn pointed out, "From a systems perspective, ATM is the lowest cost technology on the market today."

But watch where you invest your money. Fenn said, "In the market today, there is equipment that is separated by a factor of ten in cost."

The side benefit for MFS is that ATM has reduced the delay in sending information across the network. Fully loaded, a good router used in a network will have a delay of 1 ms. And that is a very expensive router, points out Fenn. An X.25 network may have a delay of 10 ms per router. If that network has to carry video or audio across multiple routers, the delay will be quite noticeable. Fenn found the delay of the slowest ATM switch to be 60 µs, and the faster ones only 30 µs.

MFS did run into one problem when setting up its network. An excessively large number of packets got lost by the switch. But when the DS-3 signal was scrambled before sending it into the switch, the problem went away. Apparently, unscrambled DS-3 signals can confuse the ATM switching system causing it to send ATM cells in the wrong direction.

ATM firmware

Although the standards are not even in place, that is not keeping vendors from bringing new products to the market. The opportunity is just too enormous. On the show floor, there were two separate ATM networks demonstrating the limited interoperability of ATM products and services.

Fore Systems led one demonstration from its booth involving 16 different vendors of ATM gear, workstation adapters, test equipment and wide area DS-3 service. Service providers included MCI, Sprint, WilTel and Pacific Bell's Data Communications Group. ATM equipment providers included Cabletron Systems Inc., Digital Link Inc., Fore, GTE Labs, Hewlett-Packard's Broadband Test Division, TRW and Wellfleet Communications Inc. Insoft provided the multimedia software for conferencing and Parallax Graphics provided the multimedia board for the connected machines.

In a separate demonstration, Synoptics created an ATM LAN based on equipment from itself, Hughes LAN Systems Inc. and Network Equipment Technologies Inc.

Alcatel Data Networks, based in Reston, VA, unveiled a 10 Gb/s ATM switch targeted at private and public networks. Called the Alcatel 1100 HSS, the switch will support ATM and several other data services. Up to 29 ports can be plugged into the switch at speeds ranging from 64 kb/s to 155 Mb/s. Alcatel said the switch is now available for beta testing and will be commercially released in the U.S. in the first quarter of 1994.

ATM leader Fore Systems introduced a 155 Mb/s SONET module for the company's ASX-100 ATM switch, which has four ports (each capable of handling OC-3 rates). The module can be used to connect to other switches, ATM desktop adapters that support SONET, ATM hubs and routers, as well as campus backbone multiplexers. It costs $6,995.

AT&T, which is supplying the ATM equipment for Time Warner's Orlando, FL, ATM trial, announced it is working on two ATM switches called the SN-2000 ATM integrated services platforms that will be available in the first quarter of next year. These switches will complement AT&T's existing GCNS-2000, which is a cell relay switch designed for carrier networks.

The smaller SN-2000 branch controller switch will support two to four LANs, 16 to 32 terminal ports and as many six wide area connections. The larger SN-2000 premises controller will support eight to 16 LANs, and 16 to 24 WAN links.

IBM recently announced it too was developing a family of ATM products, and said that it will spend $100 million per year developing the technology. The backbone switch, dubbed Autobahn, will support data rates of up to 622 Mb/s per channel and will have a combined capacity of about 6

Gb/s. IBM also is developing an ATM switch module for its existing 8250 intelligent LAN hub. It will have a combined capacity of from 2 Gb/s to 5 Gb/s. IBM will support interfaces at 155 Mb/s, 100 Mb/s and 25 Mb/s, of which the latter two are considered nonstandard by the ATM community.

Ascom Timeplex, based in Woodcliff Lake, NJ, has announced it will introduce (in the second half of next year) three different ATM switches. A work group switch will support data rates of 300 to 600 Mb/s, a departmental switch rates of 1.2 to 2.4 Gb/s, and an enterprise switch rates of 9.6 to 19.2 Gb/s.

Although the cost of ATM is high now, that may change if Dallas-based Efficient Network Technologies gets its way. Currently, users have to pay a minimum of $2,500 per workstation for ATM. Chase Bailey, vice president of ENT, claims that ENT is planning on bringing ATM to the desktop next year for only $500 per computer. If ENT succeeds, it may rewrite the economics of ATM networking and force competitors to comply.

How this fits into the cable plant

CableLabs' Green described how this ATM technology can fit into the cable plant, referring to Time Warner's Orlando full service network (FSN). "There are a lot of ways to establish virtual circuit connectivity from the headend ... through the dedicated light link ... and finally over the 750 MHz coax bus to each home in that serving area. But I know of none that compares to ATM in the potential to supply the functionality required to support long-term evolution of the cable network."

Currently most of the cable industry is working on upgrading the traditional fully coax network to fiber/coax hybrids. Last year, 3,000 fiber-optic nodes were installed, and according to manufacturers' projections, that number will double again this year. By next year over 16,000 fiber nodes will have been installed. That's 35% of the industry's household base, and the two largest companies, TCI and Time Warner, plan to have completed construction of fiber-based architectures in 100% of their markets.

"The information highway is coming at a fast clip without the help of the government and probably in spite of it."

While today these architectures are being used to duplicate the services of the past with increased reliability, tomorrow they can be adapted to provide each home with its own dedicated link.

In the Orlando FSN, the network is being rebuilt to tap this reality. That is, 450 MHz of the network's capacity will be dedicated to traditional downstream broadcast. The 450 MHz to 650 MHz band will be dedicated to providing digital downstream to the home. These channels will be multiplexed at 12 MHz intervals giving the network 16 45 Mb/s links to each 400-home service area. That's 1.5 Mb/s for each home (if each decided to go on simultaneously).

Green points out, "Thanks to the dynamic bandwidth allocation flexibility that comes with ATM, each household consumes only the amount of bandwidth required for a particular

service. This suggests that, at realistic contention levels ... where only a percentage of customers will be choosing digital programming instead of the traditional analog services ... there will be an abundance of bandwidth to support whatever programming anyone wants in an on-demand mode. It might be 1.5 Mb/s movies or 24 Mb/s HDTV."

To top it off, the FSN will have 250 MHz between 650 MHz and 1 GHz for reverse path communications left over after filtering. That's more than enough to handle the 64 kb/s telephone needs of all of the residents in the area, and then some. With 100 MHz of that used for personal communications, that leaves 150 MHz for communications from the home to the headend. That could support 100 or more interactive video communications sessions simultaneously in each 400-home service area.

Green said that the appeal of the FSN is so strong that US West, Southwestern Bell, Southern New England Telephone and other telcos are preparing to use this approach for implementing broadband services.

ATM is a key component in this network. Time Warner is installing an AT&T ATM switch to handle routing of the DS-3 signals over the network. ATM functionality is built into every level of the data stream from the server to the headend, and ultimately to the subscriber set-top box supplied by Mountain View, CA-based Silicon Graphics.

To Green the economics are compelling, "Everywhere we turn we find the specific ATM-compatible approach can be made to be extremely cost-effective against any other approach in terms of the totality of the goals we're seeking to meet. This means long-term evolvability and interoperability as certain as we can make them at this early stage."

