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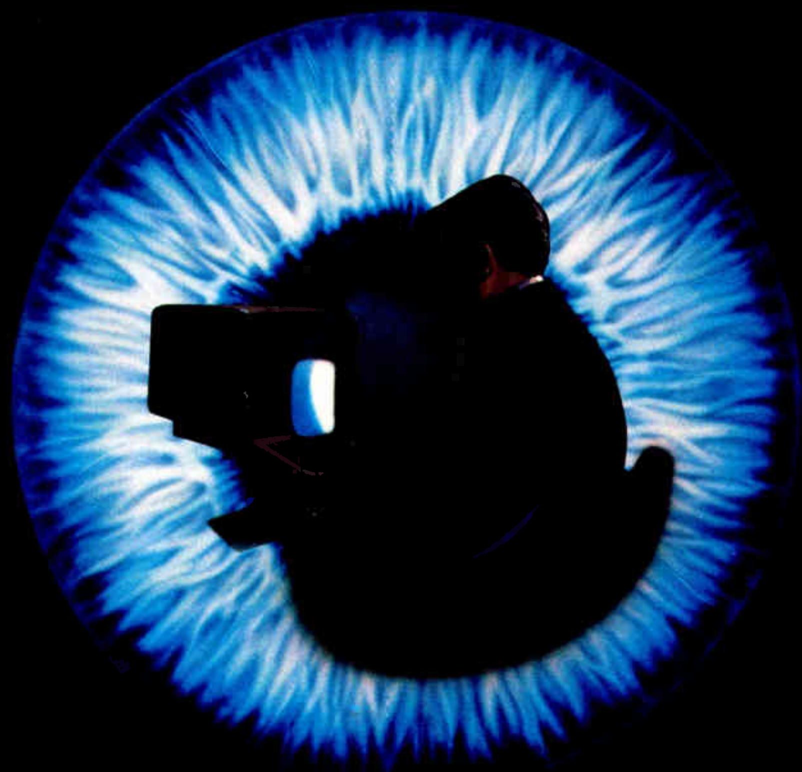

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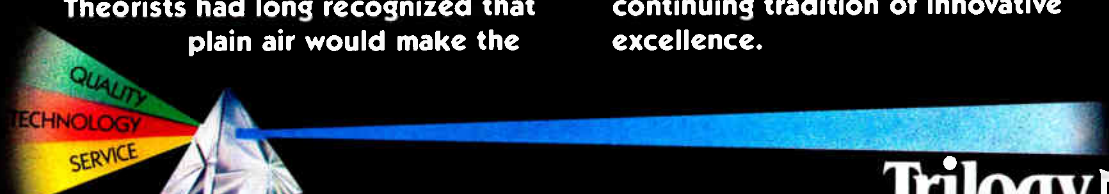

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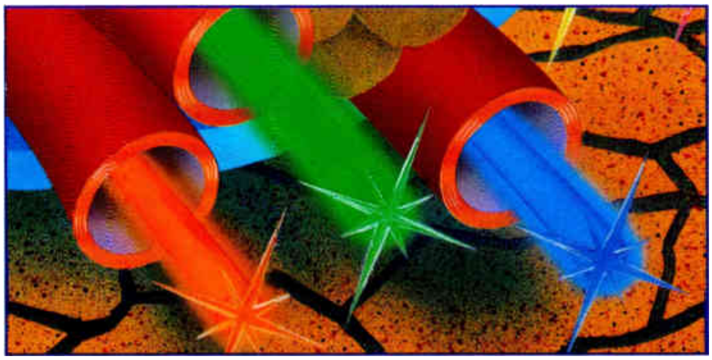
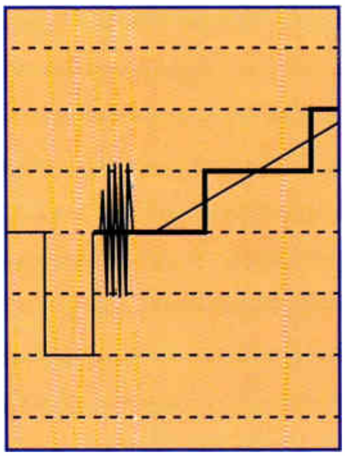


Geri Saye

Back to Basics 77



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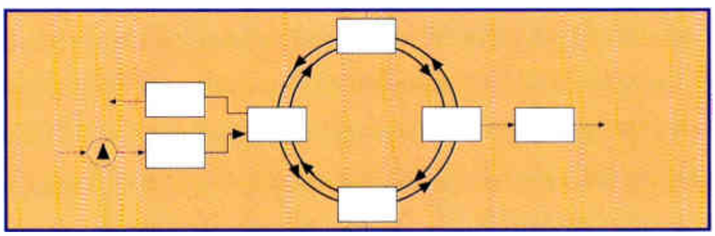

Regional interconnects 32

Features

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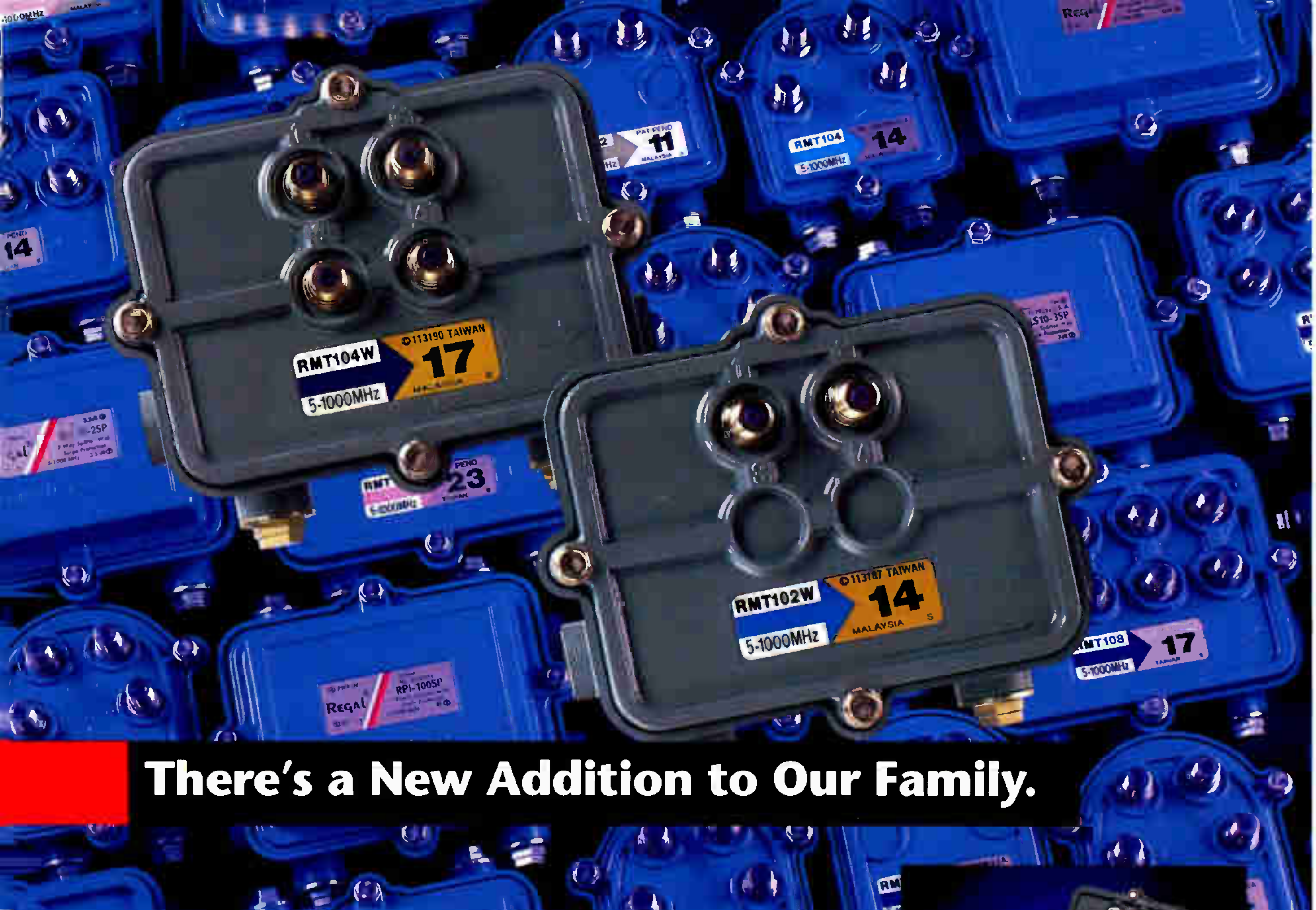

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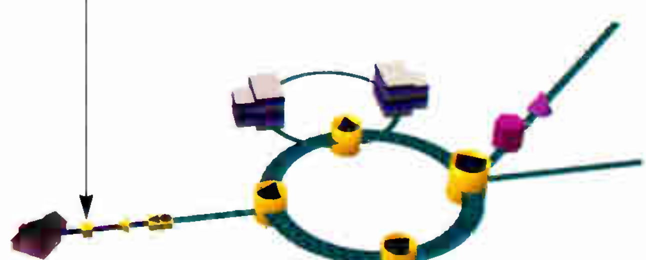


REGAL by ANTEC

Reader Service Number 5

More on wages

My March editorial ("Editor's Letter," March 1994 *Communications Technology*) generated more response and reaction than just about anything that has ever been printed in the pages of *CT*. The magazine received letters, I received letters and phone calls at my office at Coaxial International, and comments were passed along in person in some cases, and via colleagues in other cases. Check out page 10 for a sampling of some of the written comments.

Opinions were split down the middle: those who have to defend cable's low wages generally thought I should be tarred and feathered, and those who receive the low wages think management should be tarred and feathered.

I received a phone call from one technical manager who stated that his company had just spent a very large sum of money to beat a union, and he was concerned that my editorial would stir up trouble again. I listened to his comments, and politely thanked him for sharing his opinion. I wondered after the phone call ended why his and other companies like his are willing to spend big bucks to keep a union out, yet they won't spend that same money on higher wages. (Don't get me wrong. I'm about as anti-union as they come. I've yet to see a decent example in ours and similar industries where unions do much good.)

The most unusual reaction was from a technical manager who is contemplating no longer allowing *CT* to be available to his employees. I think he forgot that *CT* can be delivered to readers' homes.

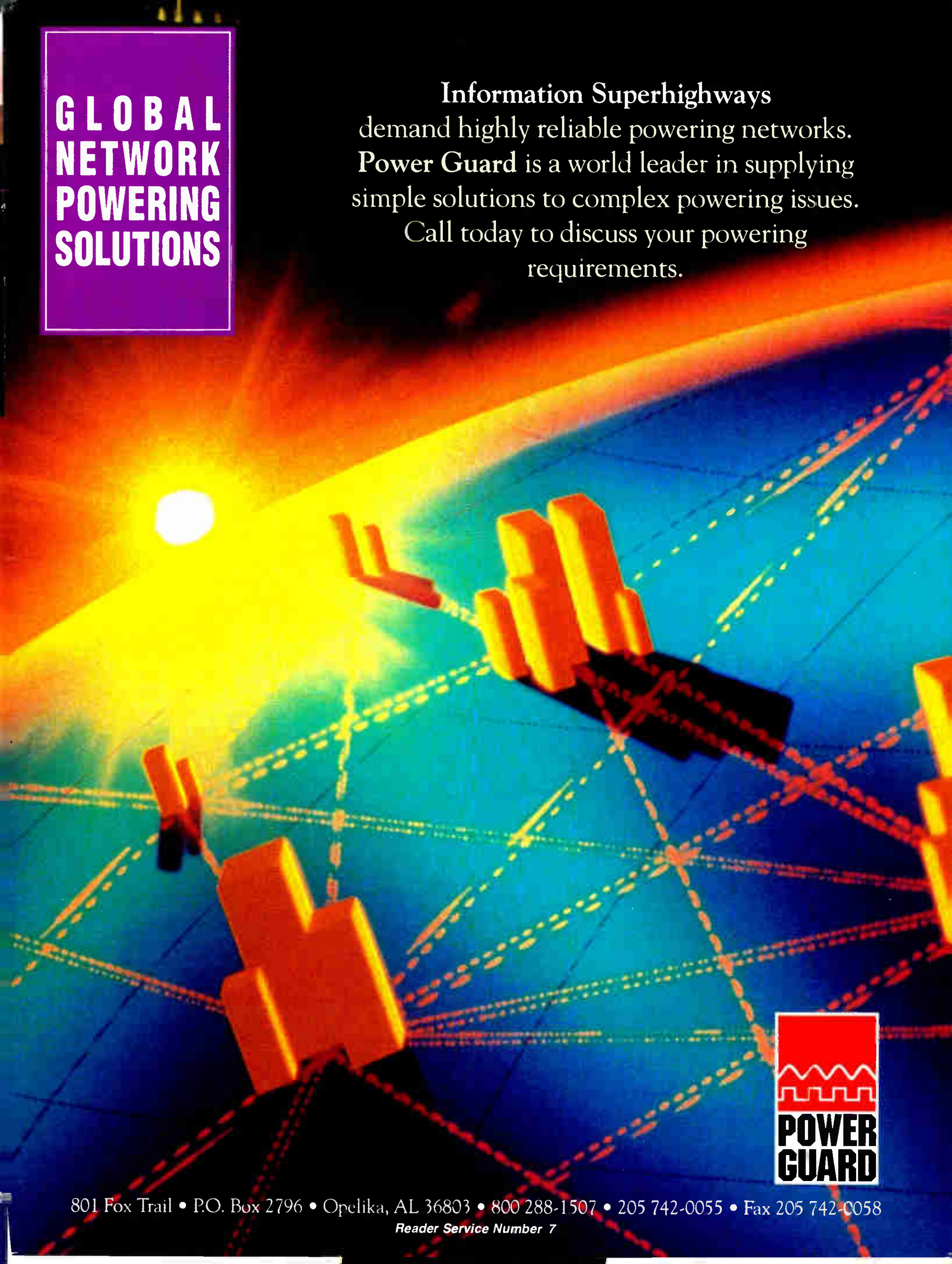
An ironic complaint that comes up time and time again is that it's hard to find qualified people to work in today's advanced cable systems. Uh, right. What kind of talent can be attracted for a S5 to S6 per hour starting wage? My teenage kids make that kind of money

at Taco Bell. If cable did pay the entry level wages I suggested, we would have a much better chance of recruiting the caliber of person that doesn't seem to exist.

I suspect we could raise our standards quite a bit, and find new hires who have a good technical background, perhaps graduates from local two-year electronics colleges. Getting away from hiring just about anyone who walks in off the street might actually help to reduce the total staffing requirements in a typical system, not to mention costly employee turnover.

After all, where do the biggest percentage of our service calls occur? Right! The subscriber drop. And a big chunk of those are craft problems. What if we could eliminate most of those craft-related service calls because of better paid, better qualified, better trained installers? Is there a possibility that we might need a couple less service techs who now spend their days replacing F-connectors?

Ronald J. Hranac
Senior Technical Editor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LETTERS

Feedback on installer wages

The following letters were written in response to Senior Technical Editor Ron Hranac's "Editor's Letter" in the March 1994 issue of "Communications Technology."

I want to let you know how much the technical information that you provide in *Communications Technology is* appreciated. I especially want to congratulate you on your article "Decent installer wages." Your thoughts on the matter are well spoken!

I work for one of the top three MSOs and when your article was received by my co-workers and myself it just confirmed in our minds what we all have known for many years when it comes to low wages.

What really bothers me is the attitude among top level management: "Take it or leave it." Either work for what we give you or leave.

I speak for a large group of technicians that say thanks for bringing up a subject that is conveniently swept under the carpet every year at raise time. Many of us take pride in what we do, but it can't continue as it is. Something needs to be done.

Any further comments or articles on this subject are certainly welcome. Keep up the good work. — *From Ohio*

I am glad that someone other than myself has the same concerns about wages for technicians in the cable TV industry. I agree with you wholeheartedly. If we want to keep good technicians in the cable industry, they have to be compensated appropriately. The technicians should be able to support a family with cable TV as their career but many can't.

I teach at a technical college in Minnesota in the cable TV technology department. For years we have seen our students take jobs with wages in the $6-$7 per hour range. The students that graduate from our program have spent two years learning the ins and outs of the cable industry. Many receive financial aid to go to school or have to take out a loan. A job that pays $6-$7 per hour is hard to live on, even in rural Minnesota.

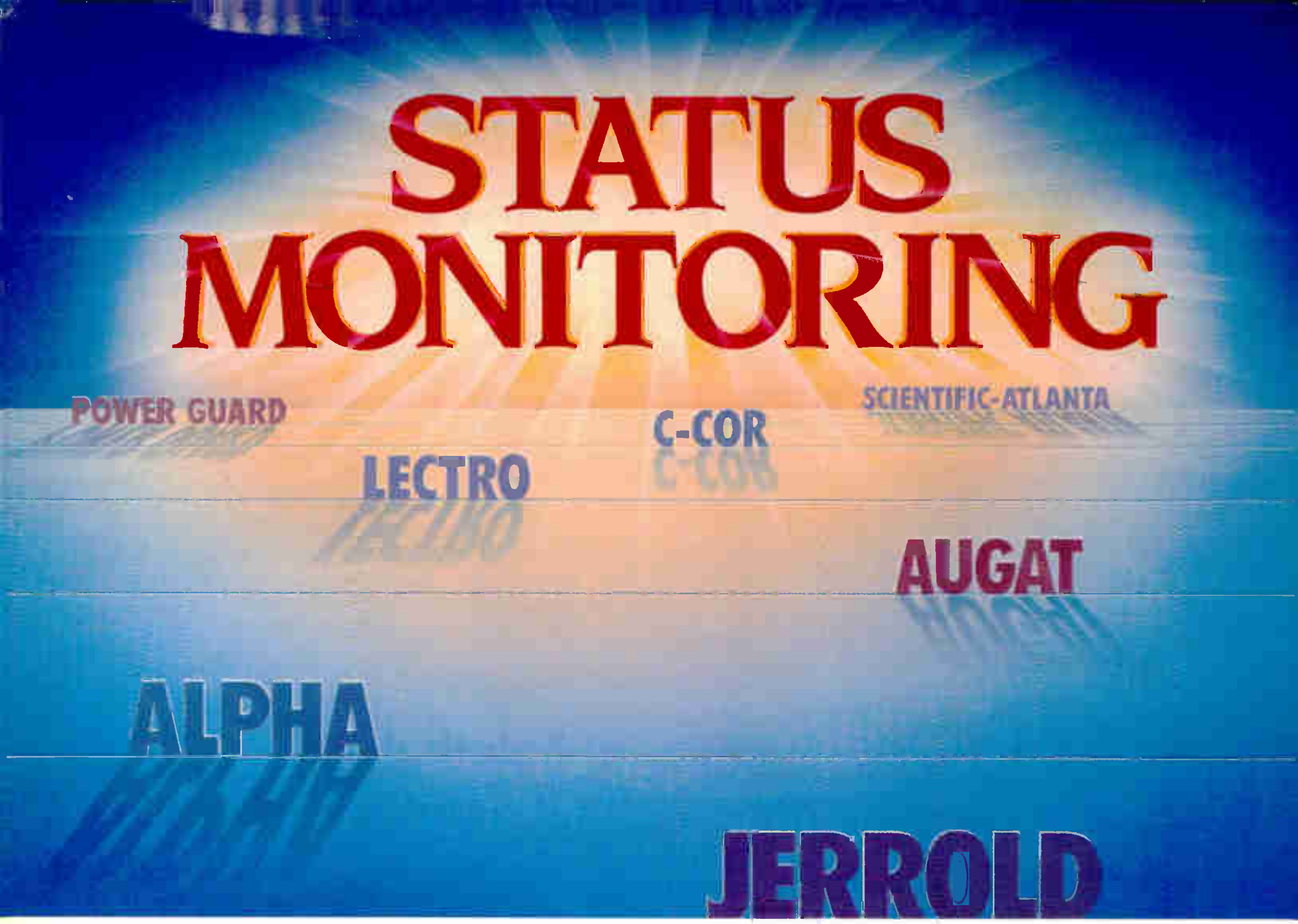
I graduated from the cable TV program here 17 years ago and started at a wage of $5 per hour. It's sad to see that the starting wage has not increased much over 17 years.

With the information superhighway fast approaching, the cable industry needs skilled and trained technicians if we are to survive. They must be and deserve to be paid a good wage. — *From Minnesota*

Thank you for writing the "Editor's Letter" in the March edition of *CT.*

I work for a major MSO in the Midwest. Our installers start in the $6-$7 per hour range but have incentive pay for retrieving converters and/or picking up payments from nonpayment accounts. This incentive bonus can add up to $200 or more a week, which helps a lot. Our customer service representatives also have a bonus for selling premium channels, which puts them in the same pay scale as our installers.

Here's what's strange to me. All of our guys in design are making less than $10 per hour. I'm making $10 an hour after three years. I have four Society of Cable



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Reader Service Number 20

Television Engineers Broadband Communications Technician ribbons. I passed chief tech/engineer training at a national MSO training center and I have an associate's degree in electronics. Our service techs start out in the range of $7.50 per hour, which makes us lower paid than the installers! Job postings go up in the office for services tech spots and no installers go for it. We have hired the last five service techs off the street, not from inside the company.

I agree with you that in order for us to attract quality people to cable, we need to pay our employees enough to afford a house and a car and clothes for our kids. When we tell management that we think we should be paid more ... well, you know the response. We get something to the effect of "Go find another job," which is what most guys do. This is my career and I'm sticking with it. I'm not staying in the field though. I'm going to school so I can get inside where the money is.

I can't tell you how nice it was to hear someone that has some clout in the industry speak out on this subject. — *From Missouri*

You are to be commended for speaking out about the deplorable wages paid for entry level jobs in the CATV industry. Unfortunately, the perpetrators of those "crimes," have no thought or concern for anyone or anything except two bottom lines — their own and the fiscal. Therefore, they will not recognize what is going on by themselves. They wreak havoc upon the "human resources," whose welfare should be their prime concern. There are those in CATV management who should return to the attitude that built the industry. It recognized that the acceptance of our product is entwined with the job satisfaction of the personnel who deal with the public and produce and provide that product.

Strong and convincing arguments can be made for keeping costs down. To really keep them down and at the same time increase revenue requires concern for much more than the miserly wages paid to customer service and technical personnel. Success is bred from and thrives on teamwork — not fear and coercion.

Today, when greed and personal gratification drive so many in authority, employees live in fear of losing what little income they have. Therefore, by keeping silent, they create the illusion of being satisfied. Many have seen loyal hardworking co-workers abruptly terminated to reduce costs, only to be replaced by a neophyte willing to work for lower wages. Training, which would increase a worker's value — and earning power — is frequently denied.

There is much that can be improved in the technical and customer service fields. Unfortunately, too many in power look outward to find blame for the problems they deal with, not inward where much of the trouble began. For the sake of the industry that for the best part of 38 years has been good to me, I hope that those who can build as well as manage will be granted the chance to encourage qualified people. Doing so will solidify the industry into a major telecommunications service provider.

Meanwhile, please continue using the forum of the printed page to speak out as frequently as you can. When the right people get the message, we shall become serious players in the telecommunications world of tomorrow. — *From Missouri*

I wonder if Mr. Hranac would pay his installers $12 an hour if he knew he could hire equivalent people for $7 an hour if

(Continued on page 100)

Jones, Bell Canada announce agreement

Jones Intercable signed a definitive agreement with Bell Canada solidifying the terms of the strategic alliance contemplated by a letter of intent between the companies announced in December 1993.

The agreement provides for BCI to invest $206,250,000 in Jones Intercable in return for 7.5 million shares of Class A common stock of Jones Intercable. This is in addition to the $55 million already invested in the company by BCI in March 1994 at $22 per share, which resulted in BCI acquiring an approximate 13% interest in Jones Intercable. In addition, BCI has agreed to purchase for cash 30% of any Class A common stock sold by Jones Intercable to third parties in the future at a price per share equal to the price received by Jones Intercable from such third parties until such time as BCI has invested an aggregate of $400 million.

BCI will have certain rights with respect to the governance of Jones Intercable, including the right to nominate up to three directors to the Jones Intercable board, and to jointly nominate with Jones International Ltd. up to three independent directors to the board. As well, BCI will obtain a future option to acquire a controlling interest in the MSO. Also, BCI will invest $18 million in Jones Education Networks (a 15% interest), $5 million in Jones Lightwave (a 50% interest) and $7 million in Jones Entertainment Group (a 20% interest).

Digital mod tests: CableLabs, vendors

Several cable TV vendors have agreed to work with Cable Television Laboratories on digital modulation initiatives. The companies are General Instrument, Scientific-Atlanta and TV/COM International.

The initiatives include testing at CableLabs' facilities various implementations of digital technology and sharing information about the attributes of cable TV systems that would affect the transmission of digital signals.

The early stages of the digital modulation testing, which were set to start in mid-June, will focus on the quadrature amplitude modulation (QAM) technology that cable operators intend to deploy in the United States beginning in mid-1995. A total of 10 cable operating companies have announced plans to deploy some 3 million digital compression boxes using the 64-QAM technology.

Also to be tested will be advanced and more aggressive forms of modulation that cable companies are evaluating for potential deployment in the future.

General Instrument has committed to provide CableLabs with a prototype of the DigiCable 64-QAM system. S-A will provide CableLabs with production 64/256-QAM modulators and demodulator board using the company's full custom 64/256-QAM chip set. TV/COM has been developing high performance, programmable single chip, all-digital quadrature phase shift key (QPSK) and QAM chip architectures for second-generation digital networks. It will investigate, in conjunction with CableLabs, the merits of variable bandwidth, variable order QAM capabilities in today's networks.

Supercomm hails cable

Supercomm traditionally has been a telephone industry trade show. Vendors exhibit everything from pay phones to telephone testing equipment. But at the recent conference in New Orleans, cable had a surprisingly strong presence.

Cable vendors displaying their wares included Scientific-Atlanta, ANTEC, General Instrument and C-COR, among others. But several traditional telco vendors are planning to sell equipment for next-generation broadband networks as well.