Storage — A key component

Storage is another crucial component in making this network go. "Storage is one of the key networking technologies," said Richard Watson, a researcher from Lawrence Livermore. "If we are going to build this national information highway, you've got to have parking lots — high-speed, high-capacity, scalable parking lots."

Watson has been working at Livermore to develop a storage architecture that will enable scientists to move around large quantities of data efficiently. He believes that to handle video we will require data bases that can hold petabytes (a thousand trillion bytes).

He believes we need to explore network architecture in which the storage is built into the switch itself. He believes these will replace traditional file server type architectures, in which the data is stored on a remote server on the network, and all of the clients that try and access it have to contend for the same connection to it.

Watson is trying one approach to build a scalable file server based on parallel storage devices. Data will come off these devices in parallel stream, which will blast data out at gigabyte rates. That's fast enough to hand the real-time video needs of hundreds or even thousands of users from a single server.

Information highway under construction

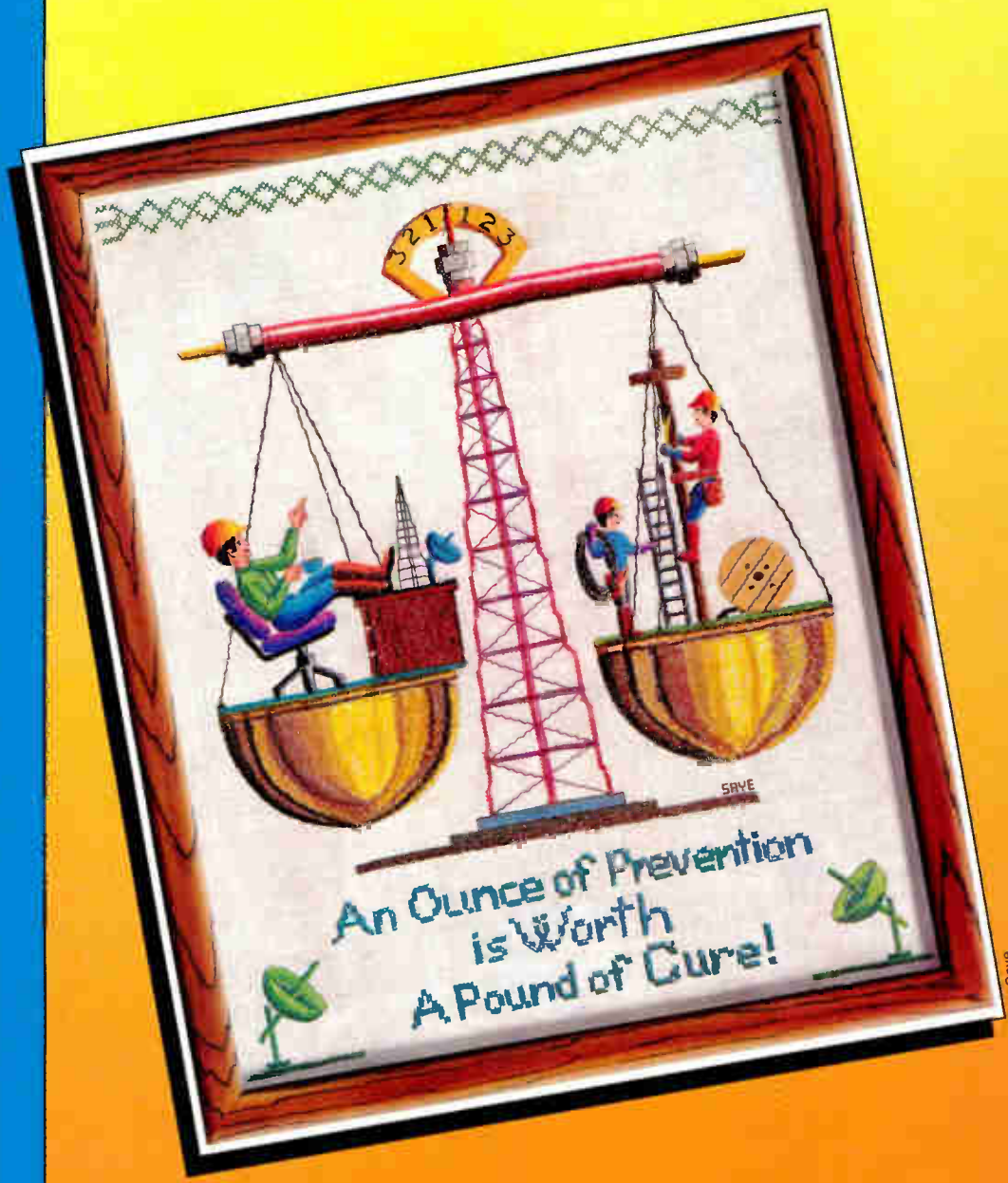
One thing seems clear: The information highway is coming at a fast clip without the help of the government and probably in spite of it. It is being driven by the sheer desire of converging industries to make a buck. They are discovering that to make it work will require cooperation and interoperability between their networks, tools and services. **CT**

November 1993

Spotlight on preventive maintenance

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.



Geri Saye

Table of Contents

The PM in preventive maintenance

By Mark Carter
Sales Manager, AM Communications Inc.

The second round of Federal Communications Commission-required proof-of-performance tests is either well under way, or recently completed by many of you. And I'd hazard a guess that not all of you are getting the results that you had hoped for. For some of you — unless you have a strong preventive maintenance program working — the variation in your system's performance over the past six months is a bit of a surprise. Isn't it?

The new PM

There is a way, a much better way, to keep tabs on the system's performance: the new PM — performance monitoring.

Before going into how performance monitoring can literally be the salvation of many system's preventive maintenance programs, let me explain what I mean by performance monitoring.

In the recent past, there have been great strides made in the area of "status monitoring" systems. Additionally, there are a number of systems available that offer end-of-line monitoring equipment that can monitor levels across a wide spectrum of frequencies. For purposes of distinguishing between the two, many people call the monitoring of amplifiers and standby power supplies, etc., status monitoring, while reserving the term performance monitoring for the end-of-line gadgets. I confess that I am just as guilty of that as anyone else. But, for the purpose of this treatise, let's assume that any form of monitoring an analog performance parameter within a cable system is, in general, performance monitoring.

In fact, the fundamental meaning of the terms applies very well to any of the routine preventive maintenance checks you all do regularly:

- When you check a trunk amp with a SLM or sweep system, aren't you monitoring its performance?
- When you put a standby power supply into standby and observe its performance, aren't you engaged in performance monitoring?
- And if you sweep an entire system, one amp at a time, aren't you doing performance testing — oops — monitoring? Preventive maintenance?

Perhaps the aforementioned distinction between status and performance monitoring is based on the idea that end-of-line testing monitors the performance of the system, while the other monitors the performance of a component of the system. In either case, performance is being monitored. And so, for the purposes of this article, the concept I want to extol is performance monitoring.

With all that out of the way, there is another factor that makes the *new* PM new, and that is the fact that all of the preventive maintenance procedures of the past — the routine day-to-day monitoring of system performance — can now be fully automated. And to make one more distinction, let me add remotely to the equation. By that I mean that you don't have to lug an expensive, heavy piece of test equipment from place to place to test the system's performance. You can do it from a computer keyboard at the headend, your office, or even from your bedroom (assuming your spouse would allow it).