Most of the next-generation equipment was in a prototype stage. Vendors had an announcement with a pretty picture of the proposed layout in their booth, or a prototype that only performed a fraction of what the finished product would do.

There were exceptions. First Pacific Networks (FPN) was showing its fiber/coax network for voice, video and power networks, which the company has been selling commercially for some time in the United States and the United Kingdom. Many of the electric companies are holding off on their deployment until the next version appears some time next year. Entergy, which had at one time intended to install a hybrid fiber/coax network to 400,000 homes by the middle of 1994 for power management, has taken a 10% investment in FPN and is working to enable all of the features it's interested in before installing the network.

GI/Jerrold was demonstrating several prototype components for its version of the network of the future. These included telephony over coax equipment, and a H.320-compatible video terminal that it is hoping to sell for about $300 without the video camera. Jerrold is working with the DSC Communications' Lightspan digital cross-connect system and is developing a module that plugs into Lightspan, as well as the coax amplifiers and set-top boxes. Trials are planned for early 1995 and full deployment of the system by the end of 1995.

Scientific-Atlanta announced its Broadband Integrated Gateway at the show, which will convert and deliver a wide variety of MPEG packet-based video, audio and data communications. It can support SONET at up to 155 Mb/s, ATM, MPEG packets, FDDI, Ethernet and QAM 64/256. S-A chose QAM over VSB because the silicon is available today at reasonable prices. The unit will eventually sell for $10,000 to $20,000 depending on how it is configured. The product is expected to be commercially available by this fall.

ANTEC was busy showing off its Cable Loop Carrier-500. It is architecturally similar to what AT&T is planning for California and Manassas, VA. One of the interesting twists is a proposed digital video server than can store scrambled analog signals. In theory this would enable a cable operator to deploy video-on-demand (VOD) services on any network with addressable set-top boxes, without having to change out the boxes.

Raynet also was showcasing a hybrid fiber/coax architecture for the local loop, which it is planning to have available this fall. The architecture is based on many of Raynet's existing products, including its LOC-2 hardware and RIDES operations support

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system software. Raynet plans to provide the components for both fiber-to-the-curb and fiber/coax hybrid networks, enabling telcos to deploy either architecture with the same building blocks. Raynet also announced a collaboration with Zenith on the development of ATM processing and digital modulation equipment based on Zenith's 16-VSB technology.

Tellabs, the largest supplier of digital cross-connects in the U.S., also plans to begin selling hybrid fiber/coax products.

What was surprisingly absent was a fiber/coax network from AT&T, considering it is sitting on top of billions of dollars in contracts to build them. Although AT&T had a broadband switch, which was being used to shunt ATM cells around, it did not showcase any of the coax local loop products. Some industry insiders speculated that AT&T will probably subcontract out much of the coax portion of the network equipment to other providers — and the Supercomm show seemed to illustrate that there was no lack of them.

Video-on-demand issues

In a Supercomm conference session, "Video-on-Demand Appears in the Marketplace," Dr. Lawrence Burton, director of strategic planning for Reliance Comm/Tec, talked about some of the issues involved in building next-generation networks. He pointed out that MPEG makes sense as a transport mechanism for near-VOD, but it is poorly suited for interaction. "But how many people want to interact with blockbusters. They just want to sit down and watch it," Burton said.

On the other hand, if you are going to be transporting video over SONET rings, there is no question that ATM will be on the backbone. Furthermore, ATM is ideal for interactive services. But there is a problem with synchronizing the audio and video. If there is any timing or delay in the network, it can throw synchronization off, creating a potential bottleneck in the ATM buffer.

Burton said, "There is never enough (buffer capacity) unless you can set maximum bounds on the total amount of jitter you can get between ATM switching elements, set-top box elements and video server elements. All those elements need to be synchronized."

Burton pointed out that the telephone network of today uses closed network management, which keeps individuals from messing around with the network to reroute their own signals. Furthermore, there is no content provision. The network of the future will not be that.

We will see multivendor signaling. Burton explained that service cannot be deployed ubiquitously unless the services can be developed independently of whose equipment you have in the network. — *George Lawton, West Coast Correspondent*

The following news appeared in the "CT Daily" at the National Show in New Orleans. For a look at the new products from the show, see the wrap-up beginning on page 61.

NCTA exhibit: "Cabletown, USA"

The National Show, with a record-breaking 22,585 attendees (up 40% over last year), featured a joint industry exhibit, "Cabletown, USA," showcasing what the cable industry is today in communities across the country in order to build the telecommunications world of tomorrow. Building on the show's theme "Cable — Bringing The Future Home," the exhibit highlighted a sampling of programs and technologies developed by the cable industry that already are in use today. This special presentation, the first of its kind at a cable show, included: Cablevision Systems' offering ATM and medical imaging in New York; Cox Cable's interactive services in Omaha as well as its debut of Prodigy in San Diego; TCI's classroom of the future in Carrollton, GA; Times Mirror's cable test of electronic commerce in Phoenix; Time Warner Cable's full service network in Orlando; Viacom Cable's new-build in Castro Valley; Jones Intercable's contribution to education via MEU and the Library of Congress project; Cable in the Classroom's Media Literacy project; C-SPAN's on-location bus; and CableLabs demonstrating telephony over cable, video telephony and high-speed data transmission. (Companies included ANTEC, AT&T, Digital Equipment Corp., General Instrument, Grass Valley, Intel, Motorola and Tandem.)

Cable vets consider FCC regs aftermath

At the National Show, several industry veterans gave their impressions on the evolution of cable TV in the aftermath of the Federal Communications Commission's new regulations.

Barry Elson, senior vice president of operations at Cox Cable, said, "With reregulation our operators are going to have to drop some of those balls they have been juggling."

Elson believes it will take 18 months to two years before the industry can figure out how to optimize services and pricing for the new regulatory framework.

John Hendricks, CEO of The Discovery Channel, said that one of the unintended side effects of the new regulations, is that it limits cable companies' ability to make a profit by offering low-cost programming. In the past, cable operators could charge 50-60 cents for programming that only cost them 20 cents. This was required in order to recoup costs for the additional equipment required to provide the service.

Under the new FCC regulations, a cable company can only charge 7.5% more for the programming, or about 1.5 cents, which leaves no margin to make a profit. Hendricks said, "The incentive for adding low-cost package services has eroded."

The tough regulatory climate in the U.S. may be forcing some companies to invest abroad where the returns on investment are higher. Richard Green, CEO of CableLabs suggested, "Many of our companies are looking for regulatory asylum offshore."

Set-top logjam on info highway

Last month the FCC issued a decree regarding the compatibility between set-top boxes and TV sets. The FCC decided to adopt all of the recommendations made by the C3AG working group composed of cable and consumer electronics engineers. However, the commission left itself 90 days to finalize its decree on the interface between the set-top and TV set.

Wendell Bailey, vice president of science and technology for the National Cable Television Association, said at the National Show there were still two issues that needed to be resolved regarding this interface still being negotiated by C3AG. First, the cable industry would like to create a standard that would enable the TV remote control to activate features on the decoder. That way consumers will have access to electronic program guides and barker channels via the TV control system.

This requires a command set for communicating between the two devices. Bailey said that the consumer industry wants to make that command set as narrow as possible, so that cable decoder services will not be able to compete with those offered through their TV sets.

But since TV sets have a lifetime of 15 years today, this could make it difficult for consumers to have access to all of the latest services in the future. Bailey said, "There will be a time when these services migrate into the TV set, and that is fine with us, but we don't want to prevent consumers from taking advantage of these."

The second issue is that the consumer electronics faction has requested that the group work on a standard for a digital tuner, which Bailey said the cable faction was reluctant to do. Now the consumer faction has decided that they really are not interested in creating the digital standard.

Bailey said, "Now we are struggling with whether we should hold their feet to the fire, or get on with getting the rest of the details handled."

H-P, GI pen DigiCipher deal

Hewlett-Packard announced that it obtained a license from General Instrument Corp. to use GI's DigiCipher II access and control, compression and transmission technology in H-P's set-top boxes. This will enable H-P's equipment to be compatible with GI's uplink encoding and headend equipment. This development motivated TCI to increase its order of H-P's set-tops to 500,000, and Comcast Corp. to order 150,000 of the set-tops.

The set-tops are anticipated to be available for installation in cable systems in 1995, and will include technology from a variety of new partners. ESP, owned by ANTEC, will design an analog descrambling system for the boxes. Broadcom will provide H-P with 64-QAM receiver technology. Dolby Labs will provide its Dolby AC3 multichannel digital sound technology that will deliver high-quality, two-channel Dolby Pro Surround-Sound compatible digital audio.

Pioneer news: New people, deals

Walt Ciciora, Ph.D., a leading consultant to the cable TV, consumer electronics and telecommunications industries, signed an agreement with the Cable and Broadcast Systems Group of Pioneer New Media Technologies to avail his talents to the company. Before starting his consultancy, Ciciora was a vice president at Time Warner Cable and a senior manager at Zenith Electronics Corp. He holds nine patents, has published numerous papers, served on several industry standard-setting committees, and has been a columnist with leading trade journals.

The company also announced the reorganization of its field service operations in Columbus, OH. Field services has been divided into sales engineering for regional and 24-hour sales support, and technical support, the in-house support group for product and software engineering. The two groups are headed respectively by

newly appointed managers Glenn Sigler and Joe Roaden. Additional promotions include: Rich Annibaldi, director of product engineering; John Unverzagt, director of quality assurance; Jerry Neal, chief software engineer; Wyatt South, senior software engineer; Mark Spangler and Mike Sterling, senior field service engineers; and Dan Wiltshire, senior product engineer.

In contract news, the company announced it is supplying 2,500 BA-9000 addressable terminals to Times Mirror Cable TV for a test of Your Choice TV scheduled for its Dimension Cable system in San Diego. Your Choice TV is a cable service that packages TV programming and delivers it to customers on demand. The BA-9000 was selected for its near-VOD/ PPV features, icon-driven customer menus and signal security.

Also, Pioneer New Media Technologies and General Instrument have begun discussions concerning the licensing of GI's DigiCipher II video compression technology. Discussions also will include DigiCipher II formatting capability with Pioneer's Digital LaserDisc and Optical Disc products being developed for digital playback.

Finally, Pioneer announced Cox Cable Cleveland has begun upgrading its customers' cable boxes with new BA-9000 addressable terminals. Cox, which serves 60,000 customers in the Cleveland area, is in the process of increasing the number of channels it offers from 38 to 72, including a proportional increase in PPV offerings.

New team: S-A, Apple, IBM

Apple Computer, IBM Corp. and Scientific-Atlanta announced their intention to form, subject to reaching a definitive agreement, a combined technical and business team in which they will work together to create an open architecture for the evolving interactive TV marketplace. The goal is to build scalable interoperable and open interactive TV interfaces, based on existing technologies from all three companies. The scalable operating environment would be designed for use with digital home communications terminals (HCTs). The intent is to develop a systems architecture describing a total operating environment and would include the ScriptX application model from Kaleida — the joint venture between Apple and IBM, the object model interfaces known as SOMobjects/DSOM and OpenDoc, and the PowerPC family of microprocessors. ScriptX is an object-oriented high level language and system software technology designed for creating multimedia titles on a wide range of digital platforms, from HCTs to interactive game machines to high performance workstations.

Scientific-Atlanta also announced a strategic partnership with Broadcom Corp. in the development of digital video transmission technology. One of the first results of this partnership is the world's first very large scale integration (VLSI) implementation of a 64- or 256-QAM chip set for digital TV set-top terminal applications. This QAMLink system chip set, developed by Broadcom with the assistance of Scientific-Atlanta, is being used in S-A's digital HCTs. A 64/256-QAM system consists of a modulator at the headend and a receiver in the digital set-top terminal. The receiver utilizes the QAMLink chip set. Broadcom intends to sell the 64/256-QAM chip set to Scientific-Atlanta and other leading terminal manufacturers that support the QAM open standard and interoperability network.

Finally, S-A announced plans for new initiatives that will double its worldwide production capacity of advanced analog and digital home communications terminals, 750 MHz cable distribution equipment and fiber-optic cable TV equipment. The two Atlanta-area plants are now in startup and are expected to be in full production by fall.

NCTA kudos: Vanguard Awards

The National Cable Television Association presented its 1994 Vanguard Awards as well as its special Board of Directors Award at the National Show. Vito Brugliera, vice president, technology market planning for Zenith Electronics Corp., was this year's Vanguard recipient for science and technology.

Other winners included TeleCable's Richard Roberts and Tele-Communications Inc.'s Sharan Wilson (distinguished leadership); Scott Sassa (young leadership); A&E's Nickolas Davatzes (programmers); C-COR's Dick Perry (associates); TCI Central's Charles Hembree (state/regional association leadership); Prime Cable's Mark Greenberg (marketing); and Showtime's McAdory Lipscomb Jr. (public relations). The Board of Directors Award went to Showtime's Winston Cox.

GI, Puma make interactive pact

General Instrument and Puma Technology announced an agreement to supply wireless broadband access software for GI's LinX multimedia platform. Based on Intel's X86 microprocessor architecture and a Microsoft operating system, the LinX serves as an interactive module for next-generation GI addressable converters.

Puma will develop a wireless "data transfer engine" to interface LinX to mobile computing products, including PDAs, subnotebooks and notebooks and peripheral/input/output devices such as remote controls and printers. The software will support wireless network access and navigation simultaneous with TV viewing; the ability to download and upload files between mobile computers and LinX networks; and the use of mobile computers as wireless I/O devices. Puma also is developing an intuitive user interface that will launch cable-ready applications and facilitate access to the many services available on the LinX network.

Philips unveils new deals at show

Philips Broadband Networks signed an agreement with Zenith Electronics Corp. and Compression Labs Inc. to combine efforts in offering cable operators, telecommunications companies and other network providers essential signal delivery products for full-service digital and analog networks. The products produced under this agreement will offer network providers the ability to operate in both digital and analog domains through open architecture, consumer-oriented decoders and, for the first time, access a common integrated network management and security system. The alliance will design and manufacture digital VOD and hybrid digital/analog set-top terminals. The first of the products is their Media Access family of set-top decoders, with which network providers will be able to bring a wide range of programming into the home such as video-on-demand, video games, home shopping and other video services, with two-way interactive communication available.

Philips also has been selected to supply over 1,800 miles of 750 MHz RF distribution equipment for Time Warner's system upgrade in Charlotte, NC. The $4.7 million contract calls for Philips to outfit the two-way interactive network with its Spectrum 2000 trunk network amplifiers, global network amplifiers and line extenders. The system upgrade begins this month and is expected to be completed no later than December 1997.

☛ Electroline Equipment Inc. will move to a new headquarters facility this summer that will triple its production capacity. The new 35,000 square foot facility in Montreal is part of a modernization program that will lead to installation of automated surface-mount technology in about a year. The firm also will increase its customer service staff by about 10%.

☛ Jerry Conn Associates announced that it signed an agreement with General Instrument that will make Jerry Conn a stocking distributor. Currently, the company stocks 600 MHz and 1 GHz taps, line extenders, mini-bridgers, 750 MHz platform amplifiers and accessories.

☛ C-COR announced that Continental Cablevision placed an order for its new 700 Series FlexNet amplifiers to be used in a rebuild project that will offer services passing 135,000 homes in suburban Chicago. The company also announced it will construct a new building adjacent to its present headquarters in State College, PA, to meet demand for new product sales.

☛ General Instrument announced that Time Warner will use 750 MHz GI Cableoptics technology for its full service network (FSN) rebuild in Charlotte, NC.

☛ Power Guard announced that it recently completed an 18,000 square-foot expansion of its manufacturing facilities. Additional manufacturing and design equipment also has been added. The expansion will allow the company to continue its rapid growth and better serve and support its existing customers in the worldwide broadband communications equipment market. The expansion was funded principally by a $3,350,000 industrial revenue bond by the industrial development board of the City of Opelika, AL.

☛ Contec has been selected by General Instrument to have the primary in-warranty repair responsibility for GI's set-top terminals. As GI's designated primary in-warranty repair operation, Contec will be responsible to GI and its customers to provide converter repair to OEM standards with rapid turnaround. As a result of Contec's successful completion of a pilot program for in-warranty repair launched in September 1993, GI will now shift a larger segment of its repair activity to Contec from its Matamoros, Mexico, repair facility. A sixth repair operation in Phoenix is scheduled to open this year.

☛ American Lightwave Systems' DV6000 has been selected by Suburban Cablevision for a regional metropolitan area backbone network linking its New Jersey systems. The network will serve approximately 240,000 subscribers. ALS also announced a contract with Ameritech for the supply of an estimated $25 million in Homeworx equipment.

☛ Cadix announced that it opened its new regional office in Southern California in April. As well, the company announced the first successful cable TV installation of the CX-2001, AD-4001 and FX-7001 in Multimedia Cablevision, Wichita, KS, and Oklahoma City.

☛ Channelmatic announced its Adcart/D digital beta test sites are scheduled for completion on June 3. Also, the company announced Mike Neal has joined its product management department. He will focus on the CATV segment of the companies digital product development.

☛ ICTV named William Grubb CEO with responsibility for managing the company's strategic direction and shaping its role in the coming convergence of communications companies. ICTV, a supplier of advanced interactive TV systems, has been selected by Cox Cable as the system integrator for Cox's upcoming trial of full-service interactive TV in Omaha, NE.

☛ ANTEC announced that Greater Media has purchased the company's Gateway optical receiver, a bidirectional, fully redundant-capable receiver platform that accommodates interactive voice, video and data transmission capabilities.

Reader Service Number 15

Awards at Expo '94 luncheon

The Society of Cable Television Engineers held its Annual Awards Luncheon June 15, the opening day of Cable-Tec Expo '94, at the Cervantes Convention Center in St. Louis. The following members and organizations were recognized at the luncheon:

• Expo Program Subcommittee members Larry Lehman and William Riker (co-chairmen), Roger Brown, Dan Delaney, Paul Levine, Ginny Morris and Wendell Woody received awards for their efforts in creating the Cable-Tec Expo '94 technical program.

• The Program Subcommittee of the Emerging Technologies 1994 conference was recognized for its efforts in the planning of the phenomenally successful January 1994 conference. Receiving awards were: Ted Hartson (chairman), Dean DeBiase, Mike Kaus, Harold Mackey, Dan Pike and Rex Porter.

• The former Floribama Meeting Group was elevated to full chapter status in the Society.

• Outgoing members of the SCTE board of directors were recognized: Norrie Bush (Region 3), Bill Arnold (Region 4), Jennifer Hays (Region 5), Jack Trower (Region 8) and Walt Ciciora, Ph.D. (Region 12).

• George Grills, Anthonie Herrman, David Hollowell, Larry Langevin and Ronald Larock were elevated to senior member status in the Society, in addition to Al Dawkins, Gaylord Hart, Randy Midkiff, Dan Nofs and Matt Stanek, who were elevated earlier this year.

• Dick Beard, Robert Behrens, Keith Burkley, Kenneth Covey, Patrick Kelley, Jack Sachs, Mark Smith and Alan Tschirner were recipients of Personal Achievement Awards. Created in 1986 as the Outstanding Achievement Awards and renamed in 1991, these awards recognize SCTE members who are outstanding in the performance of their respective jobs.

• ANTEC was the recipient of the 1994 Chairman's Award in recognition of its support of the Society and the industry.

• Sandy McKnight of Capitol Cablevision received first place in SCTE's third annual Field Operations Award competition. Mel Welch of Genesis Cable and Paul Harris of Ventura County Cablevision were the second and third place winners respectively.

• Alex Best, Ron Cotten and William Grant were inducted into the SCTE Hall of Fame. In 1988, SCTE created its Hall of Fame and honored Cliff Paul as its first inductee. The second inductee, Len Ecker, was honored at Cable-Tec Expo '91; Rex Porter, Jim Stilwell and Dave Willis were inducted in 1992; and at last year's Expo, Steve Bell and James Grabenstein were inducted.

• Wendell Woody was the 1994 recipient of the Society's Member of the Year Award in recognition of his service to the Society. The Society's chairman from 1990 to 1992, Woody currently serves as an SCTE at-large director and has a long and distinguished record of participation in the Society.

Society creates new subcommittee

SCTE has announced the establishment of the Material Management/Inventory Subcommittee, which was created to write a material bar code specification for use by the cable TV industry.

Michael Smith, chairman of the SCTE Engineering Committee, under whose auspices the new subcommittee will operate, indicated that SCTE recognized an industrywide need for a standard, machine-readable part number marking system that would allow operators to utilize state-of-the-art computerized material control systems.

Thomas Gimbel, vice president of engineering for Helicon Cablevision, has been named subcommittee chairman. Gimbel stated that the industry must become more efficient and that the bar code is the keystone of any such effort.

The subcommittee's plan is to produce a marking specification that cable operators could include as material marking requirements in their purchasing documents. A data base manager will issue part numbers to manufacturers similar to the retail industry bar code system. Once the bar code and uniform part numbers are in place, each operator could implement their own bar code reading system.

The Material Management/Inventory Subcommittee held its first meeting on Tuesday, June 14, in conjunction with SCTE's Cable-Tec Expo '94 in St. Louis.

"Cold Supper" donated to SCTE headquarters

A new art print recently began gracing the halls of SCTE national headquarters. "Cold Supper," Calvin Carlson's painting of a familiar CATV scene, was hung in the Society's offices following its donation to SCTE by Carlson and Bill Norris.

"This is a great tribute to the technical folks who make up our membership," stated SCTE Director of Training Ralph Haimowitz of the painting, which portrays a CATV line technician performing his duties on a pole while watching a beautiful sunset, fully aware that a "cold supper" awaits him to his late arrival home caused by his dedication to his work.

Carlson explains: "To accomplish my established duties, cold supper became a way of life. Now 'Cold Supper' has become a limited edition print of a commissioned oil painting and shows us the humble beginning of the cable business.

"Years ago, Norman Rockwell painted a telephone lineman, giving that industry permanent recognition of its accomplishments. 'Cold Supper,' the print, was created to recognize the past, present and future of the cable industry."

For further information on "Cold Supper," call (612) 235-8109 or write to: Fun Time Impressions, Box 536, Belgrade, MN 56312.

Past President Larry Dolan dies

It is our sad duty to report SCTE past President Lawrence "Larry" Dolan passed away May 13 after a brief illness. He served as president and CEO of Mitek Systems of San Diego. He was credited with the company's diversification into the electronic imaging market.

Larry came to California in 1985 as a sales and marketing executive vice president of operations prior to joining Mitek. Earlier in his career, he co-founded and was president of Mid-State Communications in Indianapolis

A 20-year member of SCTE, Larry served as the Society's president from 1980 to 1981.

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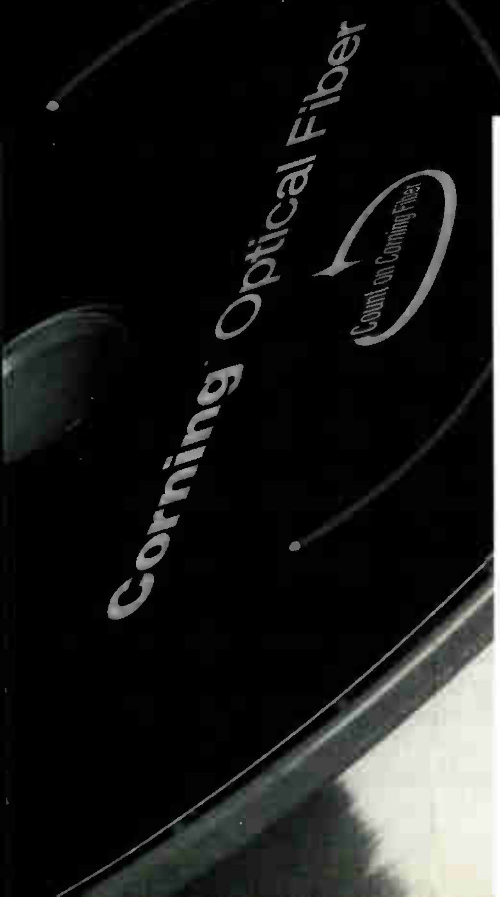

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Reader Service Number 36

Analog vs. digital: The basics

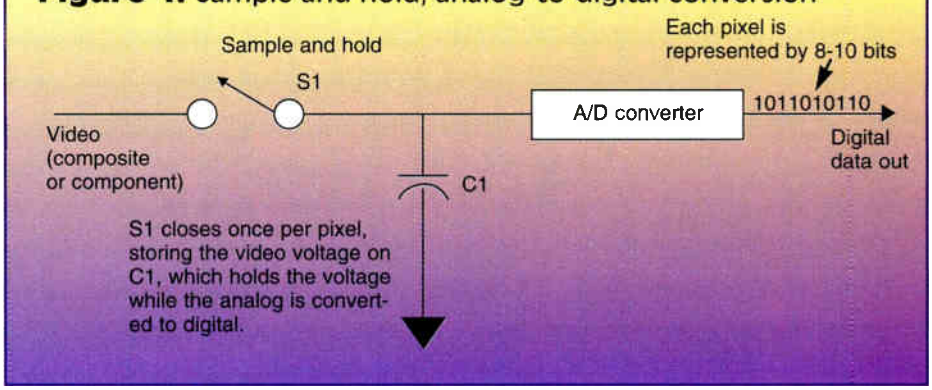
By James O. Farmer
Chief Technical Officer
Electronic System Products, ANTEC Corp.

Digital transmission is here now and will become common over the next few years. While much is being made of digital signal delivery to the home, there are those who believe that digital transmission in the plant will become popular first, primarily as a result of need/cost trade-offs. In any event, the following shall discuss briefly some of the basic issues surrounding digital transmission of video.

Remember when "analog" was not a dirty word? In fact, there was a science fiction magazine by that name. But time and technology march on, and the tide has turned toward digital processing as a result of the present state of the art in integrated circuit technology. Analog circuits require accurate correspondence between input and output but at relatively low speeds. On the other hand, digital circuits allow very loose correspondence between input and output but the trade-off is that they must operate at much higher speeds. This is the easiest way to build low-cost integrated circuits: lower accuracy but higher speed.