All this can be implemented much more economically than might be expected. And what is a little ironic (at least to me) is that the same equipment that will let you automate your preventive maintenance performance monitoring — which you may need to consider because of the FCC proof-of-performance requirements — also will let you fully automate the proof tests as well. (Or is it that the system that does the automated proof tests also can automate the preventive maintenance performance moni-

Figure 1

```
000021  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Temperature
000022  06:39   05/13/93      MCU: 06  Location:
000023  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Outbound RF Level
000024  06:39   05/13/93      MCU: 06  Location:
000025  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Laser Bias Current
000026  06:39   05/13/93      MCU: 06  Location:
000027  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Inbound RF Level
000028  06:39   05/13/93      MCU: 06  Location:
000029  06:39   05/13/93   Major Alarm Restored, Name: llcom     , Address: 209233, Inbound RF Level
000030  06:39   05/13/93      MCU: 06  Location:
000031  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Temperature
000032  06:39   05/13/93      MCU: 06  Location:
000033  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Outbound RF Level
000034  06:39   05/13/93      MCU: 06  Location:
000035  06:39   05/13/93   Major Alarm, Name: llcom     , Address: 209233, Laser Bias Current
000036  06:39   05/13/93      MCU: 06  Location:
```

Figure 2

```
Page 00001                          CURRENT ALARMS REPORT                          09/02/93   09:53

Name        Address  MCU  Location                                   Alarm Type
+-----------+--------+----+------------------------------------------+-----------------------------------------------------------------------------

                                  No Current Alarms exist.
```

Figure 3

```
Page 00001                          TRANSPONDER STATUS REPORT                      09/01/93   07:09

     Address      Name     MCU  Location                                    Unit Type  Status   Alarm Status
-------------------------------------------------------------------------------------------------------------
      121212    121212    01   nowhere                                     TMC-9015   Normal
      654321    212002    01                                               TMC-9015   Normal
        5678      5678    01   same as 121212                              TMC-9015   Normal
        7777      8041    01                                               TMC-8041   Normal
      210105      9015    01   Pa. Turnpike & RT 0663; Pole 0413           TMC-9015   Normal
      200425    alpha ps  01   bldg 35, 2nd floor                          TMC-8061   Normal
       68967    bldg 10   01   bldg 10, basement telco closet              TMC-801I   Normal
       68783    bldg 35   01   bldg 35, 1st floor, communications closet   TMC-801I   Normal
           2    c amp 1   01   bldg 35, 2nd floor                          C-COR SMT  Normal
      203586    c amp 2   01   pole 00741                                   TMC-8052   Normal
      200354    c amp 3   01                                               TMC-8052   Normal
        6535    control 1 01   room 14, bldg 103                           TMC-8040   Normal
        2345    fiber     01                                               LL-COM     Normal
       68815    headend   01   bldg 2, Computer Room, Rack 108, on top of MCU TMC-801I  Normal     Headend
      200145    j amp 1   01   bldg 35, 1st floor                          TMC-8051   Normal
      200190    j amp 2   01                                               TMC-8051   Normal
      200187    j amp 3   01                                               TMC-8051   Normal
      200195    j amp 4   01                                               TMC-8051   Normal
      200221    j amp 5   01                                               TMC-8051   Normal
      200246    j amp 6   01                                               TMC-8051   Normal
      191919    llcom     01   in the demo dummy data bag                  LL-COM     Normal
```

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toring?) Irony? Bonus? Either way, you are continuously monitoring and maintaining to the exact standards and procedures that you use for your proof tests. That's the only way I know to ensure your system is in compliance at all times. Which, in reality, is what the FCC rules require.

I bring up the FCC proof tests because, as I said earlier, you will find that it is very difficult to maintain an entire system to the standards to which you test for proof-of-performance without a massive increase in the routine monitoring of performance. The adoption of the new standards and testing requirements will make it necessary to work harder at maintaining that level of performance (the obvious intent of the rules) in between tests.

Additionally, the current trends in the business aspects of cable TV suggest that many of today's plain old cable systems plan to be tomorrow's telecommunications networks, with a host of new services. The majority of which will be interactive — and by definition that means two-way, which means virtually two systems to maintain.

At the same time, these new networks are going to find the inevitable competition with other providers will force them to follow the business trend of the '90s: lean and mean. Your technical staffs will be reduced while the demand for near perfect reliability will grow exponentially. And this means that your PM programs are going to have to be extremely efficient.

Figure 4

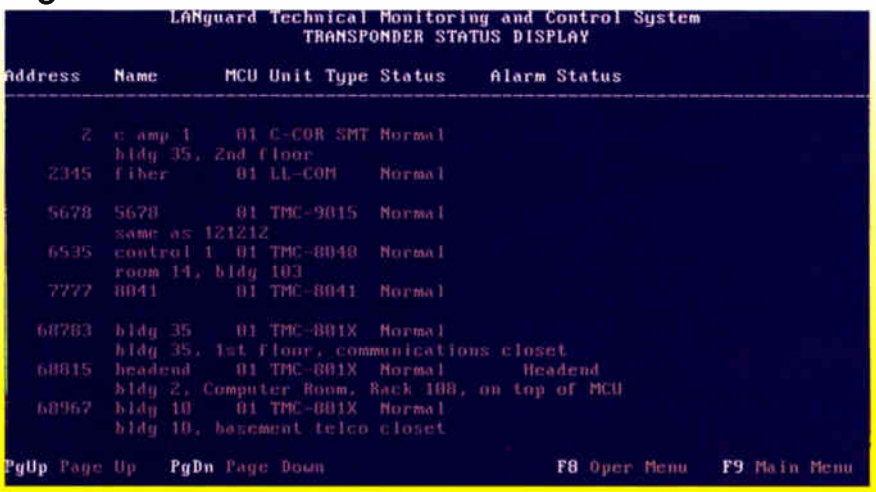

Figure 5

Figure 6

Efficient PM

Now, when I said that performance monitoring (preventive maintenance) can be automated, I didn't mean that you won't have anything to do. Oh, no. Not at all. You will still have to do the maintenance. But the routine testing — the monitoring — will be done automatically (and remotely), so that the time you spend under the hood will be real maintenance. With some hesitance, may I say, "remedial" maintenance; the kind of fine tuning that your subscribers never know is going on. In essence (and to continue to overuse the cliché) you'll work smarter, not harder. And that means that all of the promises of good PM (your choice of meanings) can be realized:

- Improved system reliability.
- Better quality pictures to your subs.
- Fewer outages (both real and perceived).
- Quicker isolation and restoration when outages do occur.

Most PM programs address four fundamental areas of system performance:

1) Most common is the continuous meter balancing of all system amplifiers (trunks, bridgers and line extenders).

2) The next most common practice is the routine of "tweaking" system performance in the same amp-to-amp fashion using a sweep system to align the amplifiers. A typical drawback to this method is that quite often the distribution part of the plant is either ignored, or is meter balanced instead of being swept. So while the system trunk may be nearly perfectly aligned, the feeder can be — and too often is — completely out of whack. The argument can be made that the trunk is the backbone, and that some parts of it

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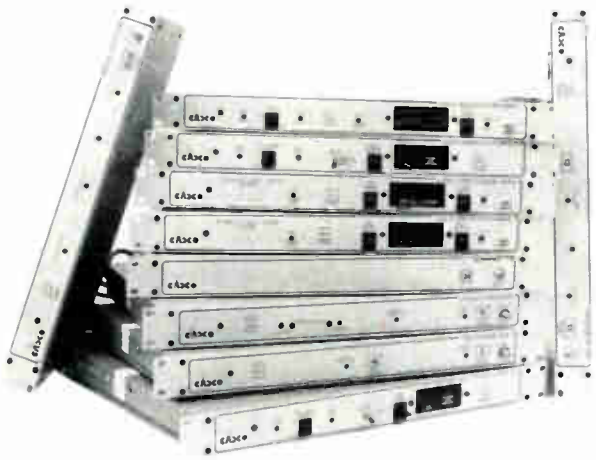

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may serve all of the subs, so it must be properly monitored. True, but in a typical system, there are four times as much feeder as there is trunk, so this technique only maintains one-fifth of the plant. That doesn't seem very effective to me.

If your PM program has you or your technical staff sweeping and balancing amp to amp to amp, ad nauseam, then you know that most of the time you spend in this endeavor is wasted. Both in windshield time and in checking system components that are performing perfectly well. This is the monitoring part of PM. And this is where you can increase the efficiency of your PM by orders of magnitude.

3) Then there are some systems that add to the sweeping and balancing by doing continuously rotating level measurement checks at feeder terminations and/or periodic (usually monthly) "mini-proof" tests where carrier-to-noise, distortion, hum and so on are measured much like they are for the FCC proofs.

This of course produces a much better monitored and a much better behaved system. The drawback here is that, in addition to the huge amount of wasted time, the manpower (expensive) and equipment (also expensive) required to continue such a program will become more and more prohibitive just at the time when its needed most.

4) And finally, there is the routine testing and maintenance of standby power supplies. It could be argued that this is more necessary than the balancing and alignment of the trunk since nothing works without power. The only reason I list it fourth is that relatively few systems actually use standby power. And in a large number of the systems that do, the PM of the supplies is limited or nonexistent. I've seen some that didn't even have batteries in the units — and didn't know it!

A reason that maintenance is limited is that standby power supply PM tests are very time-consuming when done correctly, and require expensive equipment for remedial maintenance (i.e., changing batteries, running the system on a generator while changing a supply module, etc.).

And the safety requirements for handling the batteries (by OSHA's rules) are pretty intimidating. I won't go into detail about that here, but those of you who have looked into the subject know exactly what I mean. Those of you who have standby supplies and haven't looked into the subject really need to do so.

Of course, good standby power supply maintenance is another practice wherein most of the time invested is actually wasted. Both in travel time from supply to supply and in waiting and watching while a unit is forced into standby — usually for at least 30 minutes. And again, if the supply is performing properly and its batteries are up to par, the whole trip could have been eliminated if the available technologies were in use.

Figure 7

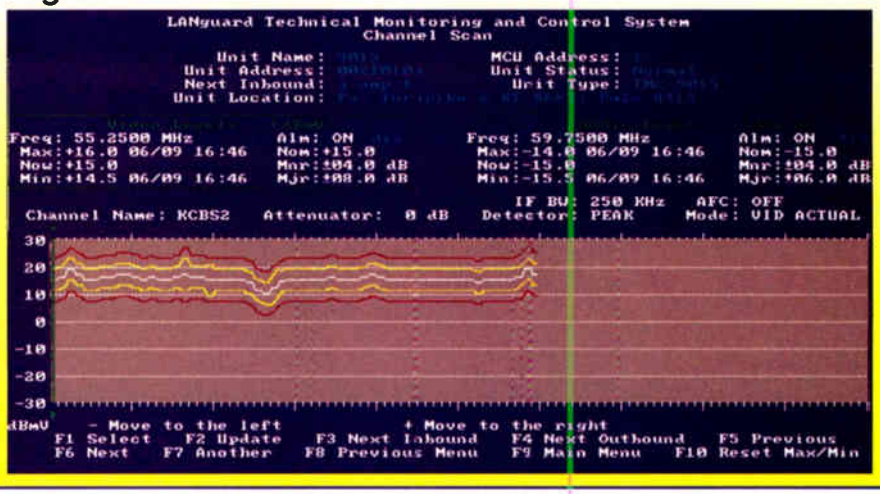


Figure 8

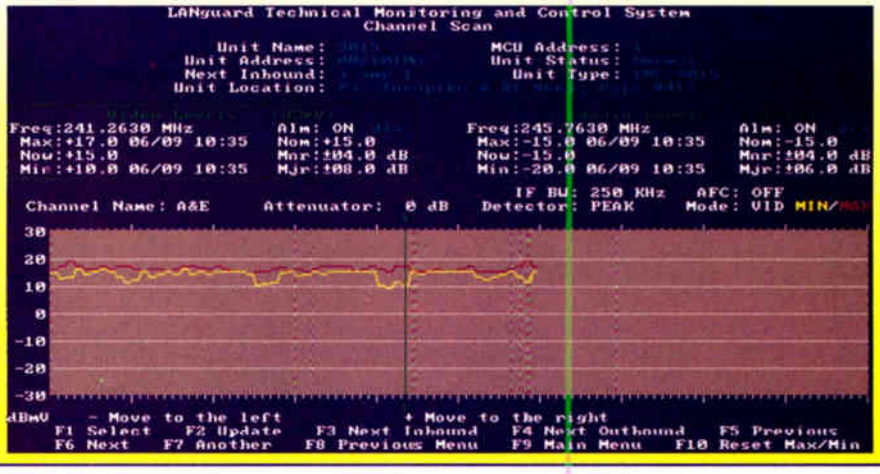
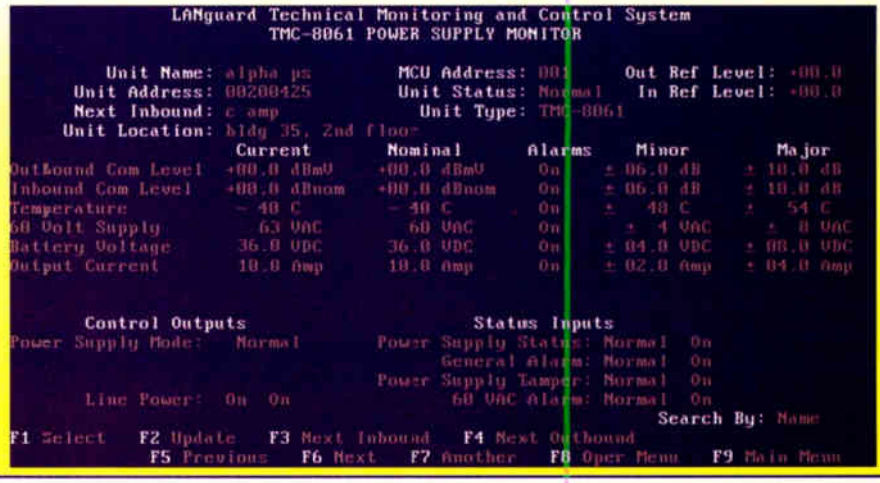


Figure 9



New technologies

With the technologies available today, the wasted time in PM can be virtually eliminated. The strategic placement of headend, end-of-line monitors, amplifier and/or fiber node monitors, and standby power supply monitors can enable the technical manager to see at a glance how

the system is behaving, and precisely where he needs to place his maintenance personnel. And perhaps best of all, he can do this dynamically, throughout the day. All of the monitoring devices can be programmed to generate alarm messages when their monitored parameters deviate from a prescribed "normal" range.