There are things that can be done more effectively with digital circuits than with analog ones. For example, analog data can bestored in charge coupled devices but we wouldn't like the results if we tried to store it for long. When we store analog data, we must store a precise voltage level, which is hard to do. On the other hand, we can store digital data for a long period without degradation. When we store digital data, we store one of two charge levels, representing either a logic one or logic zero, digital data being composed of only those two states. When we retrieve data, we need only distinguish between these two levels. The trade-off is that we must store a lot of different pieces of information (bits, or binary digits) to represent what we would have stored in just one piece of analog information. However, we can store a lot of digital information easier than we could store just one piece of analog information.

Figure 1: Sample and hold, analog-to-digital conversion

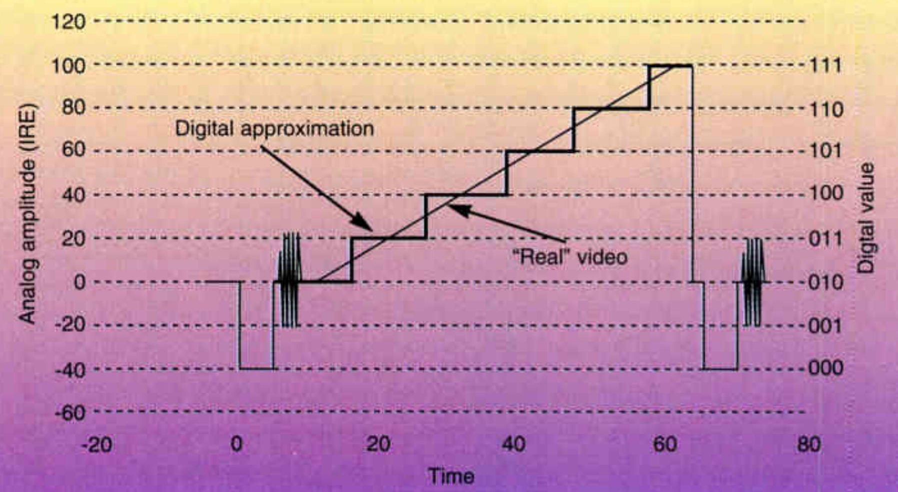


Sampling and A/D conversion

The world is analog, however, so we begin by converting information from analog to digital form. We do this using an analog-to-digital (A/D) converter. Before we can convert from analog to digital, though, we must sample the signal. This is the process of, in effect, "freezing" the signal at a particular value and holding it there until the next sample time. TV pictures are broken into frames. A frame is a sample of the entire picture, taken 30 times a second in the NTSC system. (Each complete frame is composed of two halves or fields. Thus, two fields make a frame. We have 30 frames per second or 60 fields per second.) Similarly, we must break each picture into time samples for each "piece" of the picture, which we call "pixels" (picture elements). We must sample them close enough in time to avoid artifacts — things that appear but are not really part of the scene. If we start with an NTSC picture (or any signal) that has a bandwidth of about 4 MHz and then sample it, we must do so at a sampling rate exceeding twice the highest frequency component or 8 MHz. This theoretical minimum sampling rate is called the "Nyquist" rate, named for Harry Nyquist of Bell Labs, who did much of the pioneering work in information theory. This is the same Nyquist for whom the Nyquist slope filter used in TV demodulation is named.

If we don't sample at greater than the Nyquist rate, we get aliasing, an artifact in the picture. One of the best known sampling rate aliasing artifacts is the wagon wheel that turns backwards in movies or on television. The wagon wheel turns backwards because the motion picture process is a sampling process in which 24 (30 for television) samples are taken each second, and this is not enough to faithfully reproduce what the wheel is doing.

Figure 2: Quantization of a video signal, illustrating quantizing error



As a practical matter, we must sample at greater than twice the maximum frequency in the signal. As we sample at progressively higher frequencies the filtering process associated with the sampling becomes easier. One customary frequency at which NTSC is sampled is four times the color subcarrier, 14.318 MHz. This is often written $4f_{sc}$ and pronounced "four f-s-c." Another common frequency is $5f_{sc}$ (17.9 MHz), which is close to $4f_{sc}$ for PAL signals. Other sampling frequencies are sometimes used.

Figure 1 illustrates the sample and hold, and A/D processes. At every sampling period (which defines a pixel), S1 closes briefly, capturing the video voltage on C1. The capacitor holds the voltage until the A/D converter digitizes the level, which is then passed to the next level of processing. Typically the pixel is represented by either 8 or 10 bits.

Quantizing error (noise)

Figure 2 illustrates the difference between analog and digital signals using a simple NTSC ramp. Each level is translated into a series of bits, shown to the right. For example, sync at -40 IRE may be represented by 000. As the video level increases the digital "count" goes up. We have illustrated 3-bit digitization, which "quantizes" the signal into a total of 2^3, or eight levels. This is not enough for real video, but serves to illustrate. In order to translate the continuum of analog levels into the number of bits available, we quantize the signal, or assign it to the closest possible representation. Superimposed on the analog signal is the result of quantization, expressed as it would appear when converted back to the analog domain. Note that we have taken a continuous signal and made it a stepped signal, approximating the real video level. If we were to display this, we would see a "blocky" picture, with unnatural discrete steps between luminance levels. The trick is to make the steps close enough together so that a viewer cannot see the "blockiness." This requires more bits. More bits mean a more accurate representation of the picture, but increase the amount of data we must transmit. The trick is to find the minimum number of bits that will yield an acceptable picture. Compression adds considerable confusion to this process. Typical digital video systems today use either 8 or 10 bits. All else being equal, 10-bit systems will yield better results than will 8-bit systems. (Of course, all else is rarely equal.)

In Figure 2 notice that, part of the time, the digitized signal level exceeds the correct level, and part of the time the digitized signal is too low. This is the characteristic of noise, and indeed, the error is often called "quantizing noise." It shows up in the picture much the same as does thermal noise. We compute quantizing noise based on the number of bits involved in quantizing the video. The more bits we use, the lower the quantization noise. On the other hand, we have more bits that we must transmit, so we have raised the transmission bandwidth required.

Quantizing noise is sometimes measured using a flat field but the measurement we get may not be valid. Depending upon where the flat field level is with respect to a change from one quantizing level to another, we may see "dithering" (a manifestation of the noise) from one level to the other, or we may not. A preferred method is to use a luminance ramp of the type shown in Figure 2. Some people use a shallow ramp, which only traverses part of the 100 IRE video range, and others use a full zero to 100 IRE ramp.

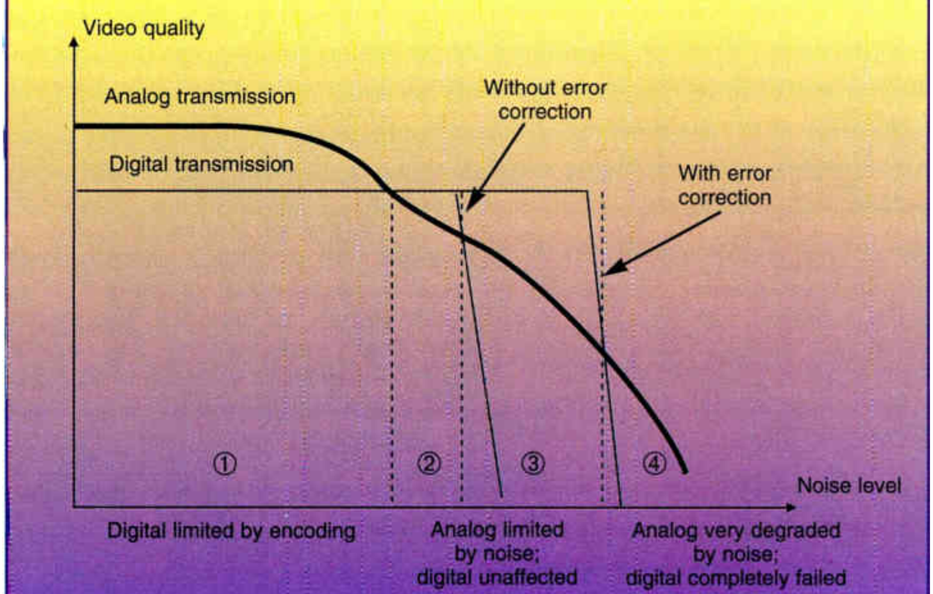
Quantization noise is not the only noise that can be introduced in a digital system. The act of compressing the signal will add its own noise, which may well be a function of the video pattern being compressed. For this reason, it is unlikely that there will be compression systems that always measure high signal-to-noise ratio (S/N), regardless of the video content. The trick is to develop a system that looks good on real video. Our standby NTSC test waveforms are still somewhat useful but we have to interpret them differently in the digital compression world.

Data reduction

If we sample an entire NTSC frame using a common sampling rate of $4f_{sc}$, we sample at 14.318 Ms/s (megasamples per second). If each sample is composed of 10 bits, we have a total transmission rate of 10 x 14.318 = 143.18 Mb/s (megabits per second). This will require a lot of bandwidth, so we don't have a practical cable transmission system yet. (This data rate is used in the professional D1 transmission and recording systems used by some broadcast and production houses. Some cable TV interconnects use proprietary systems with similar transmission rates.) In order to get from here to a practical digital transmission system, one must compress the signal, by removing redundancy (duplicate information) and by removing nonredundant information if it is not visible upon reconstruction.

This is where MPEG comes in, though other compression methods are preferred for many transmission systems. Providers of digital transmission systems for headend interconnects often employ compression other than MPEG. MPEG is designed to be unidirectional. The assumption is that systems deploy few encoders and

Figure 3: Video quality degradation with noise



many decoders. Thus, an MPEG encoder is relatively expensive. (Real-time encoders cost $30,000 and up today.) With integration, the cost of the decoder is expected to come down to consumer levels soon. MPEG is designed for extremely asymmetrical transmission systems with many receivers and few transmitters. This is the model for digital delivery to subscribers but is not the correct model for digital transmission within the plant, unless that digital information is going to go on to subscribers.

By way of illustration, one encoder/decoder (called collectively a "codec") on the market is intended for headend interconnect using standard telephone company interface protocols. The motivation is that a lot of suitable interface equipment, in the form of multiplexers and fiber transmission equipment, is already in volume production for the telephone industry, and is suitable for cable use.

The multiplexing equipment was developed to handle telephone traffic (a lot of it), but is totally suited to handling digital video so long as the data rate is compatible. After all, once the video is converted to a suitable rate data stream, "it's all just a bunch of bits," which can be handled the same way regardless of whether the bits represents telephone conversations or video. Standard multiplexing systems are useful (because they allow the cable operator to easily expand beyond just TV pictures) to alternate telephone carriage and a host of other coming services.

A common data interface rate for telephone multiplex systems today is 44.736 Mb/s, the so-called DS3 rate. (See Farmer and Callahan, "Issues in Handling Cable Signals Within Digital Optical Interconnect Networks," *NCTA Technical Papers*, 1994.) Of all the multiplexing equipment used in the North American telephone market today, this is the most common interface. You can go to any telephone company and get a DS3 circuit from anywhere to anywhere. Codecs have been developed that put one video signal in a DS3 channel, and these are in use by a number of broadcast organizations. In order to further economize on bandwidth, the compression technology is being extended to allow placing two video signals (each with three audios: left, right and SAP, and a data channel) in one DS3. This will allow one digital fiber link operating at the high speed OC-48 rate (2.48832 Gb/s) to carry 96 NTSC signals.

The compression used in the described system is adapted from a system used extensively for transmission of video at the 44.736 Mb/s DS3 rate. It was chosen over MPEG partly because the cost of the compressor is very low, so the total cost of a system serving one or two master (transmission) headends and one to 10 or 20 nodes (receive headends) will be much lower than if MPEG had been used. Another advantage is faster encoding. MPEG encoders tend to require more than one second of delay in the signal as a result of the frame-to-frame processing that takes place. A significant delay also is encountered in decoding. This delay is often not too important but if one is switching video sources, the delay may present a real problem.

It is necessary to provide for transmission of vertical blanking interval (VBI) information in any compression system. This can be a problem, since one of the first steps in compression removes the vertical and horizontal blanking intervals, which carry no information of use to the TV picture reconstruction process. VBI data transmission is often handled by converting the VBI data to a simple data format rather then handling it as video, transmitting the data and reconstructing the signal at the far end. The process is hampered by the use of at least four different data formats in North America. However, ways of solving the problem have been developed.

Stereo information also must be handled such that the BTSC stereo signal can be economically reconstructed at the receive nodes. This is done in several different ways. It will get easier as the industry migrates from DS3 interfaces to the newer, faster optical interfaces. Finally, it is desirable to transmit scrambling information such that the scrambled signal may be transmitted to subscribers without the need for scramblers at each node. Proprietary technology to do this is available.

Characteristics of digital transmission

Figure 3 illustrates qualitatively the difference between digital and analog transmission. We plot noise level (roughly equivalent to carrier-to-noise ratio — C/N) vs. video quality, measured by any convenient metric. Analog transmission quality vs. noise level is shown as a heavier curve, following the well-known rule of gradual degradation with increasing noise. At very low noise levels the quality of the video is excellent. As the noise level increases, for a while a viewer cannot perceive the noise so the picture quality appears to remain unchanged. At some noise level (perhaps 50 dB C/N) the picture quality begins to noticeably degrade with increasing noise. The degradation is gradual at first, but as the noise gets worse the picture

"While much is being made of digital signal delivery to the home, there are those who believe that digital transmission in the plant will become popular first, primarily as a result of need/cost trade-offs."

quality degrades until at some moderately arbitrary level we say the picture is unusable.

Figure 3 (page 28) illustrates two different scenarios for digital video. One scenario includes no error correction to the digital signal; the other includes error correction. With all error correction strategies, extra bits are transmitted with the digital signal, such that if some bits are received in error, they can be identified and corrected. All practical digital transmission systems employ some kind of error correction. Without error correction, digital transmission would hold few if any advantages over analog transmission.

In order to compare analog with digital transmission, the graph in Figure 3 is divided into four regions identified by circled numbers. In Region 1, the analog signal is better than the digital signal. This is because we have added processing and inevitably lost something when we digitized the signal. Compressed pictures are degraded compared with the corresponding analog signal by definition. Compression is a lossy process since some information is removed. In Region 1, both the analog and digital pictures would be considered excellent.

In Region 2, noise is beginning to affect the analog picture. The digital picture, with or without error correction, is not affected by the noise, because the noise is not yet sufficient to cause errors in recovering the bits that make up the digital signal. Above a certain noise level, the nonerror-corrected digital signal degrades quickly, going from "perfect" to unusable with just a little increase in noise (Region 3). The error-corrected digital signal in Region 3 is surviving with no noticeable degradation because error correction is masking the transmission errors. The analog signal is continuing to degrade significantly.

Finally in Region 4, the noise level is so great that even the error-corrected digital signal fails. When it fails, it does so very quickly, going from a near-perfect picture to nothing with very little increase in noise. The analog signal is very degraded but may remain recognizable.

The exact shape of the curve and the relative position of the analog and digital curves is a function of a lot of variables including the type of system through which the signals have passed, the type of digitization and compression, and the error correction used.

If a digital transmission link is cascaded with an analog link, as in a regional interconnect followed by analog distribution, the S/N of the digital link will approximately add to the C/N of the analog portion. If one reads the cascaded S/N on a meter, the addition will likely be exact.

However, the visual effect of the composite noise will not appear to add properly. The reason is that the digital noise is composed exclusively of quantizing noise related to the number of bits, plus a factor relating to the compression algorithm used and the picture content. This noise generally had a different visual effect than does common thermal noise with which we are accustomed to dealing.

Most certainly, the S/N of the digital link will not add to the carrier to noise contribution of the analog link. This can be seen from Figure 3 (page 28), which shows the digital link S/N (video quality) not changing as link noise increases in the same way noise adds signal degradation in the analog world. The S/N measured at the originating point is the same as the S/N at the receiving point.

We have been a bit sloppy in mixing baseband S/N and RF C/N. If the baseband S/N is measured using the CCIR unified weighting network, using the proper definition of "signal," then it is numerically within a couple of tenths of a decibel of the RF C/N as defined by the National Cable Television Association. This is the way many instruments make signal-to-noise measurements today. However, the S/N issue is a source of considerable confusion, and addition of noise on combined digital and analog links must be done very carefully to preserve the meaning we have traditionally ascribed to S/N.

Conclusion

Digital transmission has arrived and will gradually become a routine tool we use to deliver video. It has advantages in the bandwidth used to transmit the signal but only if the video is compressed, however the compression process introduces distortions. A good compression process introduces distortions that are not visible to the human eye, though they can be measured. Digital transmission has additional advantages in that digital signals can be processed and transmitted while encountering no added noise or distortion (if the processes are carried out correctly). On the other hand, if improperly done, transmission or processing will have a much more severe effect on digital signals than will similar improper handling of an analog signal. **CT**

A number of people contributed to this article. In particular, K. Klaer, E. Callahan, M. Dionne, R. Reynard, F. Eichenlaub and T. Engdahl were very helpful.

Digital solutions for regional interconnections

By Kathryn Lynch
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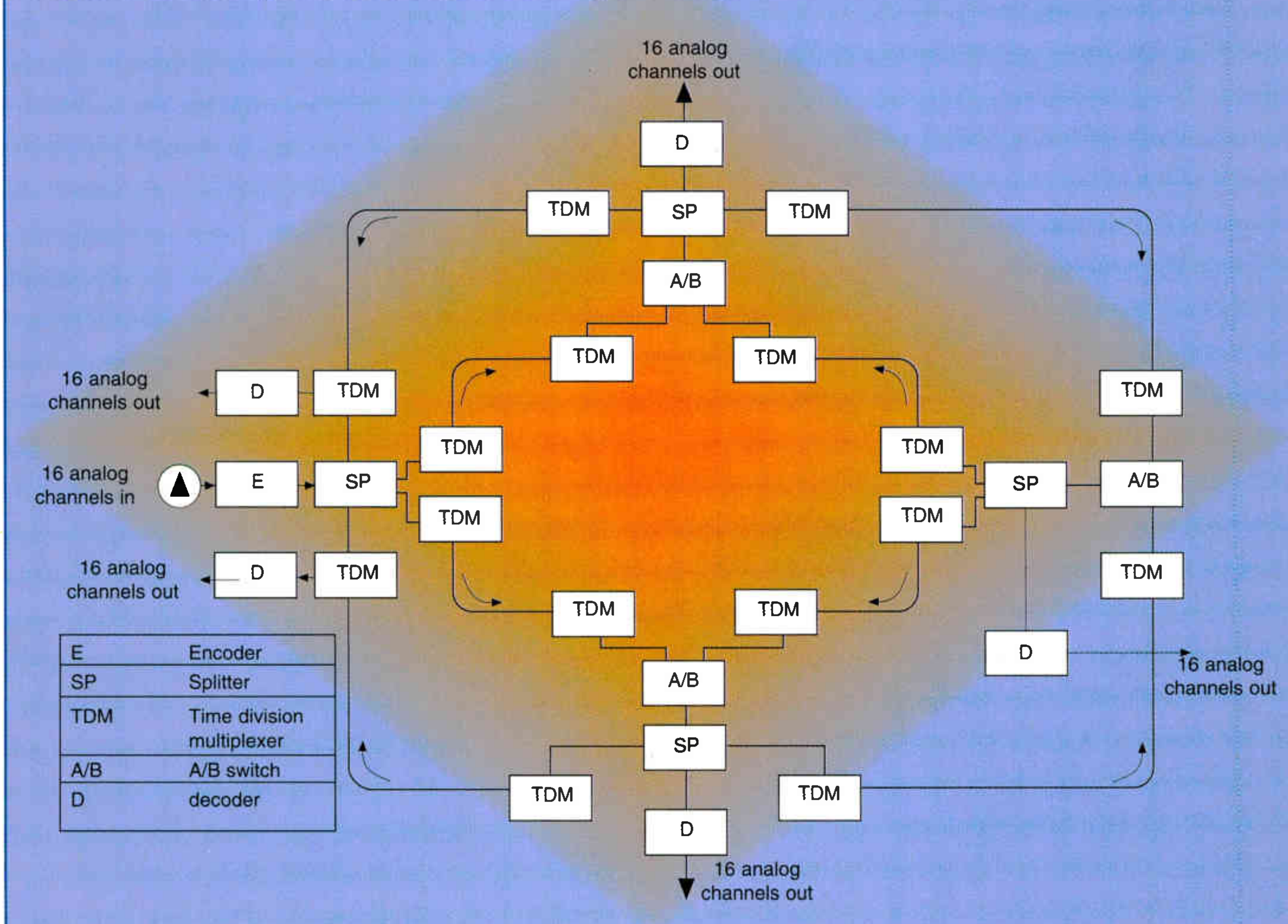
The evolution toward regionally interconnected, digitally based cable networks is certainly a trend that will continue. Regionally interconnecting headends within a geographic area offers significant operational cost savings as well as an ability to deliver any number of new services. As cable operators prepare for new, revenue-generating opportunities, more systems are exploring both the short- and long-term growth potentials that today's digital regional headend interconnect solutions can provide.

Today, the primary economic drivers behind regional interconnects rest in enhancing the existing core business — entertainment video — by saving on equipment and operational costs and increasing revenues through more targeted local advertising insertion capabilities.

Two digital solutions, linear pulse code modulation (PCM) and the synchronous optical network (SONET), have emerged to help cable systems achieve these initial goals. Both linear PCM and SONET can provide cost savings related to consolidating headends. Both can build new revenue benefits from the core business. However, for cable systems seeking to position their network for the future's multimedia and fully interactive requirements, the internationally standardized SONET platform clearly has the advantage. Increasingly deployed in telecommunication networks today, SONET's open architecture means interfaces are compatible between multiple vendors' equipment. This fact alone means those implementing SONET have the ability to source equipment from any number of manufacturers.

Initially, SONET can be used as a way to meet today's needs by reducing operational costs, increasing targeted advertising capabilities and generating new revenues from the alternate access business. However, SONET also provides the ability to grow the digital

Figure 1: Linear pulse code modulation ring architecture



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network incrementally, toward a long-term solution that will accommodate multimedia and interactive service transmission. SONET can dynamically combine voice, video and data signal formats providing cable systems using SONET with the ability to offer such future services as interactive distance learning, telemedicine, telecommunting, subscriber vs. subscriber games, local area/wide area networking and other interactive services — over the same infrastructure they may put in place today.

Interconnects of the past

Regionally interconnecting cable networks is not new. In the past, microwave systems were traditionally used to link headends. In the days before satellite delivery of the cable product (circa 1975-1976), many systems implemented broadcast microwave networks to deliver limited basic cable program material containing locally inserted advertising and the early premium channels. For the advertising business, the microwave interconnect was not even close to an ubiquitous solution because of cost and technical feasibility issues. Given that constraint, more cable systems began turning to "stand-alone" videotape advertising systems as a solution.

Today, the spotlight has returned to headend interconnects. As fiber costs dropped, more systems turned to fiber optics to build upon the network already in place. Fiber-optic technology offers a number of benefits, both for the residential portion of the network and as a means to regionally interconnect headends. Fiber offers a huge pipeline of capacity, increases the reliability of the plant, and can transport services over a larger serving area with little or no degradation to video signal quality. Fiber also has an inherent ability to handle any type of service — digital, interactive or multimedia — depending on the choice of network platform and installed equipment.

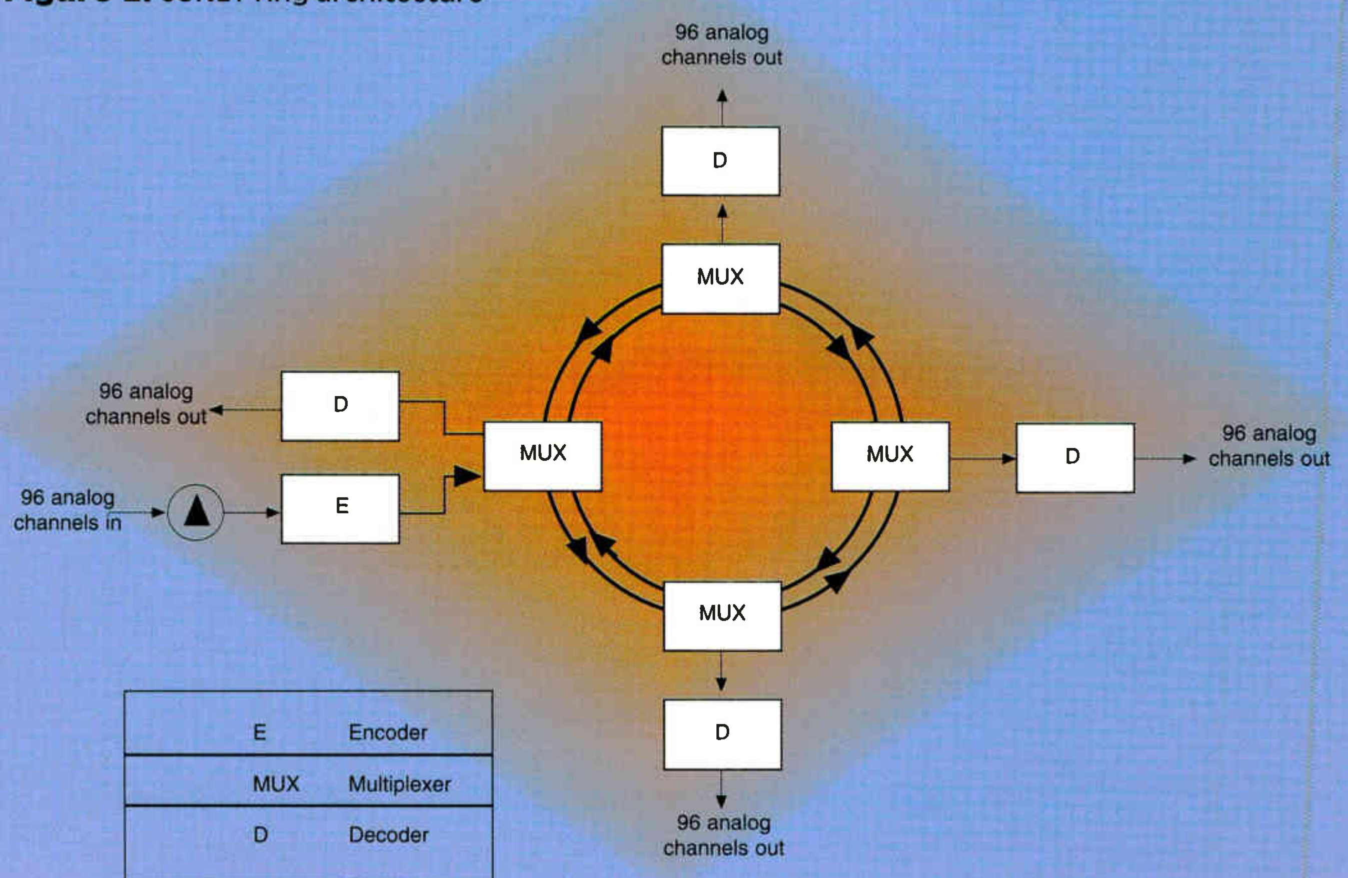
As fiber costs dropped and its benefits were realized, FM and AM fiber supertrunking emerged as the next step in the regional interconnect process. Today, supertrunking remains an attractive and cost-effective solution where distances are reasonable and there is no requirement to selectively insert advertising onto a given cable channel. For some systems, supertrunking may still be ideal as a means to transport entertainment video. For others seeking a more robust network, a digitally based fiber backbone network may be preferred.

Digital solutions for regional interconnects

The first step in analyzing today's digital solutions lies in deciding what new services will be provisioned within the backbone network. As mentioned, current linear PCM and SONET digital solutions can improve economies of scale by consolidating existing headends. Both systems can provide built-in redundancy (given the configuration of the network) to protect digital signal delivery from a potential fiber or equipment failure. Both can handle entertainment video, including satellite programming, near-video-on-demand (NVOD) and real-time video-on-demand (VOD) as well as advertising insertion.

Linear PCM systems are primarily designed to provide for an inexpensive transport mechanism between hub

Figure 2: SONET ring architecture



sites for broadcast-type services (e.g., traditional cable channels, advertising, NVOD, and VOD). Current voice capabilities are limited to internal communication between hubs and extra add-on devices will be needed to be added to offer limited interactive services such as distance learning, telemedicine, wide area networking (WAN), teleconferencing and others.

Linear PCM systems deliver video in an uncompressed format, requiring more fiber utilization than SONET. To deliver 96 channels, linear PCM requires a six-count fiber run for one-way transmission between a master and remote headend since only 16 channels can be accommodated via a single fiber. Return channels — such as a local video channel generated at a given hub — would require either the addition of another fiber and redundant electronics for two-way transmission or wavelength division multiplexing that would allow two signals to be sent in opposite directions on the existing fiber.

If greater system resilience and survivability is desired beyond the initial point-to-point configuration, system costs will increase significantly since equipment must be added at each node location to return signals back to the master headend. Linear PCM ring architectures that offer such bidirectional capabilities, as shown in Figure 1 (page 32), will mean doubling the counts of fiber runs between locations. For 96 channels, for example, the linear PCM ring configuration would mean a 12-count fiber.

"For cable systems seeking to position their network for the future's multimedia and fully interactive requirements, the internationally standardized SONET platform clearly has the advantage."

A SONET ring configuration, as shown in Figure 2 (page 34), requires only two fibers to provide both service and protection capabilities for the same 96 channels. In addition, the SONET ring offers the flexibility to pick up and drop off signals at any hub site on the ring. A local channel generated from Hub A, for example, can enter the SONET ring and return to the headend in the same manner that the headend delivers signals to the hub. SONET's overhead transport capability controls the transport and delivery of the digital signals to any location on the ring. SONET's two-way ring transport systems can survive network failures without any loss of services, a prospect many customers will find increasingly important as they turn to the cable industry for lifeline services such as telephony.

SONET's advantages

SONET emerged as a set of standards that specify stringent reliability specifications of equipment manufacturers. Since it is a standardized transmission format, multiple vendors are developing SONET-compatible equipment that will ultimately drive down equipment costs and allow multivendor compatibility between equipment. SONET's

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"open" architecture provides a highly flexible platform that can incrementally grow as greater capacity is required.

SONET transports signals at the optical carrier rates of OC-3 (six video channels), OC-12 (24 video channels) and OC-48 (96 video channels). Depending on the needs of a cable system, the SONET network could begin with an implementation of a lower capacity system that could incrementally grow as network demands and new revenues are realized.

For example, cable operators can initially implement an OC-12 SONET system in a point-to-point implementation that links two headends together today — while putting the network in place that can provide for emerging interactive and multimedia service as they become available. In the future, that same point-to-point solution can migrate to a ring architecture as additional network protection is required.

Later, this same system can grow to a full-scale OC-48 system with full ring redundancy, when revenues justify this additional network expansion. In this instance, the OC-12 equipment could be changed out and redeployed elsewhere in the network, giving network operators the means to increase capacity of the initial interconnect while developing new business opportunities — alternate access, local area networking (LAN) and WAN, etc. — in another location. Ultimately, SONET provides the cable system with the ability to utilize the same digital network put in place today, rather than building and operating two parallel digital networks or abandoning an initial interconnect platform entirely.

"Microwave links and supertrunking both remain cost-effective approaches for systems that have reasonable distances and need to transport video from one location to another."

Within this migration path, SONET will require no redeployment of fiber. The OC-12 system initially established that is later migrated to an OC-48 network will utilize the same fiber without the need to lay any new cable. And since an OC-48 system can provide for the transmission of up to 96 channels of broadcast entertainment services, in most cases, an OC-48 will offer more capacity than what might be needed for traditional broadcast entertainment services. In the case of a 60-channel system, only two-thirds of the available OC-48 capacity will be utilized. The remaining capacity would then be available for other services.

These other services are where SONET can offer its primary benefit. SONET easily accommodates MPEG-2 compression, video server-type technology and other "multimedia" applications — applications that require the combined transmission of voice, video and data signals. SONET also is able to map asynchronous transfer mode (ATM) cell packets directly into the SONET payload structure, providing a unique capability to transport multimedia applications in a manner that is quickly gaining acceptance in the cable, computer and telephone industries. Despite the fact that portions of the ATM standard are incomplete to

date, SONET remains the defined transport layer for ATM. Using ATM and other SONET-compatible equipment, the network could dynamically provide digital bandwidth, offering even smaller customers an affordable means of high bandwidth transmission capabilities through a shared, on-demand configuration.

For applications such as teleconferencing or wide area networks, this transmission capability means the smaller user is no longer in the position of leasing dedicated circuits with higher fixed costs and limited flexibility. Broadband network providers would be able to sell capacity at a competitive "retail" level, involving many customers and diverse applications. This means the SONET platform can help create more revenue potential from both business- and residential-oriented applications — applications that may rely on an interconnection to the public telephone network and, ultimately, to the global network.

Conclusions

Several solutions exist today for interconnecting headends. Microwave links and supertrunking both remain cost-effective approaches for systems that have reasonable distances and need to transport video from one location to another. Proprietary digital systems such as linear PCM also may offer short-term capital savings and, for some cable systems, may be the preferred initial digital platform. However, the limitations of today's linear PCM may require implementation of a second digital network that can handle more bandwidth, capacity and signal transport demands. The resulting "patchwork" network is likely to become virtually impossible to manage cost-effectively or efficiently.

For many telecommunication providers, including the long-distance and local telephone companies, SONET has become the digital platform of choice. Since bandwidth needs and capacity can be efficiently managed by SONET equipment developed by multiple vendors, cable operators that implement SONET can be positioned to deliver any number of new services that require combined voice, video and data transmission capabilities. The prudent network planner would be wise to carefully judge each of these various interconnect solutions to determine whether the inexpensive solution today will serve the operator in the long-term. **CT**

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Network availability and reliability

By Nick Hamilton-Piercy
Vice President, Engineering and Technical Services

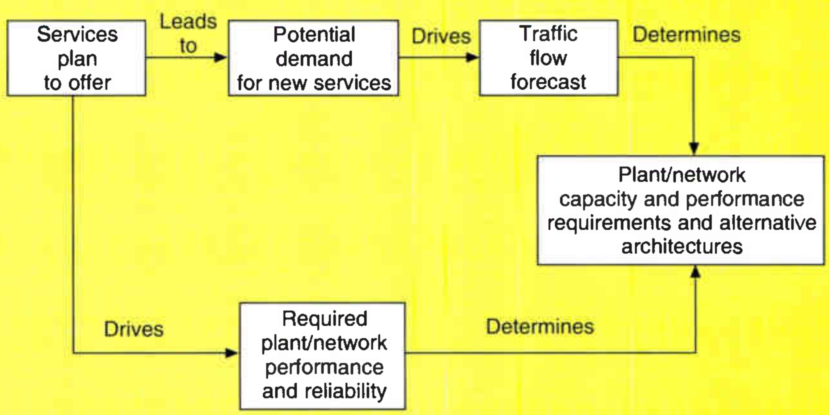
And Robb Balsdon
Director, Network Planning
Rogers Engineering

Cable TV networks that are expected to support new services and meet customers' rising expectations of service availability and reliability must be more reliable than in the past. Transactional services and on-demand services, such as near-video-on-demand (NVOD) and video-on-demand (VOD), will require higher reliability because the loss of a transaction or a sale will have a direct effect on revenue, more so than a temporary loss of a subscription premium service. Low network availability or reliability of services will alienate customers and result in lost customers in a competitive environment. If the network reliability and service availability expectations of the customer are not met the service will not be used and the cable operator will poison the customer's demand for new services.

Figure 1 illustrates that planned new services drive the required level of network reliability and this level of reliability is one of the factors that determine the type of network architecture that should be considered by the cable operator.

What should the cable operator use as the network availability specification? Should networks that support lifeline services or telephony services meet an availability objective of 99.99% or should they meet a telco guaranteed availability specification for a local DS1 access service of 99.8% on average, or 99.7% for an intercity DS1 service? (Availability specification for Megaroute DS0 and DS1 service, Bell Canada.) Availability as identified in the CableLabs Outage Report of 0.6 outages/month or 99.67% availability may be adequate for nondemand or broadcast cable TV services. On-demand services may require an availability greater than 99.67% (possibly 99.98%). The cable operator must decide on an availability or reliability target in order to evaluate and rank various network architectures.

Figure 1: New services drive network reliability



What is network reliability?

Reliability is the probability that the system will fail in a given period of time, or it can be defined as the frequency of equipment or network failures as a function of time. For devices with a constant failure rate:

$$R(t) = e^{-lt}$$

Where:
R(t) = reliability of the system for time period (t)
l = failure rate

$$l = k/nt$$

Where:
k= number of failed devices
n = total number of devices
t = observation time
MTBF = mean time between failure

$$l = 1/MTBF$$

So, $l_{system} = Sl_n$

Where:
l_n = sum of the l for all the subcomponents

The objective of 0.6 outages/month results in:

0.6 outage/month = MTBF of 1,200 hours
$l = 1/MTBF = 8.33 \times 10^{-4}$ failures/hour

As an example, this results in the reliability values shown in Table 1.

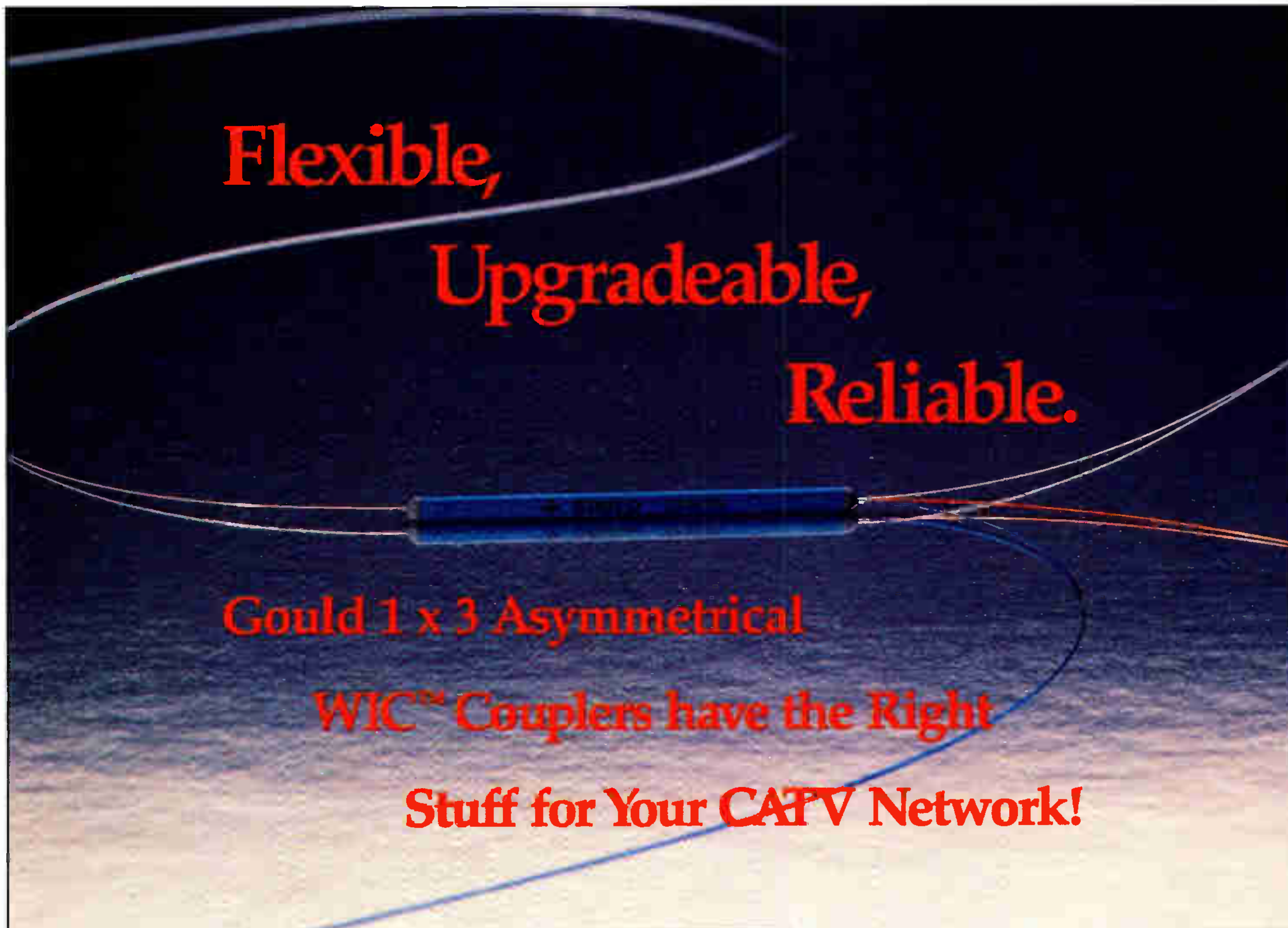
What is network availability?

Availability is the amount of time the network is available for use by the customer in a given period. For example, one year. Availability (A) is related to the mean time to repair (MTTR) and the failure rate l_s by the function:

Table 1: Network reliability

Time period	Reliability	Probability the system will fail
One day	0.9802	0.02%
One month	0.5489	45.11%
One year	0.0007	99.93%

For annual reliability of 99.99%:
$R(t) = e^{-lt}$
$R(t) = 0.9999$
t = 8,760 hours
$l = 1.1705 \times 10^{-8}$ failures/hour
Mean time between failure is 10,000 years



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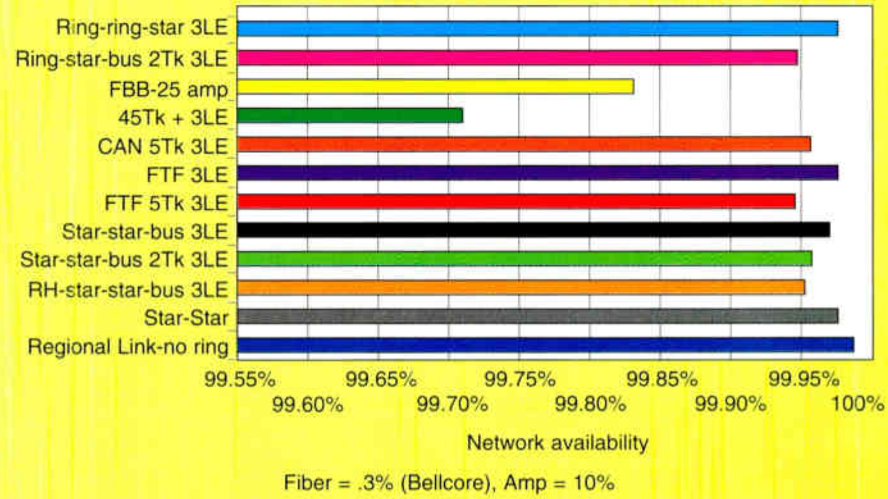
"Transactional services and on-demand services ... will require higher reliability because the loss of a transaction or a sale will have a direct effect on revenue, more so than a temporary loss of a subscription premium service."

Figure 2: Availability of alternative network/plant configurations



$A = \mu_s/(\mu_s + l_s)$

Where:
μ_s = 1/MTTR
s = system

For example:

- An outage objective proposed by the CableLabs Outage Task Force is 0.6 outages/month.
- Let's assume a MTTR (the time to diagnose the problem, dispatch a repair technician and actually repair the equipment or splice the fiber cable break) is four hours. (This is a reasonable average based on Rogers experience.) Then:

$\mu_s = 0.25$ and
$l_s = 8.33 \times 10^{-4}$ failures/hour

This results in an availability of 99.67%. As a comparison, availability (annual) of 99.99% results in:

- MTBFs of 4.57 years.
- Failures/month or outages/month of 0.018 — a factor of 30 fewer outages (or a reduced MTTR) than the 0.6 outages/month specification.

What availability do the telcos offer for a commodity service such as DS1? One particular telco guarantees a minimum availability specification for DS1 service of 99.8% averaged over several months for access and 99.7% for intercity DS1 service.

Availability may be a more understandable or direct metric, than a reliability figure of the of the cable system dependability from the customer perspective. Availability is straightforward to calculate from operational measurements. For example:

A = Outage period/sample period
= 0.876 hours/year
= 99.99%

Improving network availability/reliability

There are many ways for the cable operator to improve the network availability/reliability. A number of these are:

1) Plan for equipment redundancy were a single point of failure would affect many customers.

2) Plan for fiber cable route redundancy were a single point of failure would affect many customers. For example, Rogers plans for fiber route redundancy to any group of customers or subscribers greater than 2,000.

3) Specify and purchase equipment with better MTTF and equipment that can be repaired quickly to improve MTTR, especially if no redundancy exists for this equipment.

4) Minimize the active points of failure such as reducing long trunk cascades.

5) Improve MTTR by improving system status monitoring and diagnostics:

- Bypass of active devices during maintenance or construction (upgrade).
- Reduce pulling of equipment modules without proper authorization from the network manager/supervisor.
- Good documentation helps in troubleshooting. It reduces the period of service interruption required to isolate and determine the problem or fault.

6) Minimizing the number of system power supplies minimizes the number of point of failure. However, minimizing the amount of plant fed from or through a power supply area helps to isolate problems and reduces the number of subscribers affected by a power supply failure.

7) Standby power supplies can improve network availability and reliability if they are properly maintained.

Availability/reliability of fiber

The failure rate or outage rate use for fiber cable in network availability or reliability calculations can have a significant effect on the level of fiber routing redundancy or the fiber network architecture required to achieve a given network availability or reliability specification. The CableLabs Outage Task Force recommends an annual failure rate for fiber cable of 3%, which results in an availability figure of 99.90% for a

Table 2: Sources of fiber outages (Bellcore study)

Causes of outage	Percent of reported failures
Dig-ups	58
Craft error	7.4
Rodents	4.8
Vehicle damage	4
Fire	3.2
Firearms	2.7
Extreme temperatures	1.7
Floods	1.5
Power line contact	1.5

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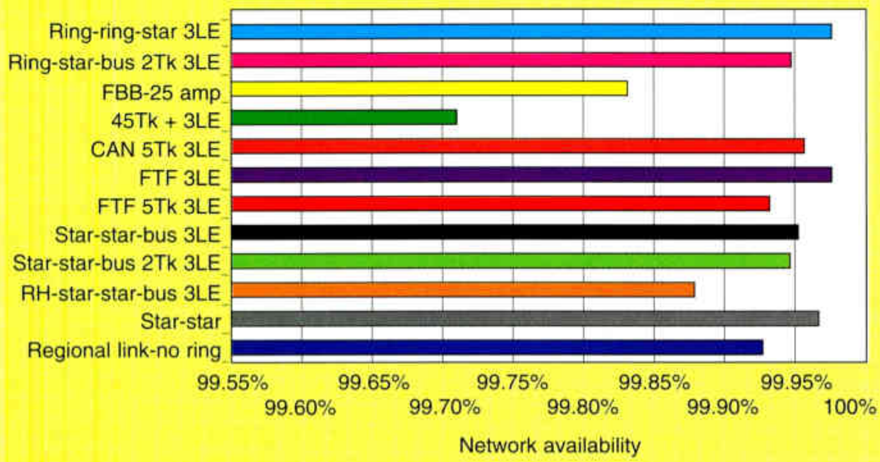
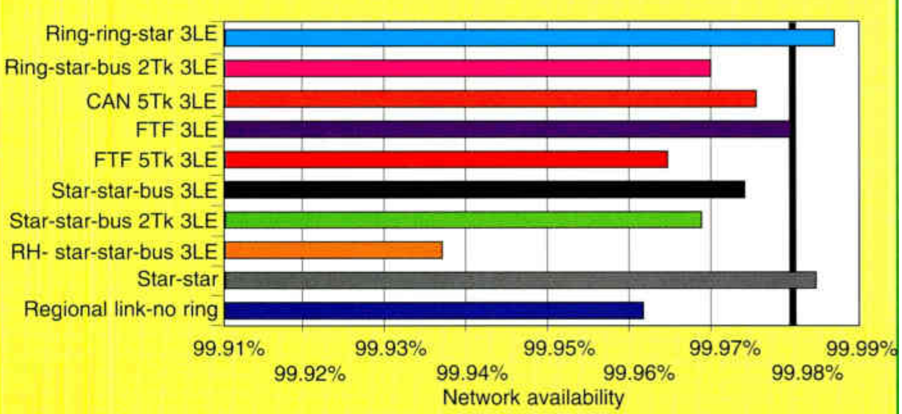
Figure 3: Availability of alternative network/plant configurations



Fiber = 3%, Amp = 10% (CableLabs Outage Task Force)

"Cable operators should develop target network availability specifications and collect and analyze reliability figures from equipment vendors, other cable operators, operational records and industry groups such as Bellcore and CableLabs."

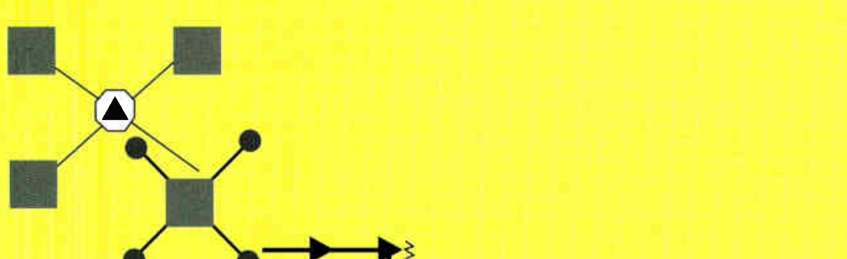
Figure 4: Availability of alternative network/plant configurations



Fiber = 1.5%, Amp = 5% (example)

Figure 5: Star-star-bus (SSB)

- Low-cost provision of broadcast services because of electro-optic repeats
- Lower reliability/availability as a result of cascaded optics
- Shortening amplifier cascades can improve reliability/availability



50-mile fiber link. A Bellcore study that reviewed fiber failures from 1986 to 1993 determined that based on a review of 650 failure reports unavailability was 1 minute/sheath mile, which results in an availability figure of 99.992% for a 50-mile fiber link. Refer to Table 2 for a summary of the sources of fiber cable outages. (This is from the *Bellcore Fiber Cable Outages Study*, 1986-1993.)

Choice of fiber network architecture

In order to rate and rank the various types of fiber network architecture based on end-of-line availability (the availability that the subscriber sees) a cable operator must develop failure rate figures for the various network components between the headed and the subscriber. For example, the cable operator must determine failure rates for:

- Electro-optic (E/O) equipment.
- Fiber cable.
- Amplifiers in the coaxial plant.
- Passive devices in the coaxial plant.
- Coaxial cable.

Failure rates can be developed using empirical data developed by the cable operator, data from other operators, data collected by CableLabs, data from telcos and data available from equipment vendors.

As an example, Figures 2 (page 44), 3 and 4 show the variability of network availability of various network architectures. The figures are based on different failure rates for fiber cable and amplifiers with failure rates for the other network components held constant.

In Figure 2, failure rates of 0.3% (Bellcore study) and 10% are used for fiber cable and coaxial amplifiers respectively. The histograms for the network architectures that achieve an availability of 99.98% are highlighted. Lower network availabilities, less than 99.98% are shown for networks that have more than three amplifiers and several cascaded nondiverse fiber links. All fiber networks have better availabilities than long trunk amplifier cascades.

In Figure 3 failure rates of 3% (CableLabs Outage Task Force) and 10% are used for fiber cable and coaxial amplifiers respectively. Again, the histograms for networks that achieve an availability of 99.98% are highlighted. The main difference between Figure 2 and 3 is that networks that have nondiverse fiber links of substantial distance, regional hub (RH)-star-star-bus and long fiber links between headends, have a lower network availability.

In Figure 4, failure rates of 1.5% and 5% (closer to Rogers experience) are used for fiber cable and coaxial amplifiers respectively. In this figure some of the network types are not shown in order to simplify the diagram and help illustrate that the only networks considered here that meet 99.98% availability are: the ring-ring-star-3LE (amplifier), the fiber-to-the-feeder (FTF) and the fiber star-star with fiber-to-the-home (FTTH).