In such a system, a typical morning might find the tech manager and his staff reviewing the overnight log for any alarming conditions or events, checking the present conditions, and deciding where the maintenance effort is needed most.

The log of overnight events might include messages something like the sample log shown at Figure 1 (page 50). The obvious message from this example is that a transponder (monitoring device) named "Ilcom" has a host of major alarms. Since this unit is monitoring a fiber receiver node and appears to be unstable, the technical manager would undoubtedly dispatch a technician to check the node as soon as possible.

Inasmuch as the transponder is still communicating, and before checking the unit's level monitor screen, it may be concluded that the node is still running. But with temperature, laser bias current and both forward and reverse (outbound and inbound, respectively) levels out of tolerance, the node's survivability is dubious.

In these kinds of scenarios it is quite common for the cable TV operator to get to a component and effect repairs before the component fails completely, thus preventing what would otherwise certainly be a major outage. And that's what PM (both meanings) is all about.

While checking the present conditions, the technical staff might consult a status report like the one in Figure 2 (page 50). Another printed report is shown at Figure 3 (page 50). A similar status check can be made by viewing screens like the one shown in Figure 4 (page 52). In any case, if no current alarms are indicated, the technical manager can leisurely peruse a variety of other screens and reports. If there are alarms, the nature and location of the alarming condition also can be viewed in more detailed screens.

The quickest way to isolate problem areas is through a mapping program. Figures 5 and 6 (page 52) are examples, more accurately described as a schematic diagram. In the near future, these monitoring systems will be linkable to the new "dynamic dispatch" and field service management systems using GPS data to track vehicles, equipment, etc., and will be displayed on real topographical maps.

Figure 5 is a "zoomed out" trunk tree diagram showing an area where the symbols are all green, and another where they are all yellow. The green symbols represent transponders in amps, etc., that are functioning "normally," while those in yellow represent transponders with a "minor" alarm condition. The operator need only identify the location of the alarming transponder nearest the headend to locate the source of the alarms.

In Figure 6, the screen is "zoomed in," and the operator has pointed to the amp

Figure 10

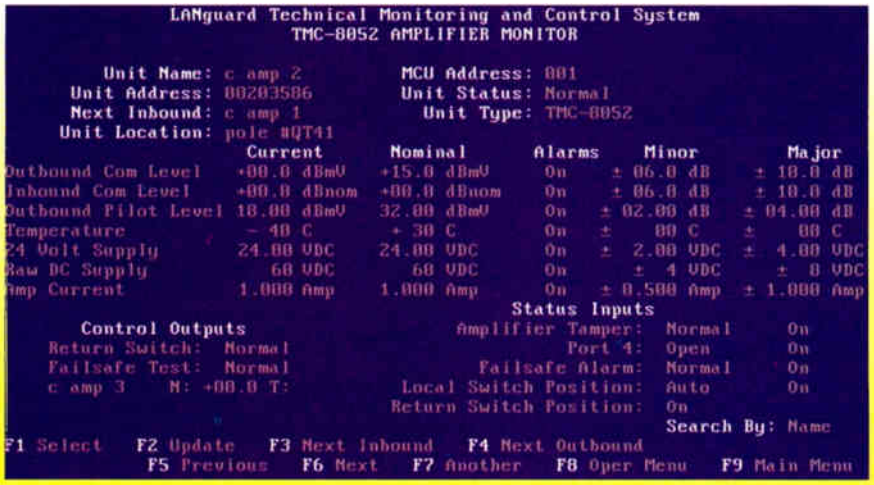


Figure 11

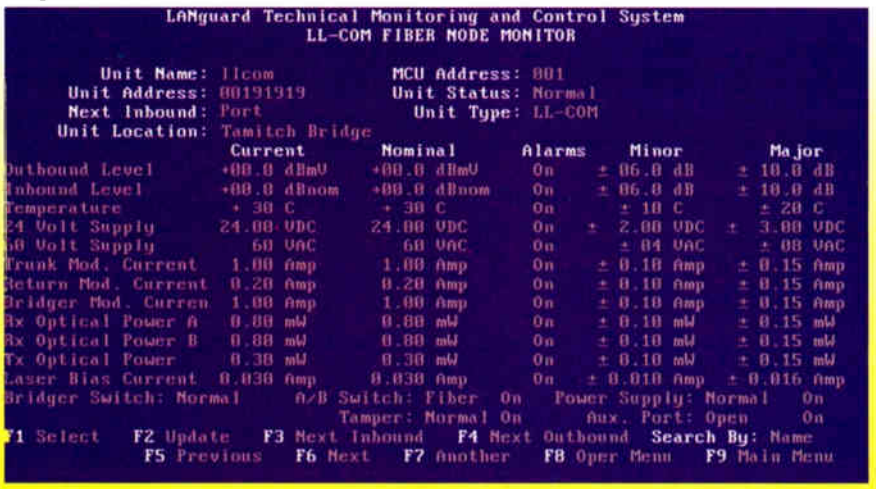
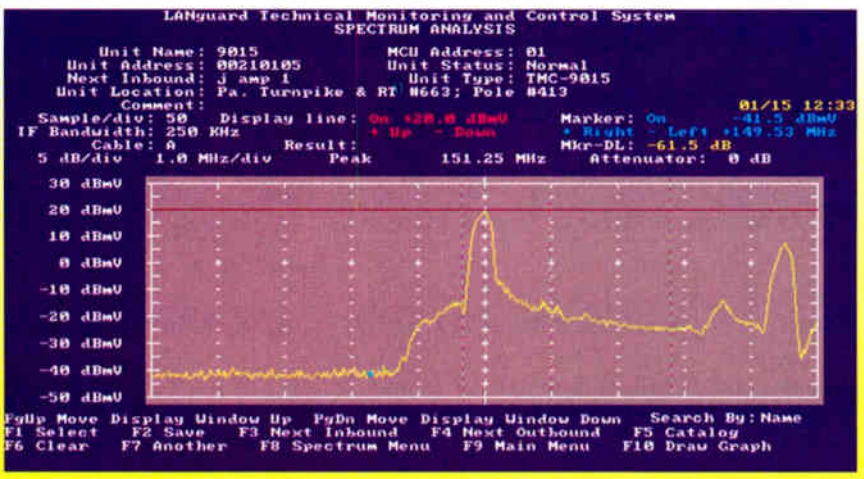


Figure 12



symbol with a mouse and clicked the button to bring up the window in the upper left that identifies the amplifier by name, shows its location and the nature of the alarm. A technician can be immediately dispatched.