In general, network architectures that minimize the number of cascaded amplifiers and provide some fiber route redundancy, especially for longer links between headends or fiber distribution hubs can achieve higher levels of network availability. Figures 5 through 9 illustrate a number of the architectures that were compared based on network availability.

Figure 6: Fiber-to-feeder (FTF)

- Higher cost to provide broadcast services to large dense areas
- Cost-effective to rebuild
- Higher reliability as a result of reduced cascades

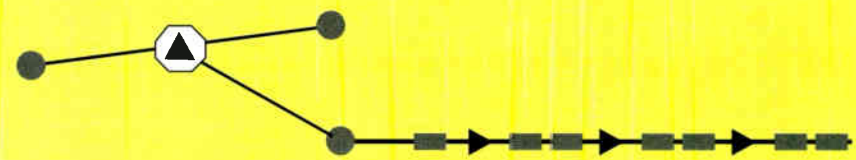


Figure 7: Fiber backbone (FBB)

- Low cost
- Lower reliability, long trunk/cascades

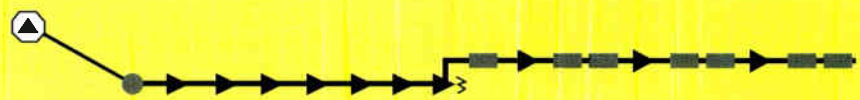


Figure 8: Cable area network

- Higher costs than FBB, lower cost than FTF or SSB
- Improvement on reliability of FBB

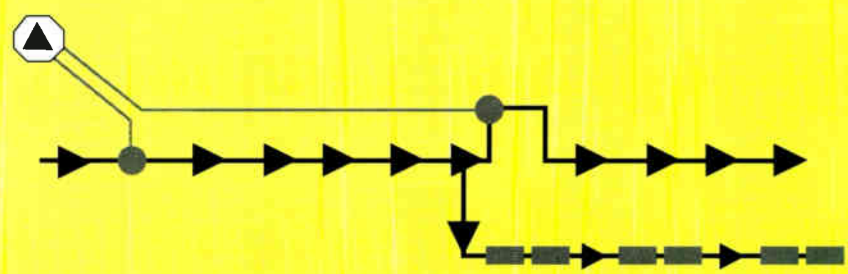
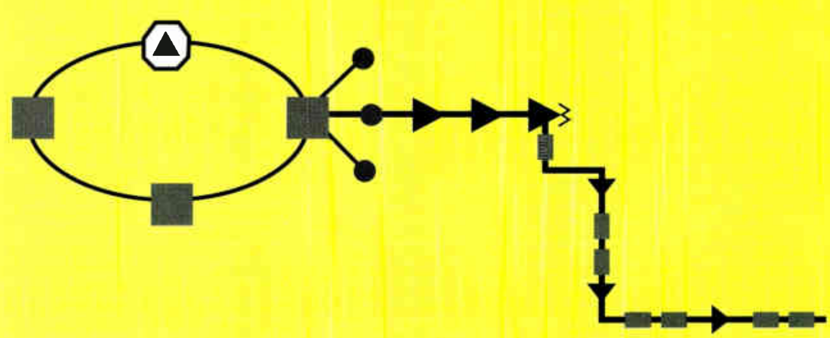


Figure 9: Fiber ring

- Higher costs than SSB and FTF
- High reliability if amplifier cascades are short



Summary

When determining which fiber network architecture should be implemented, the availability of each of the alternative architectures should be compared. Developing the failure rates for the various network components that are use to calculate overall network reliability can be challenging because:

- Typically systems are not in place to consistently and accurately track and record network component failure rates.
- Failures due to technician errors that inadvertently cause outages must be included in the overall network availability.

Cable operators should develop target network availability specifications and collect and analyze reliability figures from equipment vendors, other cable operators, operational records and industry groups such as Bellcore and CableLabs. **CT**

How to maintain system reliability/integrity

Cable TV systems are now delivering high-profile services and will deliver even more in the near future. These services require higher levels of system reliability and system integrity than have previously been required. This article discusses some alternatives for increasing both system reliability and integrity. In particular, it focuses on the use of network management.

By Colin Horton
Product Manager, C-COR Electronics Inc.

Today's cable TV systems are now delivering high-profile services such as pay-per-view (PPV) and local ad insertion. High-profile services are those services that are heavily publicized and for which a considerable additional income is projected. In the near future, more of these high-profile services such as video-on-demand (VOD) and near-VOD will be carried on cable systems. There also is the likelihood that cable systems will carry telephony service, either as a hard-wire service to replace or supplement existing twisted-pair service, or wireless service such as personal communications systems (PCS). In the United Kingdom, some cable operators are already carrying telephony service over their coaxial cable systems.

Plain old telephone service (POTS) has the highest profile of all the new services that could be carried by a cable system. This high-profile results from the "lifeline" type of service that is an essential part of today's POTS. Simply put, the phone system must work all the time to support 911 and other emergency services.

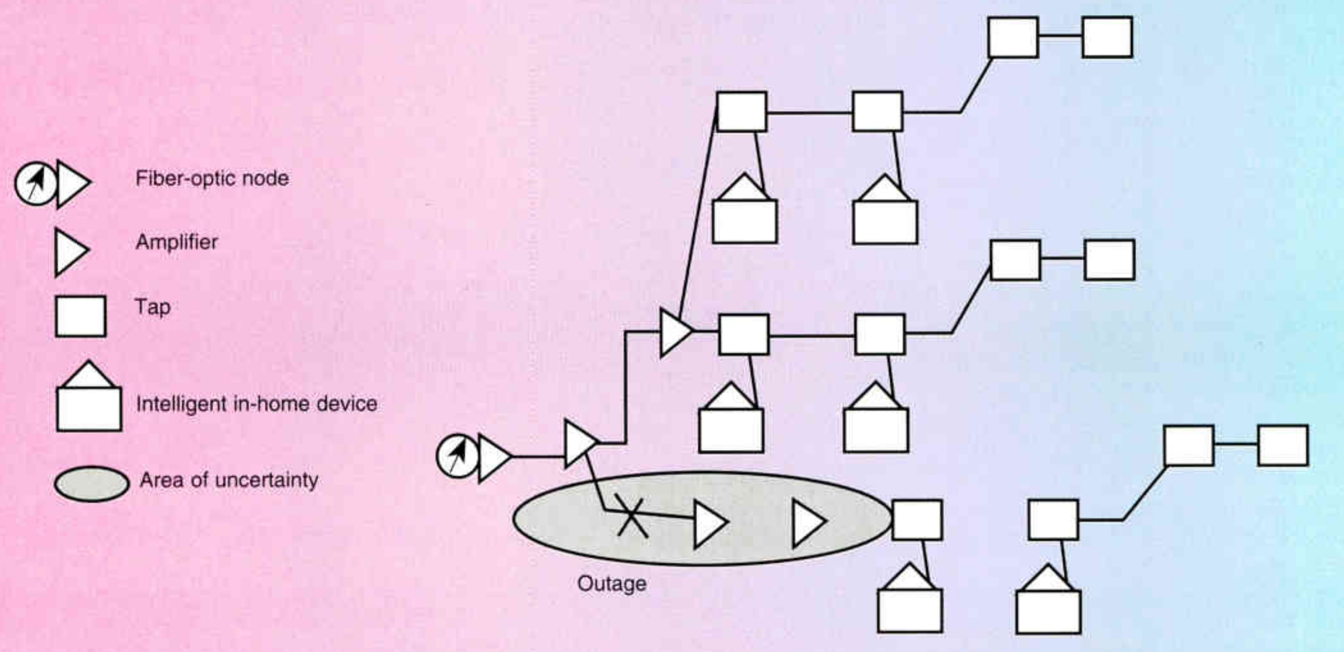
The requirements placed on a cable TV system that is to carry these high-profile services are considerable. In particular these services all require extremely high system integrity. That is the ability to operate very reliably and to consistently deliver high-quality signals (maintain good system performance).

In the last five years dramatic advances have been made in overall system reliability. These advances have been made in two main areas. The first is the use of AM fiber optics to reduce amplifier cascades. AM fiber has dramatically reduced the number of potential failure points between the headend and the subscriber. The second is the universal acceptance of the need to not only protect active devices from high voltage surges but also to provide continuous system operation after the surge. This acceptance has led to the universal use of crowbar protection circuits and to the virtual elimination of fuses in the through-power path.

These advances are the foundation upon which future networks will reliably operate. In order to build upon this foundation, careful consideration must be given to the following:

• *The reliability of the individual active components.* In active components, high reliability translates into high mean time between failures (MTBF). There are two critical contributors to a high MTBF — low operating temperatures for components

Figure 1: Area of uncertainty with in-home network monitoring



and the ability to withstand surges.

• *System architecture and redundancy.* A system architecture that reduces the number of active devices cascaded between the headend and the home will be significantly more reliable that one with a longer cascade. In a fiber-based architecture, cascades as long as six or seven amplifiers after the fiber-optic node are now used. Cascades of three or fewer amplifiers after the node would provide a higher level of service reliability to the individual subscriber because of the reduced possibility of active device failure. When the issue of service reliability for lifeline telephone service is considered, single points of failure, such as the laser transmitter, the fiber-optic cable or the fiber-optic receiver can have a devastating effect on system reliability. To offset these single points of failure, backup devices and systems that provide redundancy are required. Backup transmitters with optical switches, redundant optical fiber paths and backup optical receivers with RF switching can be used in combination to provide various levels of redundancy, and to significantly increase reliability.

• *Powering.* System powering for lifeline services requires considerable standby capacity, often on the order of eight hours. If the in-home telephone interface is to be powered from the system, additional standby powering capacity is required. In addition, contingency plans for long outages must be in place, so that continued telephone service can be provided. Like any other redundant component, standby power supplies require remote monitoring and control capability. This remote monitoring and control capability should be linked into or be an integral part of a complete network management system.

"A system architecture that reduces the number of active devices cascaded between the headend and the home will be significantly more reliable that one with a longer cascade."

• *Network management.* Network management or status monitoring has long been acknowledged as a means of detecting outages. Because the network management system detects outages, technicians can be dispatched quickly to the site of the outage and the overall mean time to repair (MTTR) is decreased. Network management software with a built-in expert system can further decrease the MTTR by pinpointing the location of an outage (and identifying the probable cause) thus reducing the time a technician takes to locate the source of the outage.

Network management implementation

The network management system must be able to detect and to locate outages cost-effectively. The ability of the network management system to detect outages depends on the location of the components it monitors. Network management components can be installed in a variety of locations:

- In-home.
- At end-of-feeder-lines.
- In fiber-optic devices.
- In RF amplifiers.

The increased intelligence of devices installed in the home and their ability to communicate back to a central point can be used to provide a fine resolution view of system outages. Assuming a high penetration of devices that are being communicated with on a very regular basis, the exact location of an outage could be pinpointed to not only the tap, but the drop.

However, in today's feeder designs, there is often express feeder (or trunk) with one or more RF amplifiers be-

Figure 2: Area of uncertainty with end-of-line monitoring

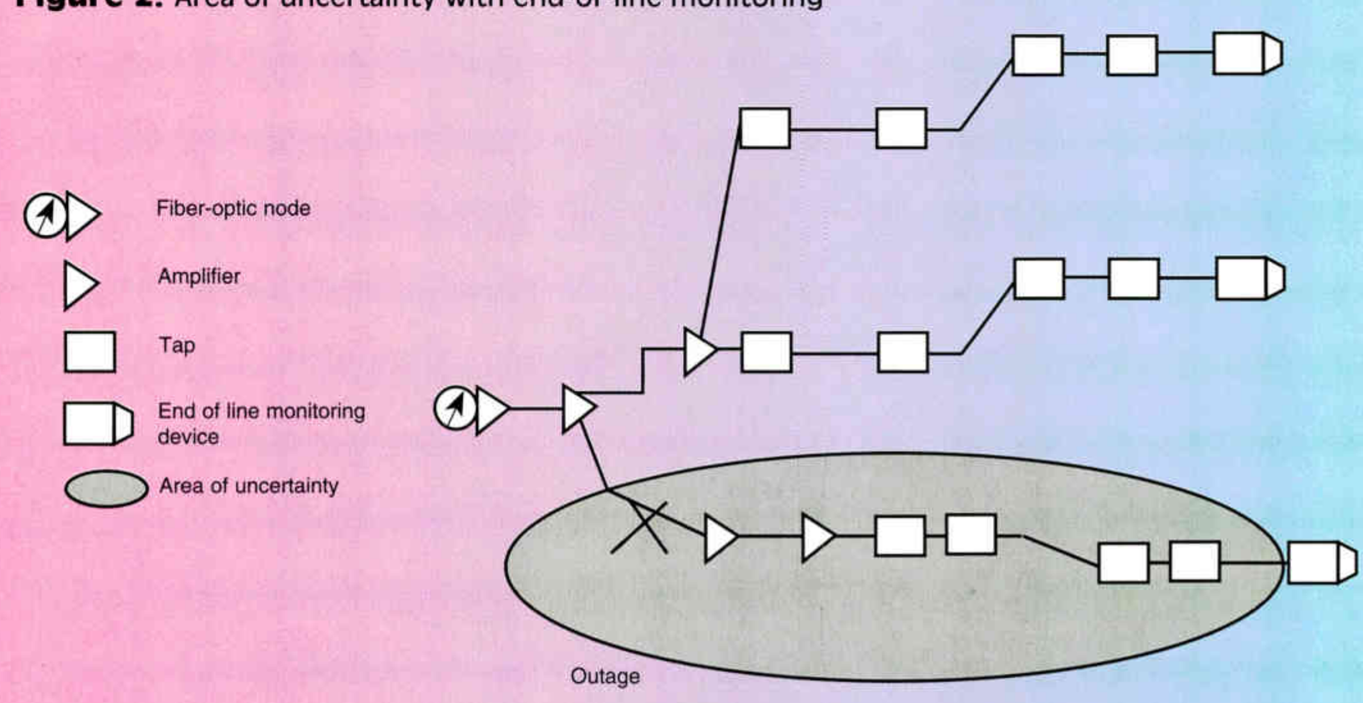
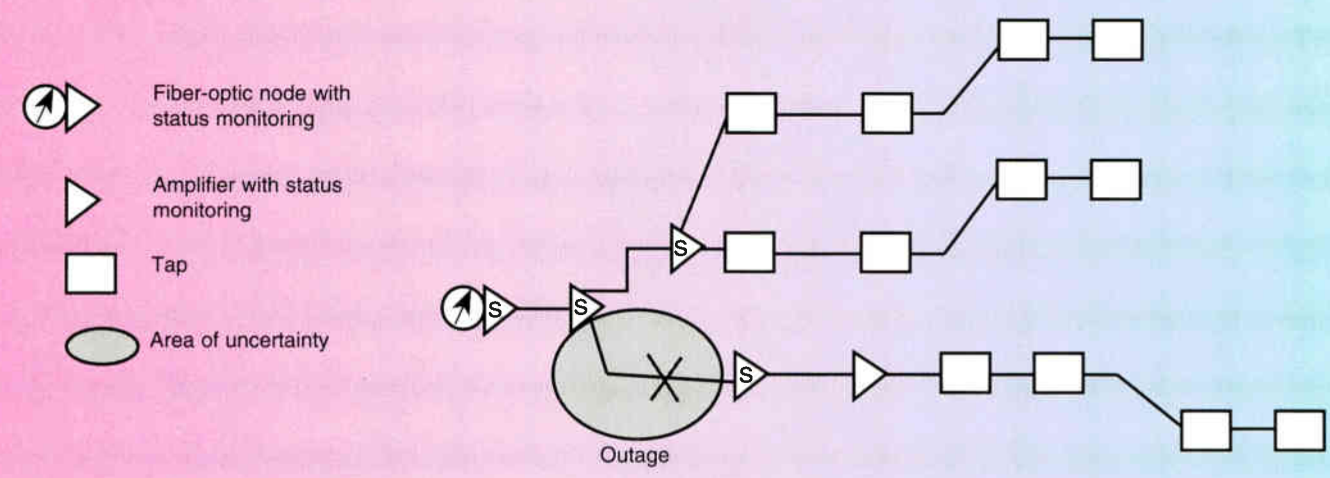


Figure 3: Area of uncertainty with RF amplifier monitoring



tween the fiber-optic node and the first tap unit. In-home monitoring has limited capability to locate outages in these systems.

Figure 1 (page 48) illustrates this type of system. The location of the outage cannot be determined exactly. Additional outage time will occur while the technician searches the entire shaded region trying to pinpoint the failed component if in-home monitoring devices are the only devices used for network management. Such dependence on in-home monitoring also assumes that there is a monitoring device installed in one of the homes fed from the first tap after the amplifier.

End-of-line monitoring devices can detect outages to a particular branch of a feeder line. Although they do not require the penetration that in-home devices do, they do need to be installed at every end-of-feeder-line to provide accurate outage location information. However, the end-of-line monitoring device's ability to locate outages is very dependent upon the architecture of the system. (See Figure 2 on page 49.) Additionally end-of-line devices are limited in their ability to locate outages in systems with express feeder.

Monitoring components in fiber-optic devices can only detect and locate outages that occur in the node, in the headend and in between the headend and the node. So in order to detect failures after the node, one of the three other network monitoring location options must be included in the network management system. However, since fiber-optic component failures can be catastrophic because of the large number of subscribers served by each node, fiber-optic components are often part of a redundant system. It is essential that any redundant fiber-optic operation be monitored by a network management system, and that the monitoring include the following:

- Satisfactory operation of the main path or component.
- Satisfactory operation of the backup path or component.
- Switchover from main to backup path or component or vice versa.
- Ability to remotely control the switchover device.

RF amplifiers with network management monitoring components also can detect and locate outages but are generally more effective than the three previously discussed monitoring component locations. But their ability to locate outages stops at the last monitored amplifier. Typically only the larger trunk and bridger amplifiers are monitored, leaving the largest number of amplifiers (the line extenders) unmonitored. However, today's systems do not always use line extenders and in some systems where they are being used, network monitoring is being seriously considered. Depending upon whether or not line extenders are used, or when they are, if they are monitored, RF amplifier monitoring can have the smallest area of outage location uncertainty. (See Figure 3.)

Outage detection and location has been known as an advantage of network management systems for some time. Another aspect of network management systems that has not yet been fully utilized is the system's ability to predict outages before they occur. If properly implemented, outage prediction can prevent outages. While outage detection depends upon "go/no go" information (is the device responding or not?), outage prediction depends upon analysis of various analog parameters. These parameters include RF signal levels, RF system performance characteristics (composite triple beat — CTB — and carrier-to-noise ratios — C/N) and AC power voltage.

The ability of the network management system to predict outages depends upon the location of the monitoring components and the ability of these components to measure critical system operating parameters. Once again, there are a variety of locations where network management components can be installed:

- In-home.
- End-of-feeder-lines.
- Fiber-optic devices.
- RF amplifiers.

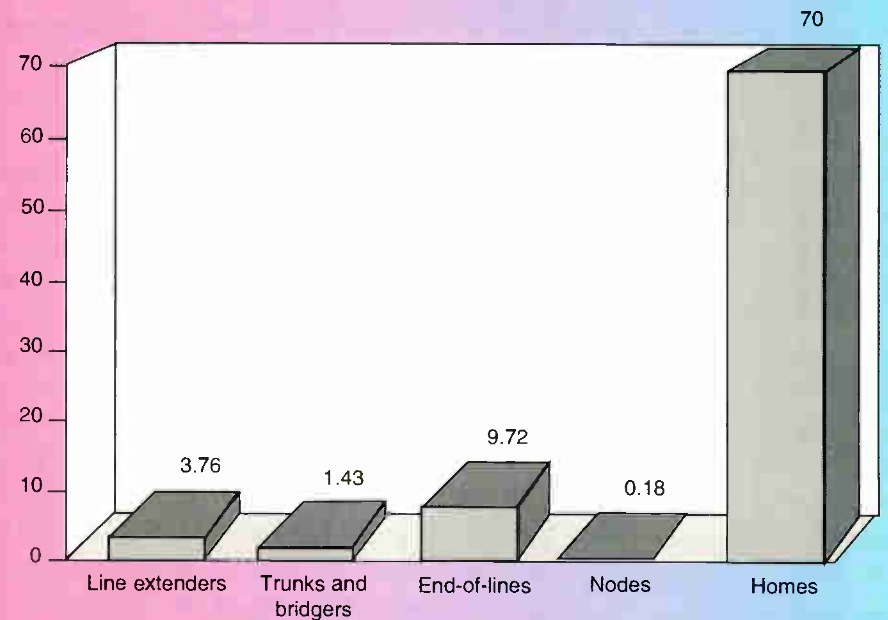
The ability of an in-home device to do quantitative measurements and to be able to report them is not always guaranteed. While some in-home devices have the ability to measure incoming RF signal levels or bit error rate, this capability is not always available. Where in-home devices are installed with RF level measurement capability they can be used to predict outages in the portion of the system after the last automatic level control (ALC) amplifier. An amplifier with ALC will automatically compensate for any system or amplifier problem and can thus mask any change in RF levels and the subsequent change in CTB and C/N from any device downstream.

In-home devices are not usually connected to the same power system that powers the amplifiers so in-home devices cannot usually monitor the 60 VAC power used to power the RF amplifiers and predict potential power-related outages. In-home devices that are designed to supply POTS will most likely be powered from the same source as the RF amplifiers and so can have the ability to predict power-related outages.

End-of-line devices can not only measure RF signal levels, they are often designed to measure CTB and C/N, and thus quantify system performance. (In fact some products are designed to do Federal Communications Commission proof-of-performance testing.) However, like in-home devices, they can only be used to predict outages in the portion of the system after the last ALC amplifier.

The performance of the system is directly dependent upon the performance of the active RF and optical devices. Distortion and noise performance of the system are driven by the active device performance. In particular, the ability of RF amplifiers, with ALC, to maintain constant output levels dramatically affects both distortion and noise performance. RF amplifier network management that monitors RF output levels and other internal amplifier operating parameters that directly affect RF output levels can detect system performance changes at their source. The received optical power at a fiber-optic receiver directly affects the system C/N,

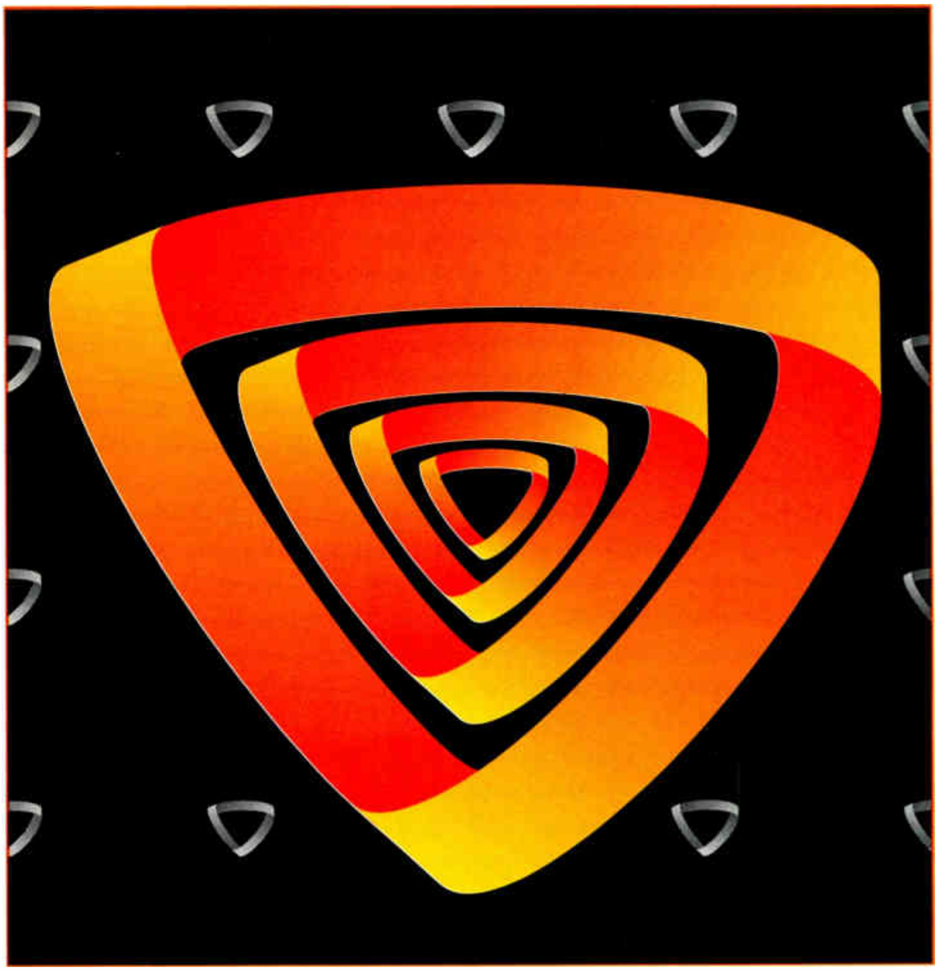
Figure 4: Number of monitoring devices per mile for a typical cable system



(Continued on page 72)

Look, no coax: Building the ubiquinetwork — Part 3

The following is the third installment in this series on the information superhighway and what it means to operators, vendors and consumers. Parts 1 and 2 ran in the March and April issues respectively.



By George Lawton
West Coast Correspondent

As cable and phone companies race to build the ubiquinetwork, they are in search of a lower cost, more reliable way of delivering services to the home. FutureVision of America Corp. and ELCOM Technology Corp. claimed to have developed a technology that enables standard household wiring to carry up to 84 Mbit/s over a range of up to 1,000 feet! FutureVision plans to use this technology later this year in its deployment of an interactive service over Bell Atlantic's digital fiber network being deployed to 38,000 homes in Dover Township, NJ.

Paul Hellhake, chief technology officer at FutureVision, said that at first he was skeptical of the technology, and that he even postponed three meetings with ELCOM before he saw the technology. "But when they went over the theories it started to make sense, and when they demonstrated it, it really made sense."