After determining the status of the system's performance, the technical staff can browse through screens to see how end-of-line levels compare to established norms. Figures 7 and 8 (page 55) show how easily system performance can be "seen." Major problems can be addressed immediately while minor deviations can be scheduled for later attention.

Figure 7 shows current levels at an end-of-line monitor (the white trace on the graph) to be well within the normal range established by the "minor" alarm limits (user-defined) as represented by yellow traces. Red traces represent the "major" alarm window defined by the operator. This unit is showing 60 out of a possible 100 channels.

Since the response at this point is normal, it would be pointless for a sweep/balance tech to spend any time in this cascade. His efforts would be directed to a cascade where the end-of-line monitor revealed an anomaly in the response.

Figure 8 shows a graph comparing the minimum and the maximum levels measured on each channel over a period of time. This can be very useful in helping to record those annoying intermittent level problems that it seems only one night-owl subscriber ever sees. Or for just seeing how your system "breathes" over time.

Figures 9 (page 55), 10 and 11 show individual power supply, amplifier, and fiber node monitor detail screens. The model numbers shown indicate that this system is monitoring Alpha power supplies, C-COR amplifiers and Jerrold fiber nodes. The monitoring system is capable of an even broader mix of manufacturers and component types, all on a single platform.

The diagnostic edge

When things do go a little out of kilter (and they do) having end-of-line devices installed gives the operator a remotely controlled spectrum analyzer at each location. What better tool for diagnosing what ails a system? The next few figures are captured PC screens of real spectrum analysis of a cable system. They show how powerful a tool the units can be for troubleshooting in addition to the routine continuous monitoring of levels.

In Figure 12, this unit has taken a "snapshot" of a channel with a missing lower adjacent channel. In this case, carrier-to-noise measurements are possible without interruption of the signals at the headend. This picture shows a peak carrier level of +20 dBmV, marked by the red display line. The small green dot marker is placed in the noise floor below the video carrier, at about the average noise level. Noting that the analyzer IF bandwidth is 250 kHz, the bandwidth correction factor for noise is +12 dB. On the right of the screen, just above the graph, the readout says that the marker — the display line (Mkr-DL) — is -61.5 dB. Adding the bandwidth correction yields an indicated carrier-to-noise ratio of 49.5 dB. And since the noise trace was taken along with the peak carrier using the peak detector mode, we also add a 6 dB detector correction yielding an actual carrier-to-noise at this location of 55.5 dB.

In Figure 13 (page 58), the same missing channel is shown at a wider scan width, with the dot marker on the composite triple beat (CTB) at the video frequency in the vacant "slot." The indicated CTB is 57.5 dB. But, as with the carrier-to-noise, the trace was taken in the peak detector mode. Again, a correction of about 6 dB tells us that the CTB at this location

is 63.5 dB. Both of these numbers (CTB and C/N) are very realistic for this unit's location in any frequency the operator wishes. It can be programmed to continuously mined, and alarms set to notify when the beat's level exceeds the limit set.

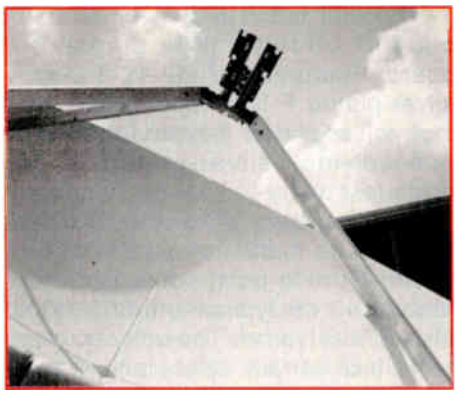
optical time domain reflectometer (OTDR). The company says the unit is the first OTDR in the industry to achieve 40 dB of dynamic range. The unit contains a 3-1/2 inch disk drive for data storage, built-in thermal printer and automated analysis software that characterizes fiber-optic cables in less than 15 seconds, according to the company. Applications for the unit include measurements of long haul and fiber-in-the-loop networks.

Reader service #201

Local loop testing

The new SpliceView system from Fitel-Photomatrix reduces costs by allowing a single splicing technician to inject tone signals, identify and OTDR test a succession of fibers from the splicing site. The system consists of a multichannel optical switch placed at the office and controlled from the splicing site via a fiber in the span. Tone sources and OTDRs connected to this fiber at the splicing site are looped back by the switch to successive fibers in the span.

Reader service #200



Multisatellite retrofit

Antennas for Communications announced a multisatellite feed system that allows simultaneous reception from two 2° spaced satellites. This dual beam retrofit is specifically designed for the company's 3.7 meter antenna or may be retrofitted on other manufacturers' antennas.

The unit is designed as a solution for new programming or to free up an emergency backup dish, and allows existing antenna the capabilities of multisatellite reception for a fraction of the cost of a new 12-foot antenna system, according to the company. Based on the theory of over-moded dielectric filled waveguide feeds, the unit is adaptable to a broad class of small focal length antennas.

Reader service #199

Composite video tool

Ultech Corp. unveiled the TV Trigger Mate, a tool for working with composite video that provides a stable trigger for oscilloscopes. It is able to sync on weak and copy-protected video and is unaffected by VCR head switch noise. The unit works with NTSC, PAL and SECAM video.

The tool offers individual line selection as well as combinations of four color fields. It can trigger on all fields,

odd fields (1 and 3), even fields (2 and 4) or individual fields (1-4). It can trigger anywhere within a TV scan line in increments of 125 ns with a maximum jitter of ± 8 ns.

The unit features a blinking marker signal available at the video output connector. The marker flashes a pixel on a TV set or monitor that corresponds to the trigger point. The marker can provide coordinates of objects on the screen such as text boxes. The unit also provides horizontal, vertical, field and composite sync from an incoming video signal. These outputs are available on rear panel BNC connectors or front panel probe terminals.

The unit is designed for developing and testing video products as well as for monitoring video waveforms at broadcast sites, cable TV headends, satellite uplink/downlink sites and production studios.

Reader service #198

OTDR

The new MW9060A optical time domain reflectometer (OTDR) from Anritsu Wiltron automatically characterizes both short- and long-haul links over a dynamic range of up to 35 dB. The comprehensive features of the unit make it well-suited for all areas of optical fiber testing including research, development, production, construction and maintenance.

A new marker function allows the unit to perform relative distance measurements and interval loss measurements using a reference marker function. An automatic event detection function creates a table to measure fiber length, total loss and transmission loss before and after the connection point, and measures return loss as well.

The unit has a 25,000 point waveform memory and high-speed full range aggregate data averaging, enabling the user to zoom in on any arbitrary position without reaveraging. A set of complete measurement procedures can be stored in the instrument, allowing fast, repeatable measurements. Hard copy can be printed from the unit's built-in high-speed thermal printer.

The 3-1/2 inch floppy disk drive stores approximately 700 screens in 500 point mode. Other specifications include a sweep speed of 300 ms, near-end dead zone as close as 1.5 meters, and distance range up to 250 km. Plug-ins for wavelengths of 0.85, 1.3 and 1.55 µm also are available.