ELCOM already has begun marketing a commercial device for LAN communications based on this technology. It enables computers to communicate at up to 1.2 Mbit/s over standard AC wiring and is selling for $495 per AC modem pair.

ELCOM also has created another version, still in the lab, that enables data communications at up to 6 Mbit/s between a given modem pair. Furthermore, each circuit in a building can support up to 14 different modem pairs, for a total of 84 Mbit/s per circuit. And most houses and other buildings have several circuits.

Hellhake said that the company plans to buy the units in small quantities for under $200 per modem. Once volume deployment begins, and the circuits are encoded into silicon, the price could drop to well under $100 each. A fully digital version is expected to be available by the end of the year. According to Hellhake the only issues involved in making this happen are engineering, not technical — they have to figure out how to shrink the bench-top unit into silicon.

Old idea

The idea of taking advantage of home wiring has been around for some time, but has always fallen short of expectations due to three primary reasons: 1) noise, 2) phase nonlinearities and 3) standing waves.

According Hellhake, this technology is totally immune to the noise generated by typical household equipment. He said that he participated in one experiment in which data communications were set up between two computers. Seven people simultaneously turned on vacuum cleaners, blenders and hair dryers, without causing the bit error rate (BER) to drop. In fact, they were able to maintain a BER of 10^{-9}, whereas traditional twisted-pair wiring is only specified to achieve a BER of 10^{-6}.

Hellhake said that they also conducted several tests between adjacent houses and adjacent hotel rooms, to determine if there was any interference from one circuit to another. Although ELCOM has developed a filter that can be deployed if necessary, Hellhake said they never had to use them, even when operating two networks in adjacent hotel rooms at the same frequency.

AC wiring is notorious for having a nonlinear phase across a wide bandwidth. Consequently, existing commercial products that operate over phone lines today are modulated in the kHz range. For example Adaptive Networks currently is selling a 19.2 kbit/s modem that runs over AC wiring for over $1,000 a pair. Charles Abraham, developer of the technology at ELCOM, claims to have developed a technique to maintain phase linearity across a much wider bandwidth.

In any ideal network, the impedance across the wiring is constant — and known. However, in electrical networks, the impedance changes constantly as new devices are plugged in and turned on, resulting in standing waves. These can have disastrous effects on devices that use AC wiring to communicate.

For example, the Intelejak Phone from the Phonex Corp. sounds exciting when you read the catalog. It supposedly enables you to just plug a device from a phone jack into a power plug, and then receive calls on any phone plugged into an AC outlet. However, the reality is quite different according to Abraham who tested the device.

He said that in order to get the phones to work he had to tune them, a process that took about an hour. (And he is an electrical engineer, can you imagine mom trying it?) However, he found that when he went to use the phone after a few hours, he had to retune the phone because the impedance on the network had changed.

Abraham said that with his technique, communications over the network are not affected by impedance changes. Abraham has three patents for the technology on file. However, he says they are holding back their being issued until ELCOM and partners can corner all of the major patents relating to the technology. Consequently, he was unwilling to go into any details about how he manages to overcome these problems.

Deployment plans

Hellhake said there are lots of applications for this technology in old building like hospitals and schools, which were not designed to be postwired. He points out that in homes it will bring a new level of convenience to consumers who will be able to get a signal from wherever they plug the TV set in, not just next to a few dedicated coax ports.

According to Hellhake, at first the telephone companies were skeptical, then they were more interested in something that could augment the network rather than replace it. Consequently FutureVision and ELCOM have been focusing on ways to use the technology for video and data.

Perhaps this technology could play a key role in power companies becoming major players in building the ubiquinetwork. Many of them already have fiber in their networks for network monitoring and control, most of which goes unused. One could imagine a fiber-to-neighborhood approach with the last 1,000 feet being carried over the electrical network to the home. With a total capacity of up to 84 Mbit/s, 14 to 28 streams of switched video per section could potentially be delivered, with enough bandwidth for return path communications. **CT**

Video testing step by step — Part 2

The new Federal Communications Commission-required "video tests" are just a year away. Remember that systems subject to the new rules are required to pass and document the tests by July 1, 1995. This article is one approach to fulfilling the testing requirements. Part 1 covered FCC reporting requirements and baseband video basics. This part focuses on two specific tests — in-channel frequency response and percent modulation. Following installments will continue to detail each of the FCC-required tests, plus include information on a few tests that may benefit picture quality and system troubleshooting.

By Jack Webb
Product Manager, Sencore

The following information is taken from various reliable sources and is believed to be accurate at the time of printing. Please refer to the FCC Rules and Regulations Part 76.601 through 76.605 to be sure that you fulfill the legal requirements. Listed with each recommended test and the FCC-required tests is information on the FCC regs, a definition of the test, a description of the picture effect, a measurement procedure and many helpful hints and precautions when making and interpreting these measurements.

In-channel frequency response

In-channel frequency response is an FCC test that was reinstituted in July '92. It is, basically, a measurement of the gain vs. frequency over the range of frequencies occupied by the video information for a specific channel. Poor frequency response will cause low picture quality. The in-channel frequency response requirement includes both the headend and the distribution system (and in 2000 the converter). The headend may be tested separately and added to the worst-case system frequency response for a single channel or the entire system measured using the following procedures. The following sections provide detailed information on the FCC Rules and Regulations, a definition of the test, a description of the picture effect, a measurement procedure and many helpful hints and precautions for making the measurements.

• FCC specification 76.601 (c): The operator of each cable TV system shall conduct complete performance tests of that system at least twice each calendar year (at intervals not to exceed seven months), and shall maintain the resulting test data on file at the operator's local business office for at least five years.

• 76.601 (c)(1): For cable systems with 1,000 or more subscribers, but with 12,500 subscribers or less, proof-of-performance tests conducted pursuant to this section shall include measurements taken at six widely separated points within each mechanically continuous set of cables within the cable TV system. Within the cable sys-

Figure 9: Frequency response

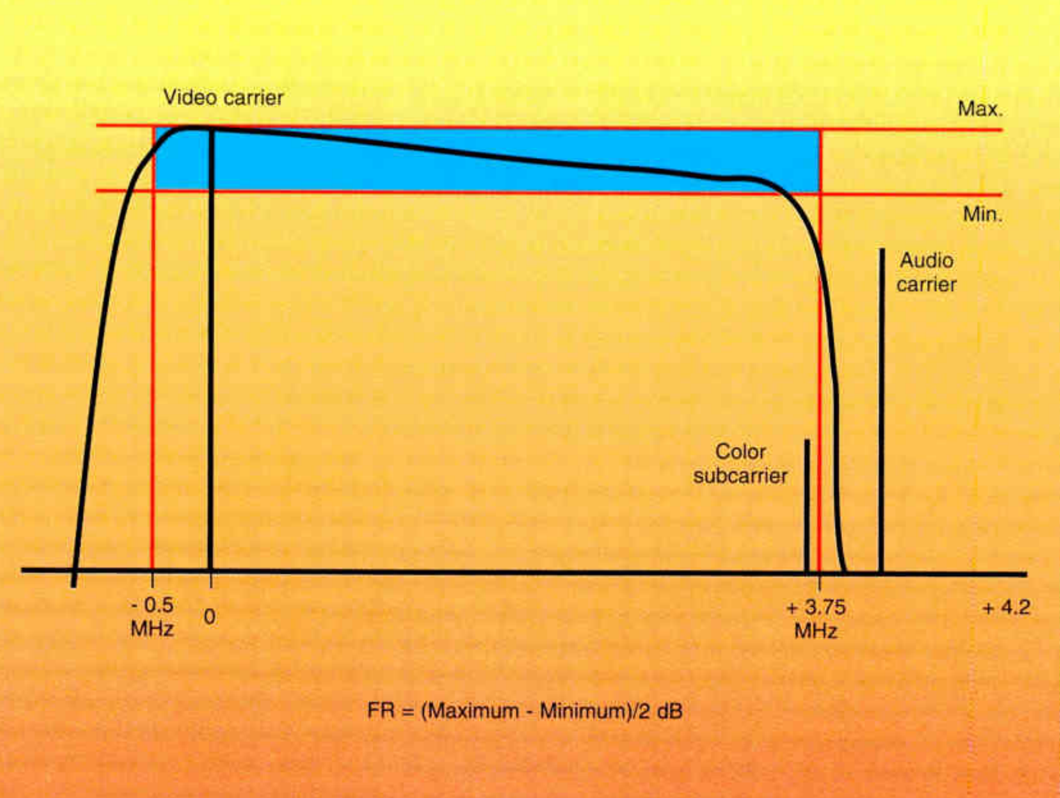
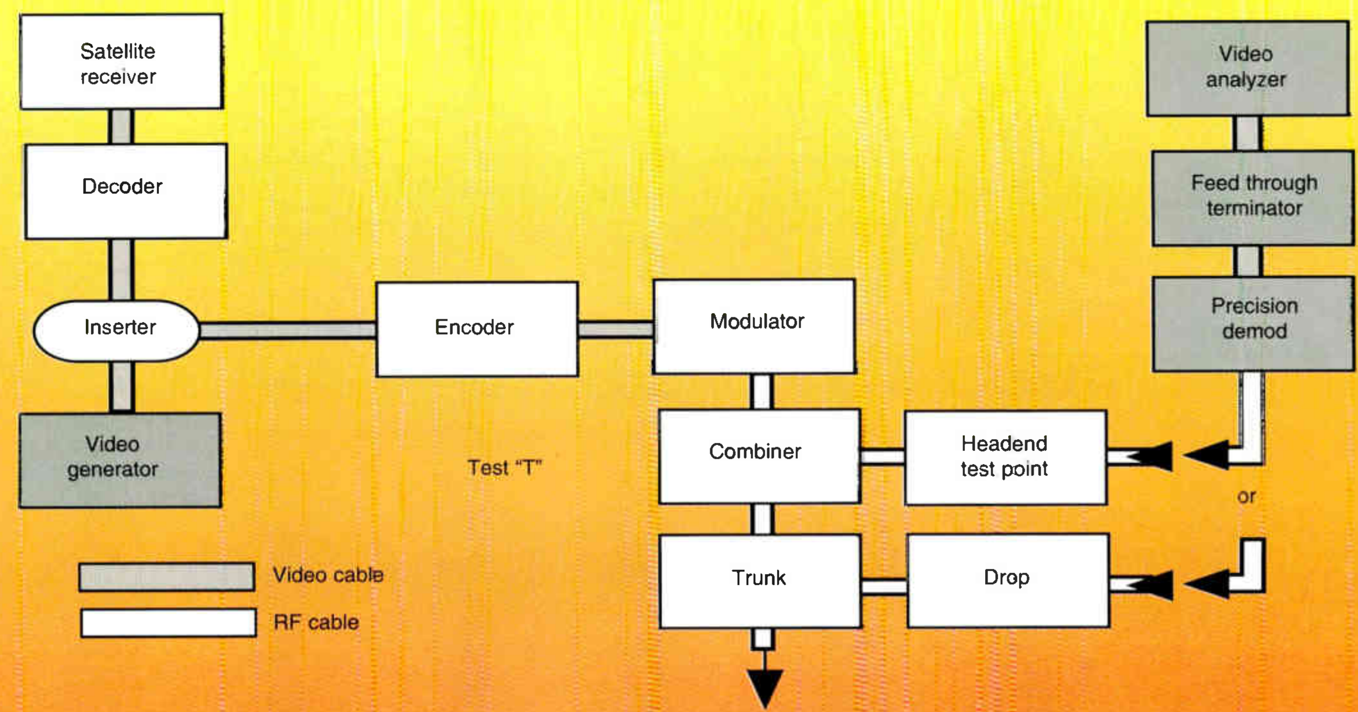


Figure 10: Frequency response measurement



tem, one additional test point shall be added for every additional 12,500 subscribers or fraction there of. Such proof-of-performance test points shall be balanced to represent all geographic areas served by the cable system. At least one-third of the test points shall be representative of subscriber terminals most distant from the system input in terms of cable length. An identification of the instruments, including the make, model number and most recent date of calibration, a description of the procedure utilized, and statement of the qualifications of the person performing the test shall be set forth.

• 76.601 (c)(2): Proof tests shall be made on a minimum of four channels plus one additional channel for every 100 MHz, or fraction thereof, of the cable distribution system upper frequency limit. The channels selected for testing must be representative of all the channels within the cable TV system.

• 76.605 (a)(6): The amplitude characteristic shall be within the range of ±2 dB from 0.75 MHz to 5 MHz above the lower frequency boundary of the cable TV channel, referenced to the highest and lowest amplitudes within these frequency boundaries. Note that prior to Dec. 30, 1999, tests do not include the converter frequency response; after that date the converter or other equipment must be included in the test, if it is provided or maintained by the cable operator.

• 76.609 (i): For systems using cable traps, measurements may be performed prior to the trap. The effects of the trap must be attached to the proof-of-performance records.

"Frequency response is the measurement of the amplitude vs. frequency variation in an RF system. (The video processing equipment contributes to the overall frequency response.)"

Definition: Frequency response is the measurement of the amplitude vs. frequency variation across a specified bandwidth. (The video processing equipment contributes to the overall frequency response.) Typically the frequency response is measured in dB (ratio of the maximum to the minimum gain variation) and is stated as ±x dB where x is one half the total variation. In some circumstances the maximum total variation is stated as the peak-to-valley.

The frequency response of the channel is measured from 0.75 to 5 MHz above the channel's lower frequency boundary or from -0.5 MHz below the video carrier frequency to 3.75 MHz above the video carrier frequency. Across this frequency range the gain of the system must not exceed a difference of 4 dB peak-to-valley or ±2 dB from the mean level. Figure 9 illustrates a typical frequency response.

Picture effect: The frequency response's effect on the picture quality will depend on the particular signature of the response and the degree of gain inequity at various frequencies in the channel. Disturbances may include fuzzy edges of objects in the picture, unintentional brightness variations from top to bottom or right to left in the picture and or color streaking and smearing. High end "roll off" within a channel is a common problem. If severe enough this will produce pictures with weak colors and low contrast.

Measurement procedure: The total channel frequency response includes both the effects of the headend processing equipment (demodulators, descramblers, encoders, video switches, modulators, etc.) and the distribution system frequency response over a particular channel. Test procedures are outlined in the NCTA Recommended Practices, which provide for adding two individual measurements or for making a total measurement. Both procedures have advantages and disadvantages that the user must consider.

If we assume that we want the most accurate measurement without interfering with system operation, then the most desirable procedure is to use a VITS test signal inserted at the headend and measured at our distribution system test points utilizing a demodulator and video signal analyzer. This technique is applicable to all channel configurations except those using hetrodyne processors. If the programmer supplies a VITS signal on the processor channel, using the supplied test signal avoids the difficult process of inserting a test signal, which requires system interruption. The major drawback to testing the complete system is that two personnel are required; one to make the field measurements and one to set up the test signal generator in the headend.

Setup time is saved if the composite and combination test signals are both provided by the generator and are programmable on any VITS line and field. Using either method the test procedure is the same, whether measuring at the headend test point or at the subscriber drop. Using the multiburst method, as described in the "Reference Measurements" section, by documenting the amplitude of each frequency packet, will provide relatively accurate and consistent information. System end-to-end testing will provide the most accurate measurements.

"Remember that systems subject to the new rules are required to pass and document the tests by July 1, 1995."

To measure the frequency response of a channel without interference to the system's operation you will need to insert a VITS test signal in the VBI of the channel to be tested. This should be done at the satellite receiver output (or following the decoder if used). See the insertion diagram in Figure 10.

Choose a VITS test signal with the multiburst pattern. The multiburst test signal is shown in Figure 11. Other VITS patterns may be used for manual measurements, such as one of the multipulse or line sweep test signals. Be sure that the test signal chosen is compatible with the measurement device and the equipment under test. Multipulse can give erroneous readings when high differential gain or phase is present in the system.

Procedure:

1) Connect the test equipment as shown in Figure 10 (page 55).

2) Test signal generator setup:

a) Connect the signal insertion device or loopthrough as required.

b) Select the VITS insertion mode.

c) Select the desired test signal.

d) Connect to the insertion device, enable the generator output.

e) Using the CATV video signal analyzer, verify the test signal insertion.

3) Demodulator setup:

a) Tune to the channel to be tested.

b) Use the envelope detection mode to prevent incidental carrier phase modulation from affecting the measurement. *(Editor's note: Use caution when measuring the mutliburst with envelope detection. This can create burst axis shift because of quadrature distortion creating measuring accuracy errors.)*

c) Be sure the "zero carrier reference" mode is turned off.

4) CATV video signal analyzer setup:

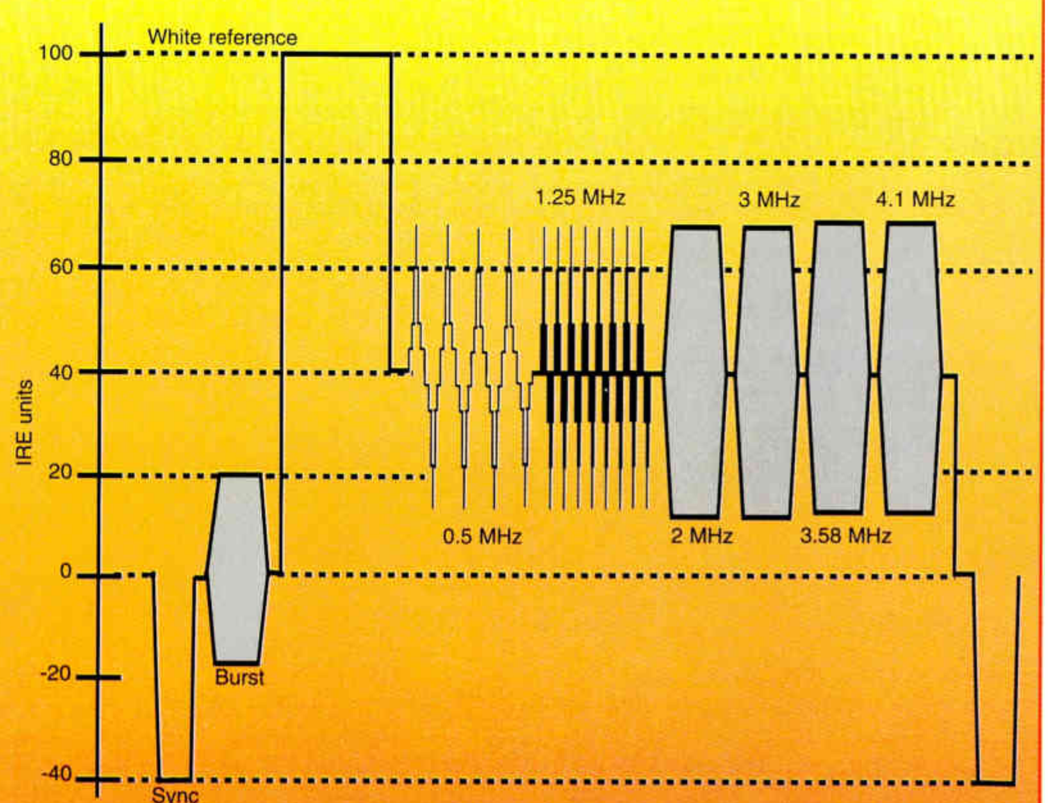
a) Check the cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the line and field where the VITS test signal is inserted.

c) Select the 1 H sweep mode so that one horizontal line is displayed.

5) Press the freq. resp.

Figure 11: FCC multiburst test signal



key and read the LCD for the frequency response variation in ±dB.

Or, for manual measurements:

a) Adjust the vertical position and gain control as required to position the white reference bar on the 100 IRE graticule and the sync pulse on the -40 IRE graticule.

b) Identify and measure the "packets" with the minimum and the maximum peak to peak amplitude.

c) The frequency response (FR) in ±dB can be calculated by the following formula:

$$FR = 20\log(Minimum_{p\text{-}p}/Maximum_{p\text{-}p})/2$$

6) If unacceptable measurements result, troubleshoot the system back up the video path using the CATV video signal analyzer. Be sure to remove the feedthrough terminator where appropriate.

Precautions:

1) If multiburst test signals are measured using a spectrum analyzer, only those multiburst test signals using equal time packets of burst will produce the proper spectrum analyzer display. See the detailed information on your generator for specific timing and frequency information. Generally, the FCC multiburst test signal may be used, where the NTC-7 combination test signal may not. Note that spectrum analyzer IF filter shape factor also may affect the ability to measure multiburst packet amplitudes, especially the lower frequency bursts.

2) Check the insertion point to be sure that the inserted test signal and the video source are set to the proper levels.

3) The standard FCC multiburst test signal's last "packet" consists of 4.1 or 4.2 MHz signals and is above the required 3.75 MHz upper frequency limit. Your system may pass at 3.75 MHz and fail at 4.1 MHz.

4) If you elect to measure the headend and the system separately, do not forget to add the worst-case system frequency response measurements to each individual channel frequency response measurement at the headend.

5) Remember that if you are switching video sources or using commercial insertion equipment, you will want to include these items in your analysis of system performance to comply with the FCC requirement to test channels "typical" of those on your system.

"Percent modulation is one of the historically disregarded specifications or has been entrusted to the 'idiot' lights on the modulator."

Percent modulation

There are no FCC specifications on percent modulation for cable systems, also known as depth of modulation. Percent modulation is, however, one of the most critical parameters in the headend. The proper level of modulation is 87.5% for NTSC video. Overmodulation produces far more sever problems than does undermodulation. Overmod almost ensures that your system will fail the otherwise easy to pass specifications for differential gain and differential phase. Overmod also produces "sparkles" or washed out picture and sync clipping. The effect of clipped sync varies from TV to TV and VCR; some will not sync properly or occasionally roll.

Undermodulation reduces the brightness of the picture and degrades the video signal-to-noise ratio. This will be especially noticeable when switching between channels with more than 5% difference in their percent modulation. A low percent modulation will produce a weak luminance signal at the video detector of the receiver. Turning up the set brightness to compensate for the weak signal "enhances" the noise present in the signal. Again, larger screen sets will display this problem more predominately.

Percent modulation is one of the historically disregarded specifications or has been entrusted to the "idiot" lights on the modulator. Percent mod cannot be properly set using the indicators on most modulators or by "looking at a monitor, turning up the modulation until you see sparkles, and backing off the modulation slightly." Indicators on the modulator usually cannot respond properly to active program video. Using the sparkle test depends on the characteristics of a particular receiver. There are three procedures described in the NCTA Recommended Practices. Any of these, used carefully, will provide a proper percent mod setting. Be sure to follow the specific instruction for the particular equipment that you are using and practice the basic procedures outlined in the baseband basics section in last month's installment.

Definition: Percent mod of a video carrier is the percentage of the difference between the maximum and the minimum of the RF envelope amplitude divided by the maximum RF envelope amplitude. See Figure 12.

% mod = 100 x (A - B)/A

Figure 12: Percent modulation

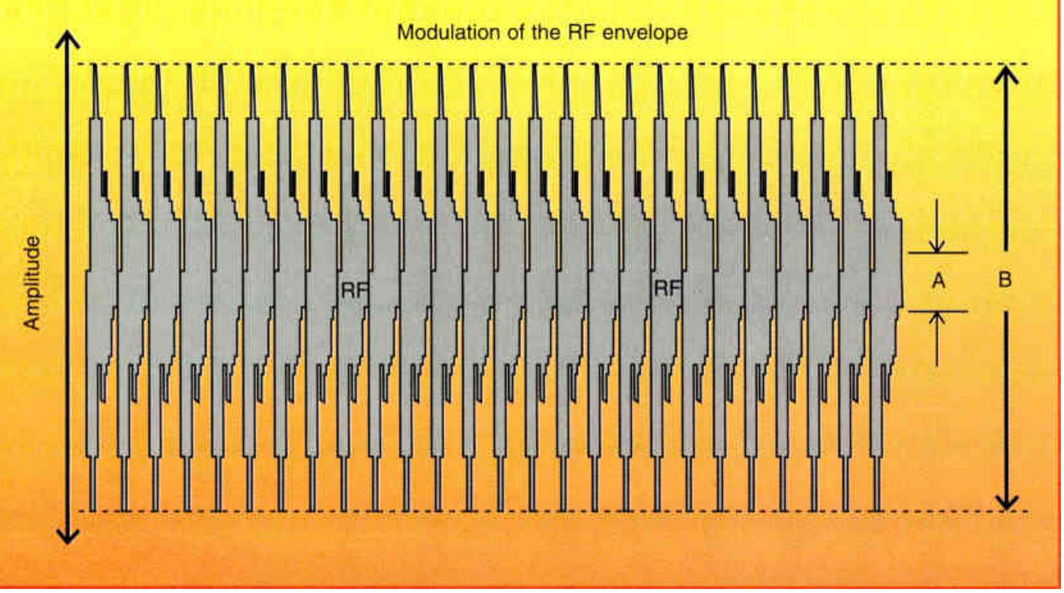
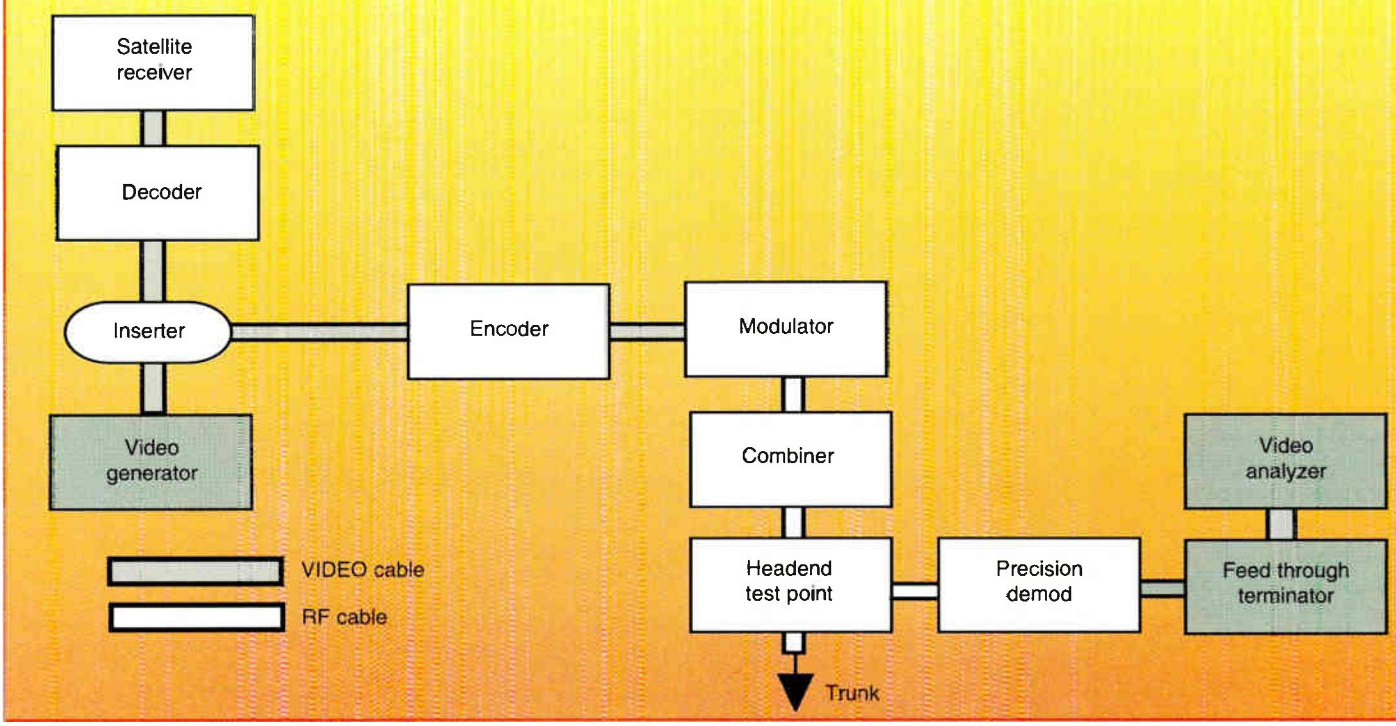


Figure 13: Percent modulation measurement



The maximum RF envelope amplitude occurs at the sync tips. The minimum RF envelope occurs at the whitest part of the picture. To properly measure or set the percent mod, the modulated carrier must contain both sync tip peaks and a 100 IRE white signal. If suppressed or stripped sync is used in your scrambling system, the scrambling must be turned off or a procedure permitting measurement of the unsuppressed sync during VBI must be used.

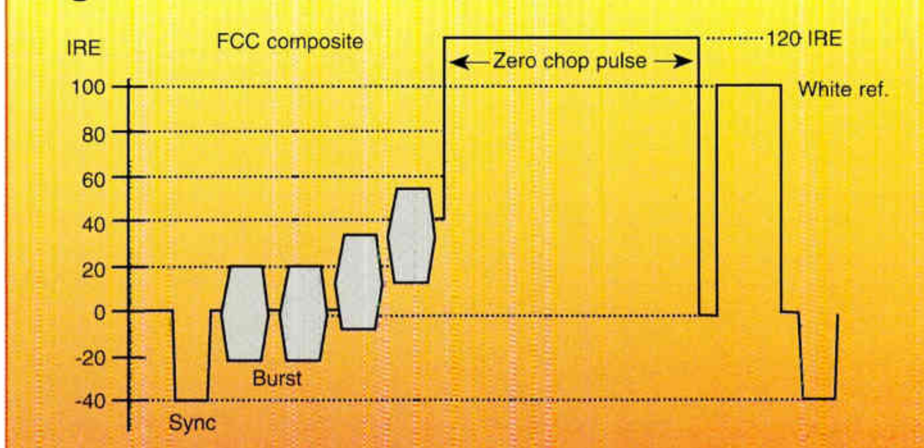
Picture effect: Overmodulation is far more detrimental to picture quality than undermodulation. Overmod produces a picture with sparkles, sync clipping and distortion of the higher level luminance and color signals caused by nonlinearity in the modulator. The nonlinearity is measured in terms of differential gain and differential phase. High differential gain produces a picture distortion characterized by changes in the color saturation as the brightness changes — when only the brightness on the picture should change. High differential phase produces changes in the hue of a color as the brightness changes — when only the brightness should change. Undermod will produce a picture with low brightness. This low brightness or weak luminance signal will produce a soft low contrast fuzzy picture.

Measurement procedure: There are three measurement procedures described in the NCTA Recommended Practices. Of the three, the preferred method is to use a precision demodulator and waveform monitor/vector scope, or wide bandwidth oscilloscope. Using a spectrum analyzer requires taking the channel out of service although with full field test signals will produce extremely accurate results. A VITS signal cannot be used because most spectrum analyzers cannot easily be triggered on a specific line containing the VITS test signal with a white reference.

The signal level meter method has the same limitations as the spectrum analyzer method. In addition, some SLMs may have additional characteristics limiting their ability to perform the demodulator function. Some meters have video AGC circuits to maintain a 1 V video output, which prevent linear changes in video output proportional to RF input level changes. Thus the described measurement procedure cannot be used with this type of SLM. Similarly, some SLMs have an AGC IF system, which also prevents the desired video level amplitude change with RF level changes. SLMs also are typically designed to detect only the peak signal level amplitude and do not exhibit linear detector characteristics.

The precision demodulator and

Figure 14: Zero carrier reference



CATV video signal analyzer method can be accomplished with no interference to system operation. This method uses a demodulator with a "zero carrier reference" pulse that effectively turns off the carrier, simulating 0% modulation. As with the other percent modulation measurement procedures, it is best that a test signal with a white reference be used for the measurement. This can easily be done using a generator in the VITS mode, generating the composite or combination test signal as used for the other tests. Follow these basic steps.

Procedure:

1) Connect the test equipment as shown in Figure 13 (page 59).

2) Demodulator setup:

a)Tune to the channel to be tested.

b) Use the envelope detection mode to prevent incidental carrier phase modulation from affecting the measurement.

c) Turn on the zero carrier reference mode.

d) While viewing the test signal on the CATV video signal analyzer, adjust the analyzer so that the sync tip, the white reference signal and the zero carrier reference pulse are all displayed. Generally, the position and width of the zero carrier reference pulse may be adjusted on the precision demodulator. See Figure 14 (page 59).

3) Video signal analyzer setup:

a) Check the cal signal and be sure the display gain and vertical position controls are properly set.

b) Set the line select to the line and field where the VITS test signal is inserted.

c) Select the 1 H sweep mode so that one horizontal line is displayed.

4) Press the % mod key and read the LCD for the % modulation.

Or, for manual measurements:

a) Adjust the vertical position and gain control as required to position the zero carrier reference on the 120 IRE graticule and the sync pulse on the -40 IRE graticule.

b) 87.5% modulation will place the white reference bar on the 100 IRE graticule (seven divisions of the eight peak-to-peak).

$$\% \text{ mod} = V_{\text{sync to white ref.}} \div V_{\text{sync to zero chop pulse}}$$

5) Adjust the modulator control for 87.5% modulation on the LCD or until the white reference is positioned on the 100 IRE graticule.

Precautions/hints:

1) Be sure that the satellite receiver output, and all other video sources used for that channel, are set for 1 V. Changing the input level to the modulator will change the % mod on most modulators.

2) Permanently install an insertion device in each channel's video path at the output of the satellite receiver, so that test signals may be injected without interrupting the channel. Be sure that only a single 75 ohm termination exists on each video line.

3) Also, install a "T" at the input to any device in the video path of each channel. This will provide troubleshooting test points without interrupting the channel. Be sure that only a single 75 ohm termination exists at the end of each video line.

4) Before connecting the video signal analyzer to any test point, be sure that it is in the high impedance mode (not using the feedthrough terminator). **CT**

CT DAILY
From *Communications Technology* magazine
National Show Wrap-up Edition

S-A Integrates NVOD

Scientific-Atlanta introduced Press Movies, an integrated system for providing near-video-on-demand and enhanced pay-per-view programming over today's cable TV networks.

The product combines an innovative PC-based digital video file server architecture with advanced analog home communications terminals to provide cable TV system operators with a cost-effective method of delivering new entertainment services. The product line takes advantage of today's analog-based CATV networks and emerging digital storage and retrieval technology to offer easy entry into new, unregulated revenue streams.

With the system, CATV operators store digitally compressed movies on low-cost hard disks housed in an industry standard PC-based file server architecture. The movies are retrieved from the hard disks, decoded into analog NTSC video and audio streams, and spooled out as analog broadcast signals at predefined intervals. Operators have the option of determining and revising broadcast schedules to fit virtually any staggered start frequency desired.

The system consists of three components integrated into a unified end-to-end solution. The digital video file server is based on the company's MPEG digital storage and retrieval (DSR) product line introduced in 1993. The primary components include an MPEG-based encoder unit that compresses the video and audio signals in real time and loads the compressed data onto hard disks. MPEG-based decoder boards are integrated into a PC-based file server and periodically decode this data in real time into NTSC analog signals for transmission throughout the cable system.

The second major component is the 8600x analog home communications terminal. This advanced gateway provides a choice of electronic program guides and movie listing options, easy one-button ordering and confirmation, VCR-like pause, forward and rewind control, and bit-mapped graphics capabilities to support enhanced program marketing activities.

The 8600x terminal in the home and digital video file server at the headend are connected and controlled by application-specific enhancements to the company's System Manager 10, a PC-based computer system that executes and confirms orders, delivers video and audio programming, and handles all access and billing operations. Enhanced features and functionality of this system even enable operators to remotely reconfigure movie lineups, add or remove individual movies, and revise movie start times and broadcast frequencies virtually at will.

According to the company, the system is an ideal application of integrated analog and digital technologies that is well-suited to today's CATV networks. **Reader service #208**

The Future Of Cable Networking At Northern Telecom

Northern Telecom launched D-TV: The Digital Network. The company now provides digital interactive networks for video, data, voice, wireless and multimedia services. Purportedly, it was the first exhibitor to bring a public network telephone switch to the National Show.

On display were the building blocks of a full-service broadband network, including the OC-12 TransportNode SONET ring and Magellan Gateway ATM switch carrying live switched video traffic from a DV-45 video codec. The DV-45 is a key component of an integrated community network (ICN), a shared public network linking schools, hospitals, government offices and businesses with a host of voice, data and video applications. **Reader service #207**

Eagle Intros Traps, Filters

Eagle Comtronics introduced the Model EXN 1 GHz negative trap for expanded band cable operations. The very narrow notch in many applications is ideal for adjacent channel usage in terms of LAS and upper video loss. The short length is convenient for cascading units. Utilizing these traps now saves replacement labor when digitally compressed spectrum is required.

Also introduced was the Model EXD 1 GHz decoding filter. This unit has the same electrical and mechanical characteristics as the EXN. Because of its narrower response, an old decoder can be replaced, resulting in improved picture clarity without changing the encoder. **Reader service #204 (trap), #203 (filter)**

Go Addressable And Digital With Pioneer

The Cable and Broadcast Systems Group of Pioneer New Media Technologies Inc. exhibited a full line of new and recently introduced addressable terminal and digital-based products for the cable TV industry, including the BA-10000 next generation addressable terminal, which features extensive on-screen display capabilities, multiple program guides, downloadable firmware, virtual channels, audio masking and enhanced near-video-on-demand functions.

Also on display was the DRM-604X CD-ROM automatic mini-changer, which the company says is the fastest for interactive functions, and the stand-alone LaserDisc-based pay-per-view playback system. **Reader service #206 (BA-10000), #205 (DRM-604X)**

Jerry Conn Intros Digital Co-Channel Filters, Processor

Jerry Conn Associates Inc. introduced two new products from Intelvideo: the Model CF and Model HQ. The CF is a digital co-channel filter that significantly reduces co-channel interference, random noise and other video errors. The HQ significantly improves the picture quality of video signals contaminated by impulse noise, dropouts, FM threshold noise, "sparklies," white noise and other unwanted random interference.

Also displayed was Telecommunication Products' 4575 Processor. The unit was originally designed to work in conjunction with Intelvideo's Impulse Noise Reducer and Models CF and HQ. The unit works at IF and demodulates a composite NTSC signal to baseband. The audio portion is routed directly to the output while the video signal is passed through for further processing. At the output, the unit remodulates the signal for the source. **Reader service #202 (filters), #201 (processor)**

Status Monitoring At Alpha

Alpha Technologies introduced its IR-XP status monitoring system, a handheld, infrared data retrieval device designed for use as an integral part of a cable TV system preventive maintenance program. To encourage more effective maintenance programs, the unit accelerates information collection and provides consistent, usable data for system performance evaluation. Information is transferable to a PC data base, where it can be formatted by a maintenance records program, allowing the development of history files such as battery performance and outage data.

The unit allows a technician to verify correct power supply operation and anticipate potential problems before they occur. Multiple test points are accessible from a single power supply connection, reducing technician time in recording and logging information necessary for continued trouble-free operation. The compact, light-weight design eliminates the need for bulk test equipment. A lit LED display makes it easy to read information under all lighting conditions. Fully electronic recording replaces inconvenient manual log sheets. **Reader service #200**

Electroline's Show Roll-Outs: DropAmp, Addressable Taps

With the advent of digital video transmission to the home, cable operators must contend with damage to digital signals caused by microreflections generated inside the home, at numerous outlets, populated with numerous video devices. Electroline Equipment's new EDA 4G-ISO high-isolation DropAmp, introduced at the show, eliminates many of these problems that could disrupt reception of digital video signals by customers.

The new DropAmp offers 35 dB of isolation between any of its four outputs. It also features the standard 1 GHz bandwidth and low-noise performance of other members of the DropAmp family of products.

The new high-isolation subscriber amplifier addresses the problem of microreflections and other signal discontinuities caused inside a consumer's home by multiple outlet, multiple connector, multiple TV set and VCR environments. When customers channel surf on numerous sets, for example, unwanted energy travels back from the converter, TV tuner or VCR toward the tap. Because in-home splitters often have inadequate isolation, these unwanted reflected signals can impair the reception of pictures at other TV sets inside the home also outfitted with digital decoders. Though analog signals may tolerate such disturbances, complex digital signals, such as those typical of compressed video, are not so fortunate.

All DropAmp versions feature: 1 GHz-plus bandwidth; 15 dB gain block; noise figure less than 3 dB; filter options for 30 or 40 MHz return bandwidth; port-to-port isolation greater than 22 dB; remote powering option; and one, two, four or eight outputs. The high-isolation DropAmp (EDA 4G-ISO) offers 35 dB isolation and is specially optimized for networks delivering digital video.

Also at the show was information on the company's new compact addressable tap (CAT), an addressable multitap available in both amplified and nonamplified versions. Operators can install a 1 GHz tap that features no loss, eliminating the need for additional distribution amplifiers in an apartment building, for example. The compact CAT features a form factor one-third the size of a passive eight-way tap. CAT is available in four-port, eight-port, 12-port or 16-port versions, and supports on/off control of one or two tiers of service. **Reader service #197 (DropAmp), #196 (CAT)**

Tellabs Operations Closes The Gap With Telephony Over Cable

Tellabs Operations Inc. introduced its Cablespan 2300 universal telephony distribution system, designed specifically to meet the unique demands of cable operators. It allows operators to increase the value and potential of their existing hybrid fiber/coax networks by offering telephony plus a variety of new services such as telecommuting, video conferencing and access to information services.

Compatible with cable distribution systems and topologies, the system is an ideal vehicle for the delivery of enhanced two-way services to residential and business customers, offering low start-up cost, reliability, ease of administration, asset protection and scalable growth that enables investment to keep pace with demand. The company offers the system through a joint venture with Advanced Fibre Communications. **Reader service #199**

Ipitek Manages Interactive Networks

Ipitek introduced the user-friendly and Windows-driven FiberSentry network management software, described as a powerful and flexible status monitor and control package for CATV fiber-optic networks. Advanced features include customer-defined sense and control points, remote PC monitoring, user-programmable alarm actions and network equipment performance history.

The software was designed to be used with the return path hardware available with the company's Fiber-

Trunk CATV transmission equipment. When the return path hardware and FiberSentry are used together, the system minimizes network downtime, dramatically reduces service calls and enhances service quality. If self-healing and redundancy are utilized, the system will provide a full network management system with respect to these features. **Reader service #198**

Add Channels And Services With S-A's Updated Modulator

A new version of Scientific-Atlanta's Model 6350 TV modulator was introduced, with 750 MHz capability to provide added channel capacity for new cable programming and services.

The included integrated stereo encoder can generate industry-standard BTSC stereo signals within the modulator to save rack space. The video switch with automatic gain control provides automatic video loss protection and switching to an alternate source for backup, emergency broadcast requirements and other switching applications.

Dual IF loops furnish separate audio and video IF signals for use with pulse-sync and sine wave suppression scrambler systems. IF automatic gain control provides amplifications and gain control of an external high level IF input. The modulator can be upgraded to 1 GHz. Also, current Model 6350s can be modified to be 750 MHz or 1 GHz capable. **Reader service #193**

Telecorp Unveils System 6000 ARU Release 7.0

Telecorp Systems announced the System 6000 ARU Release 7.0. It encompasses a variety of new software and hardware enhancements and incorporates a la carte software. Many of the features that are offered with Release 7.0 are ones Telecorp cable customers have specifically requested. One feature cable operators have asked for is a la carte software. Release 7.0 provides the ability to modularize the software, thereby allowing companies to purchase only those features they desire.

The PPV ordering module, the hallmark of the System 6000, has been revamped to offer more flexibility with PPV ordering. With enhanced PPV, cable operators have the flexibility to set up ordering by category, title, date or time. Advanced ordering allows subscribers to order up to two weeks in advance. Event listing priority control allows the user to assign priority to the events that should be promoted most, therefore they are spoken first on the ARU's voice menu.

Release 7.0 provides enhanced data base capability to give the reporting package new flexibility to further break down the usage of major transactions within the system. As well, the System 6000 can

C-COR Intros Fiber System, Video Encoder/Decoder

C-COR introduced its LinkNet AM fiber system especially designed for today's fiber-rich architectures. Benefits of the new system (featuring the high-performance Ortel laser) include 750 MHz capability (80 channels + digital) on single or dual fibers; redundant optical backup; flexible, modular upgradable 1 GHz platform; a network management option; simplified installation and maintenance; and compact size, easy-to-use configuration. The LinkNet family includes both headend and strand-mounted equipment. The headend equipment uses a modular mainframe that houses a power supply module for operation in a "load sharing" or redundant environment and is capable of housing a combination of six transceiver modules.

Also new is a 10-bit digital video encoder/decoder, which is part of the company's Comlux Series 3000 digital fiber systems. The codec is said to be well-suited to accommodate the wide variety of TV signal formats found in today's video service business. Its 10-bit digital sampling accuracy, plus a very high digital sampling rate, produces signal performance exceeding RS250C short-haul specifications in all parameters, including video signal-to-noise ratio. **Reader service #195 (LinkNet), #194 (encoder/decoder)** now support dBase file format.

The System 6000's system architecture has been redesigned to take better advantage of its multitasking environment. These improvements allow better communications with the cable billing systems as well as supporting multiple billing systems or hosts. The interactive outage reporting feature now gives users a new multitude of options when designing an outage reporting system for their ARU. In addition, cable technicians are able to better manage outages through the ARU from the field.

With Release 7.0, the System 6000 ARU supports the latest versions of cable billing system/addressable controller interfaces including CableData, CSG, ISD, BSI, EDS, and Zenith/Science Dynamics OLQ interface. The release includes a number of new features that provide tighter integration between the ARU and the PBX/ACD systems including the ability to pass ANI (automatic number identification) and DNIS (dialed number identification) numbers between the ARU and the PBX/ACD.

Integration between inbound and outbound applications is now supported by the System 6000. The ARU can place an outbound call to a subscriber, play a prerecorded message and then give access to the ARU as if it had started as an inbound call. This is especially effective with the interactive collections reminder, where a collections message is played and the customer is prompted to enter the account number for more information. The ARU then allows the customer to access the inbound account inquiry application providing details about the past due balance. **Reader service #192**

Drake Slims Down With Commercial IRD

The R.L. Drake Co. announced a new, high-performance, high-quality commercial integrated receiver descrambler (IRD), the ESR1260. Designed and engineered for the most demanding CATV installations, the unit has a compact design that saves the operator needed rack space while incorporating the VideoCipher RS commercial module. The unique removable front panel allows easy access to the VideoCipher RS descrambler module without removing the receiver from the rack. Frequency-synthesized tuning of video IF and audio subcarrier frequencies provides maximum stability. The IRD features a 16-character LCD that indicates all receiver parameters, a dual-input tuner for operation on C- and Ku-band and two IF bandwidth filters of 27 and 22 MHz to maximize receiver performance.

The IRD has a standard 950 to 1,450 MHz block IF input and utilizes a low-noise 140 MHz IF with threshold extension to provide the best possible picture. The video output is automatically switched between descrambled video from the descrambler module and normal clamped video if an unscrambled signal is being received.

Also, Drake is offering two new distribution amplifiers, the DDA-1218 and DDA-1236. The new amps are designed for applications in SMATV, private cable and other TV distribution systems. The DDA-1218 offers 18 dB of gain while the DDA-1236 boasts a full 36 dB. All Drake amplifiers feature 14 dB variable gain adjustment. The amplifiers offer a one-piece construction with built-in power supply and a continuous frequency coverage from 40 to 1,000 MHz. The push-pull amplifier design allows higher input levels with no distortion of signal. The DDA-1218 and DDA-1236 amplifiers' circuitry is designed for maximum stability and is housed in a rugged aluminum housing for years of maintenance-free operation. Noise figure, gain, VSWR and all other specifications are carefully engineered to maintain the highest signal quality. **Reader service #177 (IRD), #176 (amps)**

NCTA Releases 1994 Technical Papers

The National Cable Television Association released the 1994 NCTA Technical Papers. Highlights of this year's 484-page book include interactivity, digital video servers and video telephony design.

The technical papers can be ordered from NCTA's Science and Technology Department for $45 for members and $55 for nonmembers. The extra cost includes domestic shipping. Only prepaid orders are accepted. Call the NCTA Science and Technology Department at (202) 775-3637. **Reader service #191**

New Sub Management System At Suntech

The newest version of SunTech System's subscriber management system was unveiled. It's a comprehensive software package designed for the PC/486 or Pentium-based computer. It does billing, maintains accounts receivable and manages subscriber files. The system also tracks converter inventory, provides work order management and accumulates management and marketing information. As well, it offers optional addressability, pay-per-view (PPV) and MSO corporate consolidation. The program may be configured to operate on a single microcomputer or in a network environment using most leading network systems such as Microsoft's Windows for Workgroups, Windows NT, Novell Netware and Lantanstic.

The Microsoft Windows graphical environment makes the computer easier to use and applications easier to learn. Also, it allows several programs to run concurrently, permitting access to several applications at the same time.

System highlights include on-line subscriber inquiry, various billing format printing, fee and tax breakout, deposits tracked, management reports, subscriber profiles and more. Optional features include an addressability module, PPV module and MSO consolidation module. **Reader service #179**

Get Interactive With Motorola

Motorola demonstrated a prototype of CableComm, a new technology that will allow the delivery of interactive services to homes and businesses over the existing fiber/coax infrastructure.

The CableComm system will enable network operators to distribute next-generation interactive and multimedia services over the broadband infrastructure that currently reaches more than 60% of the homes in the U.S. The technology will allow system operators to fully exploit the two-way capabilities of hybrid fiber/coax networks. This will enable rapid and cost-effective deployment of a wide variety of integrated wired and wireless telephony services — voice, data, video phone, as well as PCS — over a common hybrid fiber/coax network.

CableComm addresses two of the principal technical obstacles to delivering interactive services to home and business subscribers connected to a cable system. They are the availability of bandwidth on the upstream path (from the subscriber to the cable headend) and the susceptibility of the cable infrastructure to interference and noise. Both of these limitations have slowed the deployment of cost-effective interactivity over the fiber/coax infrastructure. **Reader service #171**

Philips Debuts Broadband Communications Gateway

Philips Broadband Networks Inc. introduced its new Broadband Communications Gateway system for transmission and delivery of telephone and data services to individual subscribers using a hybrid fiber/coax transmission network typical of today's state-of-the-art cable TV systems. It interfaces to the telephone central office switch and adapts the communications for transmission to the end-user via the HFC. At the end user's location, a network interface unit adapts the subscriber's customer premise equipment to the network. **Reader service #178**

Get Your Fiber Organized At Siecor

Siecor's booth contained information on the company's new Headend Distribution Frame (HDF). This complete system is used as an interface between outdoor cable and equipment cables in the headend of a fiber-optic system. It can be used in a cross-connect or interconnect capacity, housing connectors, splices, splitters and couplers in the same frame.

Fully modular, the HDF is designed with full frontal access, an essential feature for space-constrained headend environments. Fiber routing guides and strain-relief provisions within and between housings provide fiber and signal protection with appropriate bend radius controls. Connections can be accessed without violating fiber and cable bend radius.

Each 7-foot HDF bay houses up to

1,224 fibers in 17 housings. The three shelves within each 72-fiber housing accommodate 24 connectors and 24 splices per shelf. Fully controlled and protected buffer tube and jumper service loops allow no-tools access of all components. This simplifies fiber rearrangements, upgrades and maintenance. Housings accommodate attenuators up to 1.5 inches long, which eliminates the need for additional attenuator hardware.

Connector density is maximized without sacrificing craft-friendliness, fiber protection and system flexibility for upgrade as demand requires. **Reader service #174**

Homeworx Assigned Modular Design

American Lightwave Systems Inc., a subsidiary of ADC Tele-communications Inc., introduced its Homeworx hybrid fiber/coax strategy. It consists of the company's new ISX outside plant transceiver and distribution node, each designed to provide POTS, fractional T1 and VOD services to a 500-home serving area. It combines a video and telephony receiver with reverse path transmission. The modular design makes upgrading equipment to future telephony and advanced digital services easy: simply insert the plug-in modules. There is no need to modify existing outside plant design. The system node size can be modified without modifying existing fiber or coaxial plant. **Reader service #175**

Lock 'Em Up With Reliance Comm/Tec

Reliance Comm/Tec introduced the UE66TV universal enclosure that provides a versatile and economic deployment vehicle for broadband cable TV applications including coaxial cable, copper, radio (wireless) and fiber-feed systems.