Reader service #197

Battery charger

Yuasa-Exide Inc. introduced the microprocessor controlled rectifier (MCR) Series AT10 charger, available in conventional outputs of 12, 24, 48 and 120 VDC with current outputs of 6, 12, 16, 20 and 25 amps.

Standard features include: automatic or manual float and high rate timers, 1% digital display, switchboard wiring, touch panel control, self diagnostics, high DC shutdown, parallel operation and 0.25% regulation. Options include primary alarm board, high AIC breakers, temperature compensation, filtering and battery elimination.

The unit is field upgradeable without special tools or training. Standard input power (120, 208, 240 VAC, single phase) can be field adjusted by the installer. All calibrations can be made via the front panel while on-line, allowing adjustments in seconds using the touch panel display. Option selections can be electronically secured to assure that settings are not changed by unauthorized access.

Reader service #195

During the Annual Membership Meeting held at Cable-Tec Expo '92, the national board and staff learned the importance of the development of new training programs to the membership. As a result, SCTE enlisted the services of William Grant, author of the widely recognized textbook, "Cable Television," to conduct a series of seminars to be professionally produced as video programs and made available on videotape to the members. These programs follow the textbook and build upon it. Together with the text, the videotapes provide a comprehensive treatment of the basics of CATV design and operation. The tape listed here is available by mail order through the SCTE. The price listed is for SCTE members only. Nonmembers must add 20% when ordering.

• *Elements of System Design* — This seminar covers Chapter 12 in Grant's textbook. It provides a thorough understanding of tapping, including calculations and equalization, as well as a number of examples and possible design solutions. (1 hr.) Order #T-1127, $45. **B-IV**

Note: Videotapes are in color and available in the NTSC 1/2-inch VHS format only. They are available in stock and will be delivered approximately three weeks after receipt of order with full payment. The appearance of the symbol **B-** indicates a videotape relating to a certain Category (noted by a Roman numeral **I-VII**) of the BCT/E Certification Program.

Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or surface shipping charges (please specify). "Rush" orders: a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a Visa or MasterCard.

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (215) 363-5898.

A listing of other publications and videotapes available from the SCTE is included in the March and October 1993 issues of the Society newsletter, "Interval."

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24	50	76	102	128	154	180	206	232	258	284	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Television Engineers)?
01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (please check only 1):
Cable TV Systems Operations
03. ___ Independent Cable TV System
04. ___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Company
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Cable TV Investor
13. ___ Financial Institution, Broker, Consultant
14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distrib.
16. ___ Advertising Agency
17. ___ Educational TV Station, School or Library
18. ___ Other (please specify)_____

C. Please check the category that best describes your job title:
19. ___ Corporate Management
20. ___ Management
21. ___ Programming
Technical/Engineering
22. ___ Vice President
23. ___ Director
24. ___ Manager
25. ___ Engineer
26. ___ Technician
27. ___ Installer
28. ___ Sales
29. ___ Marketing
30. ___ Other (please specify)_____

D. Do you plan to rebuild/upgrade your system in:
31. ___ 6 months
32. ___ 1 year
33. ___ 2 years
34. ___ 5 years

E. In the next 12 months, what cable equipment do you plan to buy?
35. ___ Amplifiers
36. ___ Antennas
37. ___ CATV RF Distribution/ Distribution Electronics
38. ___ CATV Passive Equipment Including Cable
39. ___ Cable Tools
40. ___ Compression/Digital Equip.
41. ___ Computer Equipment
42. ___ Connectors
43. ___ Converters
44. ___ Controllers
45. ___ Descramblers
46. ___ Fiber-Optic Cable
47. ___ Fiber-Optic Electronics
48. ___ Headend Equipment
49. ___ Interactive Software
50. ___ Lightning Protection
51. ___ MMDS Transmission Equip.
52. ___ Microwave Equipment
53. ___ Other Security Equipment
54. ___ Receivers and Modulators
55. ___ Remotes
56. ___ Safety Equipment
57. ___ Satellite Equipment
58. ___ Splitters
59. ___ Subscriber/Addressable Security Equipment
60. ___ Telephone/PCS Equipment
61. ___ Power Supplies. (Batteries, etc.)
62. ___ Vehicles
63. ___ VideoCiphers
64. ___ 2-Way Radio

F. What is your annual cable equipment expenditures?
65. ___ up to $50,000
66. ___ $50,001 to $100,000
67. ___ $100,001 to $250,000
68. ___ $250,001 to $500,000
69. ___ $500,001 to $1,000,000
70. ___ over $1,000,001

G. In the next 12 months, what cable test & measurement equipment do you plan to buy?
71. ___ Fiber Optics Test
72. ___ Oscillators
73. ___ Service Monitors
74. ___ Signal Level Meters
75. ___ Spectrum Analyzers
76. ___ Sweep Tester
77. ___ CATV RF Test Equipment

H. What is your annual cable test & measurement equipment expenditures?
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Meet us in St. Louis

By William W. Riker
President, Society of Cable Television Engineers

The Society of Cable Television Engineers board of directors traditionally holds its fall meeting at the site of the next year's Cable-Tec Expo and this year's gathering, held Sept. 17 in St. Louis, was no exception.

The board meeting was preceded by a morning session that hosted meetings of the Society's five standing committees: Training, Engineering, Operations, Planning and Finance. A highlight of this session was the presence of representatives from the engineering subcommittees (Design and Construction, EBS, Interface Practices, In-Home Cabling, and Maintenance Practices and Procedures) currently operating under the supervision of the Engineering Committee.

Committee reports

SCTE Chairman Tom Elliot began the reports from the Society's standing committees with coverage of recent Executive Committee activities. In an update of the board on the progress of the Ad-Hoc International Research Committee, I indicated that there seem to be no major problems in the establishment of international SCTE chapters and no indication that we would need to substantially change the current organization of the Society to accomplish this.

I also reported on SCTE's joining of and participation in the American National Standards Institute. Staff's recommendation is that we participate by becoming a standards developer within that organization.

Western Vice Chairman and Region 2 Director Pam Nobles reported on the Training Committee's recent activities, which include increasing the pool of questions available for use in Broadband Communications Technician/Engineer (BCT/E) exams. Nobles also said the *Installer Certification Manual* was currently being reviewed and a revised edition was planned for publication next year, with a Spanish edition to follow. Also currently in the works are the *OSHA/HAZCOM Manual* and additional chapters of the *Health and Safety Manual*.

Engineering Committee Chairman Michael Smith reported on the committee meeting held that morning with representatives of the engineering subcommittees. The Design and Construction Subcommittee is proceeding well with its fiber and CADD layering projects. Smith also reported that EBS tests have been concluded but the results have not yet been released. The FCC rule making process regarding EBS is currently underway and Smith urged all cable operators to file comments with the commission.

Diana Riley, chairman of the Operations Committee, announced three names that the Senior Membership Subcommittee submitted for elevation to Senior Member status: Gaylord Hart, Randy Midkiff and Dan Nofs, all of whom were unanimously approved for elevation by the board.

In his report on the Planning Committee, Chairman Steve Allen told the board that the Cable-Tec Games Subcommittee is seeking additional members and nominations are being solicited for individuals to run for open seats on the board of directors.

That afternoon, the board formally convened for its meeting, which began with the distribution of the *1993 SCTE Membership Directory and Yearbook*. It is the first edition of this annual publication to be entirely produced in-house by the Society staff, which was represented at this meeting by Director of Training Ralph Haimowitz, Director of Chapter Development Marvin Nelson, Manager of Special Projects Anna Riker, Manager of Editorial and Promotion Howard Whitman and Manager of Membership Services Pat Zelenka.

Expo preparations

The board then heard a presentation on hotel accommodations and convention facilities for Cable-Tec Expo '94. As we were in the city where it will be held, board members expressed their initial (very favorable) impressions of this locale.

The following morning, the Expo '94 Program Subcommittee met to discuss policies and procedures for the upcoming conference. Among the results of the subcommittee's discussions were to move the Expo Evening from Thursday, June 16 to Friday, June 17, and the addition of exhibit hall hours on Saturday, June 18, the final day of the conference.

This gathering in St. Louis enabled the board, staff and guests to "take in" the sights of the city, allowing them to learn of the many attractions and benefits of holding Expo in the "Gateway to the West" and promote them to members in their regions.

On Sept. 16 the board enjoyed dinner and a baseball game (the St. Louis Cardinals vs. the Montreal Expos) at Busch Stadium. Even though the home team lost, we had a great time, and the close proximity of the stadium to the Expo hotels and convention center makes this a very viable activity for Expo attendees in their spare time.

The board had the opportunity to tour the facilities at the St. Louis Cervantes Convention Center, the setting for all Expo '94 activities. The directors and guests were impressed with the center, which is centrally located in town, making it easily accessible to attendees.

We also toured potential sites for the 1994 Expo Evening. The first, St. Louis Live!, is a sports bar that allows patrons to take part in sumo wrestling matches, shoot basketballs, play pool and enjoy a variety of video games.

Another potential Expo Evening setting is the St. Louis Science Center. We all were impressed with the center's many interactive attractions, which included performing "surgery," operating a "spaceship," using radar to determine the speed of passing motorists and building a replica of the city's historic landmark, the St. Louis Arch.

The arch was the final stop on our tour of St. Louis. We watched with great interest a film documenting the construction of the arch (a feat of great architectural and engineering accomplishment) in the early 1960s. While we didn't get the opportunity to ride the tram through the arch itself, all present enjoyed seeing it up close.

As we departed from St. Louis, all in attendance left with a confidence that Cable-Tec Expo '94 would be an enjoyable and exciting event in a city that, from June 15 to 18, will be a gateway to learning, training and fun. **CT**

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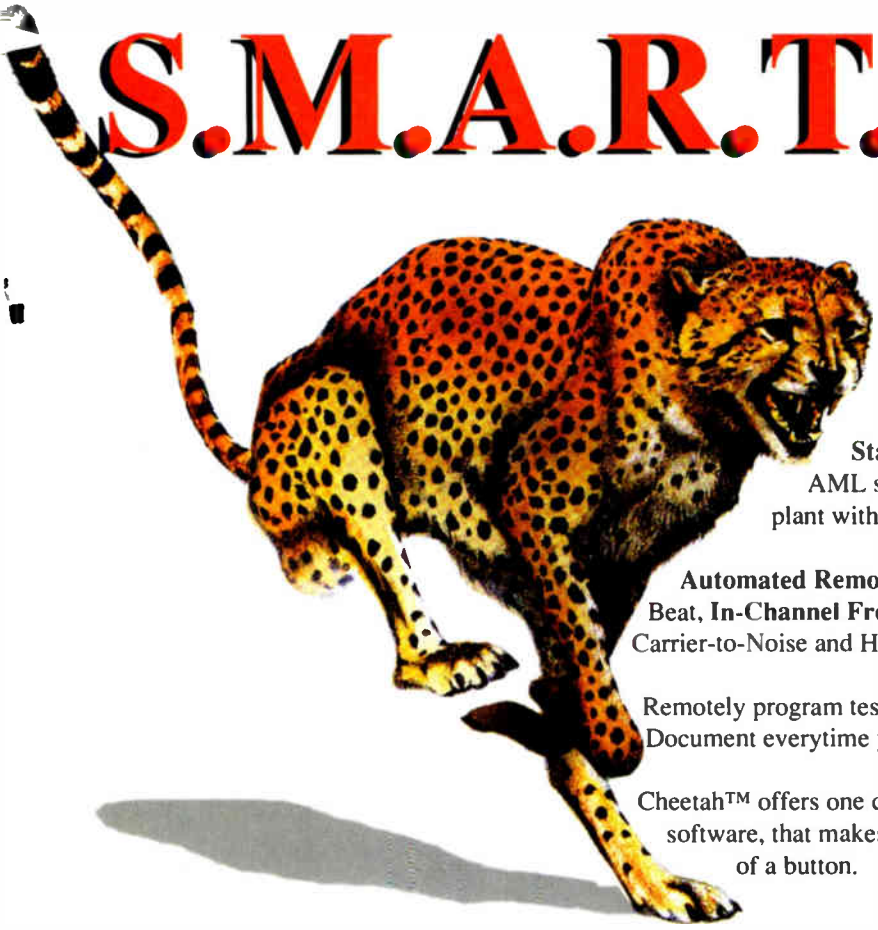

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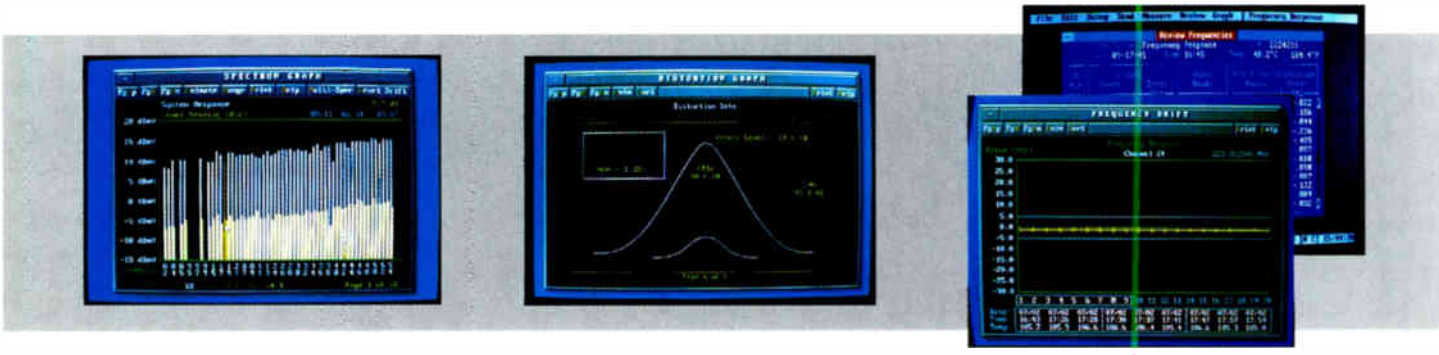

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