This front access, walk-in cabinet is environmentally controlled to protect electronic equipment and batteries from severe weather conditions. One 12,000 BTU/HR air conditioner, a sump pump, an alarm package that includes intrusion, high water, smoke, high temperature and toxic and explosive gas alarms, are standard equipment to ensure safe operation and security. An optional fiber management facility (FMF) provides easy and organized access to cable connections.

Also standard are a 100-ampere external emergency power inlet and exterior access transfer switch for an additional backup power system in the event of commercial AC and DC power system failure. As an option, the Reliable JuiceBox power transfer pedestal may be installed to provide a meter housing, or to provide AC power transfer switch access away from the cabinet.

As well, the company rolled out the Hinged SuperSafe, a high-security apartment enclosure designed to prevent cable theft. The Hinged SuperSafe may be used in most apartment complexes and dwellings where multicable service is available. It will house taps, traps, splitters, couplers and assorted distribution equipment. Constructed of rugged mill-galvanized steel, the Hinged SuperSafe has welded corners to prevent penetration and prying. An additional theft deter-

Ipitek Adds T1/E1 Repeater Capability

Users of the IMTRAN digital fiber-optic transmission system can now span up to 40 digital T1/E1 repeater channels per fiber. This adds even more flexibility to the IMTRAN delivery system. A variety of personality modules including video, audio, RS-232, RS-449 and composite IF can be mixed and matched within a 3 RU IMTRAN frame, allowing the user a fully customizable system. Each T1/E1 module can multiplex up to four channels, with room for up to 10 modules per frame. Distances cover more than 40 miles over single-mode fiber, and up to 2 km using multimode.

Difficult networking problems can be solved by using multiple units set up to create a fiber digital video ring network capable of dropping and inserting signals at any site. Full digital node relay ensures signal integrity no matter how many destinations are passed, with drop and insert combinations easily reprogrammed at any time. Customers can order frames with just enough modules to cover immediate needs, adding more channels as required. **Reader service #173** rent is the lockable chamber that accepts Diversified, Diversified Slam Lock or Inner-Tite locks. The mill-galvanized grid plate and demarcation plate allow neat and efficient installation of distribution equipment. The hinged lid conveniently lifts up, out of the way, for ample work space.

The company also displayed its new OTB55 cabinet, a versatile enclosure designed to house fiber-optic (optoelectric) voice transmission equipment, RF amplifiers, power supply and battery backup.

The OTB55 is divided into main, splice/load center and slide-out battery tray chambers. Standard equipment includes: AC power system (two dual-ground fault interrupter outlets), fan cooling system, F-81 test port knockout, accessible main chamber grounding bar, UL-listed load center, recessed emergency generator outlet, two star-slotted mounting brackets, DC intrusion alarm/light switch, and standard 19- and 23-inch mounting racks with 1/2-inch mounting centers. (The 23-inch rack can convert to a 19-inch rack for applications requiring two 19-inch racks). A slide-out battery tray will house three batteries, and can be ordered with an optional heating pad and thermostat. **Reader service #165 (UE66TV), #164 (SuperSafe), #163 (OTB55)**

Sencore Launches Insertion Generator, Signal Analyzer

The new model VIG791 from Sencore can insert two test signals for complete testing and FCC proof-of-performance measurements on active channels without service interruption, interference or inconvenience to customers.

The exclusive synchronous router lets you put the VIG791 on-line while remaining transparent to customers. The product lets you inject two signals simultaneously to make testing quicker and easier. The FCC composite and multiburst signals can both be selected in the VITS mode for complete FCC testing. The unit allows video tests to be made in minutes without disrupting service or waiting until early morning hours.

Any of the unit's 12 test signals may be selected and set up for VITS or full field operation. The special test signals are specially designed for tests such as differential gain and phase, in-channel frequency response, chroma-to-luma delay, percent modulation, S/N and hum. The VIG791's four-line LCD lets you set up test signal parameters with simple, easy-to-read screens.

Also new from Sencore is the VSA794 that provides easy and accurate FCC performance testing with minimum training and capital investment, according to the company. The user receives automated measurements of the key CATV baseband measurements including differential gain and phase; chroma-to-luma delay; S/N; in-channel frequency response; percent modulation and hum.

The VSA794's direct digital readout of all key parameters eliminates complex calculations or interpretations to ensure accurate measurements. Along with the automatic tests, the unit offers full manual waveform and vector measurement capabilities providing maximum utility in testing and troubleshooting. Plus, the product is completely compatible with the Sencore VIG791 VITS video signal generator for complete testing. **Reader service #162 (VIG791), #161 (VSA794)**

Powering Up With Alpha

Alpha Technologies announced the Power MUX, a 60 VAC/48 VDC multiplexing power supply to help meet the needs of today's converging technologies. The unit facilitates the remote powering of 48 VDC telephony equipment from cable TV networks. The unit rectifies and conditions 60 VAC power from a cable trunk to provide high-quality 48 VDC, 4 amp output. Designed for optimum reliability, the unit is equipped with redundant AC input to further ensure the integrity of the DC being supplied to the telephony equipment.

The unit provides status information concerning the condition of the AC input as well as the DC output of the unit. These signals also can be cabled into a remote status monitoring system, allowing the system manager access to vital information.

In the event that more backup time is required for the telephony equipment than can be supplied by either cable trunk power supply, the unit can be connected to a small standby battery pack. The DC output also can be tailored to properly maintain the battery pack over a wide operating temperature range. Designed to meet UL, CSA and VDE safety standards, the unit is extremely rugged, reliable and versatile. **Reader service #168**

EDS Exhibited By EIA

The Electronic Industries Association's Consumer Electronics Group demonstrated extended data services (EDS), a new TV feature that will significantly expand cable service providers' and broadcasters' ability to communicate with viewers on TV screens.

Among EDS's features are the information-display applications that are activated when viewers change channels or press a button on their TV sets or remote controls. **Reader service #172**

ANTEC Builds Bridge To Interactive Service

ANTEC Corp.'s new business unit, Digital Video, has developed a line of cable TV-specific file servers designed as a bridge to future interactive digital services. The line of video file servers use today's existing cable TV infrastructure to incrementally build and develop new revenue streams from targeted advertising insertion, near-VOD, VOD and other interactive services without the need to invest in ATM switches.

The hierarchical file server architecture includes the DV20 unit that can be placed at an existing headend to internally store up to 100 hours of video programming. High-demand movies, for example, can be stored via the DV20 units that could then be delivered to subs in near- or real-time.

For targeted commercial insertion, Digital Video's DV300 unit stores up to 12,000 30-second commercials, offering users an unparalleled storage capability for developing new revenues in local advertising insertion, according to the company. Individual nodes can then be targeted with specific ads based on an analysis of demographics.

Digital Video uses existing transmission networks that can include hybrid fiber/coax cable systems, SONET and fiber-to-the-home technologies. The family of file servers also includes the DV1000 program server that can store and transmit video or data information from programming sources on-demand. **Reader service #167**

Arrowsmith Unveils New 2.0 Version of FLEETCON

Arrowsmith Technologies unveiled FLEETCON 2.0, a workforce management system designed specifically for cable companies. It combines computer-aided dispatch technology with a geographical interface to help cable ops increase the efficiency of their operations. New 2.0 features include UNIX work stations, outage detection capabilities, status monitoring, auto routing, handheld signature capture, and additional icons to provide even more user-friendly interaction between dispatch personnel and field technicians. A primary benefit is the system's ability to help cable companies increase profits and deliver better customer service — two elements that make FLEETCON attractive to cable companies looking to improve their bottom line and meet FCC regs for improving customer satisfaction. **Reader service #170**

Fujitsu Introduces End-User ATM Broadband Gateway

Making its move into the broadband multimedia end-user market, Fujitsu Network Switching of America (FNS) introduced an ATM gateway to enable end-users to easily access the emerging high-speed broadband public information highways.

The broadband multimedia gateway, called the SMX-6000 ATM Service Multiplexer, is one of the first commercially available products to provide access to public ATM networks at rates as high as 155 Mbits per second, according to the company.

The SMX-6000 takes data from multiple communication services and assembles it into ATM cells, then sends these cells simultaneously over a 155 Mbps optical link to a public network ATM switch. The unit is designed to work with all public and private network ATM switches and other ATM equipment that comply with ATM standards. As additional standards are defined, the SMX-6000 will evolve to assure continued interoperability.

The first use of the SMX-6000 is expected to be for the provision of interactive, multimedia services. These first applications include videoconferencing, the transport and switching of high-resolution images for distance learning, remote medical diagnostics, and consultation between urban and rural areas. In such an application, for example, the SMX-6000 uses ATM cells to establish 45 Mbps DS-3 circuits for video and provides switched multimegabit data service (SMDS) for sending high-resolution images and data over a single ATM link.

The SMX-6000 ATM Service Mux is available with interface cards for DS-1 and DS-3 circuit emulation service at 1.54 Mbps and 45 Mbps, respectively, and SMDS at both DS01 and DS03 rates. It has six service interface card slots. A 155 Mbps OC-3 SONET-based optical circuit links the unit to a public network ATM switch. A 45 Mbps DS-3 coaxial interface also is available. Additional interfaces for other services and speeds will be added as needed.

In addition to distance learning and remote medical diagnostic and consultation applications, the unit is expected to be used for LAN-to-LAN connectivity over an ATM network, and to aggregate variable bandwidth end-user traffic on a single ATM port. **Reader service #160**

Splice, Calculate Loss With Siecor's Micro Splicer

The new X-75 micro-fusion splicer from Siecor is said to simplify field splicing and automatically calculate splice loss. Taking advantage of improvements in optical fiber geometry, the hand-size X-75 splicer incorporates a fixed V-groove alignment system to quickly and simply position fibers for splicing. The X-75's one-button unit automatically sets the proper gap between fibers and fuses and then determines the quality of the splice using its two built-in video cameras. Average loss is less than .06 dB for single-mode applications. Results are displayed on a high-resolution LCD screen.

The product's factory-set programmed splicing parameters can be changed by the installer or technician in the field to accommodate various appli-

System reliability

(Continued from page 51)

so network management devices monitoring received optical power in fiber-optic receivers also can detect performance changes at their source and be used to prevent serious performance degradation. Similarly, network management devices installed in fiber-optic transmitters also can detect CTB performance changes at their source and before system performance degradations occur. Network management devices installed in strand-mounted fiber-optic receivers and RF amplifiers can both monitor the 60 VAC power and have the ability to predict power-related outages thus giving them an extensive fault prediction capability.

Network management costs

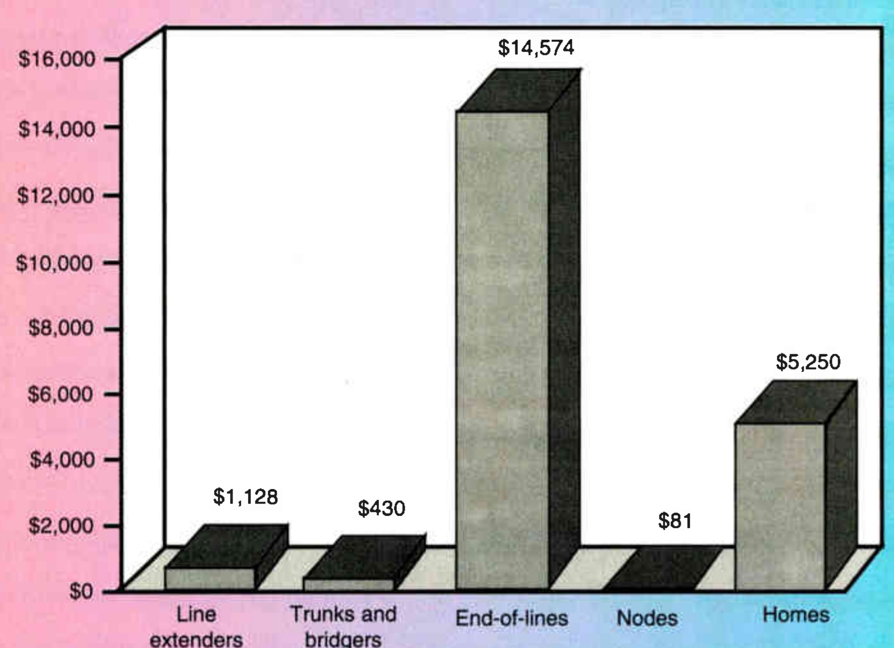
In looking at the implementation of network management systems, it is important to look at the relative costs of various monitoring device location options. The number of locations where each type of device can be installed dramatically affects the relative cost of each option. Figure 4 (page 51) shows the number of potential network management device locations per mile for a typical cable system.

Another factor that helps determine cost is the relative complexity of the monitoring device. The most expensive monitoring devices are end-of-line devices because each must have a complete housing, power supply, communication circuitry, microprocessor and RF measurement circuitry. The next least expensive (by a factor of 50%) are monitoring devices installed in fiber-optic equipment and RF amplifiers. These devices use the housing, power supply and RF measurement circuitry of the amplifier, fiber-optic transmitter or fiber-optic receiver that each is installed in. They require only the addition of communications circuitry and a microprocessor to enable them to report back the desired information. The least expensive monitoring device is the in-home subscriber terminal because its powering, communication circuitry and microprocessor are already included. However, if in-home RF measurement capability is required, additional cost could be incurred by adding the necessary RF measurement circuitry. Based on the quantities show in Figure 4 (page 51), a comparison can be made of the cost per mile of the various monitoring location options. (See Figure 5.) The cost per mile for the end-of-line devices assumes an incremental cost for RF level measurement and 100% penetration of in-home monitoring devices.

Other factors affect the cost to implement each of the network management options. The in-home device's ability to provide high-resolution views of outages, depends entirely upon the penetration of these devices in a system. These in-home devices will be relatively expensive and will only be installed when specialized services (VOD, etc.) are required. It is therefore unrealistic to rely on in-home devices solely for network management from the outset. Since the in-home devices are used primarily for the supply of revenue-generating services, they are not principally used for network monitoring. So, the software that manages the in-home devices must communicate with the network management software to provide the outage information. At this time this software does not exist.

"The installation of monitoring devices in trunk, bridger and line extender amplifiers or fiber-optic monitoring devices is the most cost-effective means of providing network management from the outset."

Figure 5: Cost per mile of monitoring location options



Conclusion

High system reliability can be achieved through the installation of reliable active components, using short amplifier cascades, utilizing redundancy to protect against single points of failure in the fiber portion of the system, using standby powering with monitoring, and by installing and using a cost-effective network management system. The network management system also has the capability to ensure high system integrity by monitoring system performance and by predicting outages.

The installation of monitoring devices in trunk, bridger and line extender amplifiers or fiber-optic monitoring devices is the most cost-effective means of providing network management from the outset. If combined, they provide excellent outage detection, outage location, redundancy monitoring and control and outage prediction capabilities. If in the future appropriate software is available, the combination of RF amplifier and fiber-optic device monitoring with in-home monitoring will be possible. This combination will ensure an even more reliable network. **CT**

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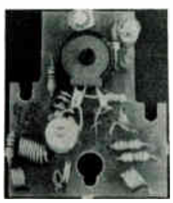

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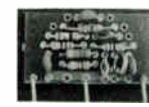

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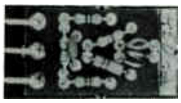

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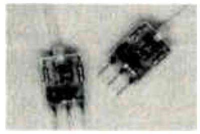

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Reader Service Number 68

July 1994

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Focus: Fiber maintenance

Table of Contents

From routine to emergencies: Maintaining fiber in the headend

By Randy Reynard
Technical Training Manager

And Frank Eichenlaub
Technical Trainer
ANTEC Corp.

With the proliferation of fiber-optic systems becoming the norm rather than the exception in today's cable TV systems, properly maintaining fiber-optic systems represents a critical concern in the overall reliability of cable network. Several key steps can be taken by the astute technician and technical manager to keep the fiber-optic system at top performance levels from the headend.

Routine maintenance

Fiber is tough; it is not, however, indestructible. A snag of a coat button against an exposed fiber or a misplaced step atop a fiber jumper could cause serious harm to cable services, especially in the headend where more foot traffic around fiber may occur.

The first step in fiber maintenance is, to put it simply, routine. On a regular basis — preferably monthly — the headend fiber-optic system should be visually inspected by technical personnel to verify that fibers are not strained, pinched or in any way kinked. Any one of these prospects will reduce output signal quality and could cause service calls if not outright breaks to fiber. Further, this visual inspection allows technicians to notice if fiber cable is properly stored to keep it out of harm's way. Fiber should be kept as neat and orderly at every splice point as possible to help reduce the likelihood that any type of human contact will not unnecessarily pull on the fiber cable and cause damage to the glass inside.

Routine maintenance also should encompass an examination of the system documentation. On a monthly basis, the existing documentation should be analyzed to ensure that the records are completely up-to-date. Between routine maintenance checks, did an emergency repair take place that might have changed the routing of fibers? If so, were those changes documented? The importance of proper documentation of all aspects of the fiber plant — both at the headend and in the field — cannot be stressed enough.

One easy way to keep up to date on what changes may have been made to headend fibers is to train personnel to use temporary circuit identification tags, commonly known as "toe-tags," to identify any fiber that technicians might have worked with between routine maintenance checks. These toe tags should clearly identify what changes took place so that the exact information can be transferred to the system documentation once an emergency repair has taken place and operations return to normal. In this way, the stress of an emergency repair will not result in corrupting the system's documentation. Without up-to-date information, technicians will probably not be able to respond to an emergency situation as quickly or efficiently should a fiber failure occur.

Preventive maintenance

Preventive maintenance primarily focuses on monitoring the performance of the fibers. The most important thing to remember is to never test active fibers; test only spare fibers. Testing active fibers could eliminate the precision of the splices and could result in a degradation to signal performance that could, ultimately, take customers off-line. In most cases, spare fibers should be spliced all the way down to a particular node in a fiber-optic system, offering technicians a way to test performance of the entire fiber run without needing to test and potentially harm in-service fibers.

Technicians should use an optical time domain reflectometer (OTDR) or other type of optical equipment to test these spares. An OTDR provides the fastest and most efficient way to measure splice losses and the characteristic attenuation of the fiber. Several key steps in setting equipment parameters will help in attaining optimal results from the OTDR.

"The most important thing to remember is to never test active fibers; test only spare fibers."

First, clean the connector. The front panel connector is one of the most critical elements in obtaining an accurate waveform. Ideally, alcohol, a lint-free swab and an air bottle should be used to clean critical connections for an OTDR. The areas to be cleaned include the front panel connector, or bulkhead connector, and the connector of the jumper used to interface with the outside plant.

Second, set the range. It is important to choose an available range that is just large enough to fit the actual fiber run in fiber distance. For example, if a 30 km fiber run is being tested, set the range for 40 km rather than 100 km. This will reduce the time it takes to make measurements and allow for better resolution in the measurement results.

Third, establish the pulse width. Often, if you don't know what to expect on a fiber run, it's difficult to choose an initial pulse width setting. If the fiber run is unknown, start with the largest pulse width available, normally 250 meters and begin testing. From there, lower the pulse width setting for each measurement (i.e., 250 meters, 100 meters, 50 meters) until the best combination of resolution and distance is attained. A proper waveform should have well-defined points on top of the reflection. Several OTDRs will give you a selection of pulse widths depending upon the range selected.

Fourth, never take a final system measurement without averaging. Because noise is a random function, it must be averaged in order to obtain a true measurement. All OTDRs have a data average function that enables true data points to be obtained after averaging out the noise.

Also, depending on the sophistication of the system, some OTDR software can actually perform computer comparisons that will point out differences in performance. Any resulting traces — either computer or manually generated — should then be compared to an initial proof to accurately determine differences in fiber performance. Traces made on thermal paper (more are) should be copied to preserve them over time.

Emergency restoration

One of the most important aspects of fiber maintenance lies in having an effective plan that can be quickly and efficiently implemented in the event of an fiber break or service outage. Even the most ardent proponents of scheduled routine and preventive maintenance can stall services if an emergency restoration plan is not developed, practiced and used when a problem arises.

The first step lies in developing the "game plan" that details what is to be done, who is to respond and where necessary tools and supplies can be found in the event of a fiber cut. At the headend, often the first step should be to conduct a fast but thorough visual inspection. In many cases, fiber breaks close to the headend will impede the capabilities of an OTDR to detect problems. A visual inspection could, in this case, identify the problem without the need to hook up any equipment and may result in a fast and efficient fiber repair that only momentarily impedes service.

If this initial visual inspection fails to identify the problem, the next step is to implement the rest of the plan. Here again, system documentation is critical. A stick print of the system layout at the headend will provide an informational map of the way fibers are routed. Based on an incoming subscriber call or other means of network outage reporting, headend personnel can then turn to this stick print to identify (from the headend) the fiber serving that particular area.

The network stick print should include sheath and fiber counts, an identification of working fibers, a priority plan for which fibers should be restored first and what signal losses are expected. All of this documentation should be included in a restoration manual that pares the information down to the essentials. This manual should be easy to read but detailed enough with the pertinent data to provide technicians with the information needed to restore services. Keeping this manual — along with the system documentation — up to date is just as important as developing each of these documents in the first place. During regular maintenance activities, this plan should be examined to reflect changes in personnel, procedures and fiber reassignments.

Although developing the plan is very important, a plan alone is not enough. Personnel responsible for carrying out the plan must perform regular dry runs to gain confidence in their abilities and detect flaws in the game plan. To keep current, system supervisors or technical managers should execute a dry run every quarter. Such drills are an excellent means of training new personnel and maintaining the skills of trained personnel. Dry runs also can scare up problems such as taking too much time to locate test sets, keeping batteries charged, or keeping a cool head when a key person is unavailable.

To execute such a dry run, a supervisor can initiate a "break" on a spare or simulated run of fiber in order to stand back and observe the plan in action. The time it takes to successfully restore service should be fully documented and discussed with personnel after the dry run is complete. Are people fully up to speed on what needs to be done? Is all the required equipment on hand? Watching how the dry run is performed will go a long way to improving the initial plan so that when an emergency occurs, personnel are ready. Any alterations to the restoration plan should be communicated not only with headend personnel but with field personnel as well since many of the same problems will occur in both scenarios. Make any of the needed alterations part of the latest restoration plan.

One quick, cost-effective and safe approach to responding to a fiber cut can be facilitated best by operators that have a complete fiber restoration kit at the ready. Some kits consist of two cases that include all the tools and supplies necessary to make an emergency repair in the field. For headend purposes, this kit can be conveniently stored at the headend to provide the tools necessary to complete a quick splice. In the field, two kits can be used to allow technicians to simultaneously work at two viable ends of fiber cable to effect a restoration.

Another worthwhile exercise during the routine and/or preventive maintenance processes is to have personnel break out these restoration kits as well as all related test gear and fault locators periodically. Battery levels, restoration splices, and all other related supplies can then be monitored to ensure that everything needed for emergency repair is available.

Summary

Fiber-optic technology is no longer new to most cable TV operators. However, several rules of thumb exist for maintaining their performance levels. This article has touched on several key areas for concern in maintaining fiber systems and responding to fiber problems. The key to effective headend fiber maintenance lies in developing routine and preventive maintenance procedures that are completed at designated times. An emergency restoration program also will aid in preparing technicians for the inevitability of an unexpected fiber break or cut. In the end, effectively training your personnel on fiber-optic systems and how they can be maintained and restored will ensure that when a problem occurs, your personnel are completely ready. **BTB**

Troubleshooting guide for CATV optical fiber systems

By Michael Ott
Field Engineering Supervisor

And Doug Coleman
Applications Engineering Supervisor
Siecor Corp.

Geri Saye

The intent of this article is to define possible faults in cable TV optical fiber systems and provide a systematic approach to the resolution of a fault in the unlikely event that one occurs. Typically, a fault's existence is detected through end-to-end attenuation measurement, an optical time domain reflectometer (OTDR), or through the loss of system service. The procedure in this article provides effective troubleshooting techniques in any of the previous scenarios.

In the cable TV optical fiber system, faults can be grouped into the following categories:

- Loosely coupled connectors in interconnect sleeve.
- Bad/damaged connector.
- Poor pigtail splice.
- Permanent cable damage.
- Bad interconnect sleeve.
- Dirt on connector end-face or inside interconnect sleeve.
- Fiber microbend or macrobend.
- Violation of cable minimum bend radius requirement.
- Bad splice.
- Excessive crushing force on cable.
- Optical fiber cable manufacturing defect or incorrect cable design for environment.

• Cable environment beyond cable design limits.

Today, the most effective troubleshooting tool available is the high-resolution OTDR. However, many of the faults cited before can cause similar indications on an OTDR trace. Therefore, a systematic technique must be used to identify the true fault from the possibilities that exist. In cases where the system lengths are too short to test with an OTDR, optical power meters and HeNe lasers can be used to help isolate the fault.

General guidelines and precautions

1) The wavelength of light used in optical systems is outside the visible spectrum and cannot be detected by the human eye or microscopes. Always ensure that no optical sources are transmitting on the fiber when testing. Serious eye damage can result from exposure of the eye to powerful optical sources.

2) Do not force fiber-optic connectors into position within interconnect sleeves. Threaded connectors, such as the FC, should be tightened until they are just snug or finger tight. Do not overtighten optical connectors. Clean connectors thoroughly using recommended procedures.

3) Ensure that keyed connectors (FC, SC) are aligned properly into the key slots on an interconnect sleeve prior to insertion into the sleeve.

4) When using an OTDR to troubleshoot systems, ensure the correct index of refraction is in use.

5) Use an appropriate pulse width and range scale on the OTDR. In general, choose the longest pulse width on an OTDR that still allows resolution (or separation) of known events of interest (splices, connector pairs) in the system. For example, most high-resolution OTDRs can resolve two events separated by 100 meters when a medium pulse width is selected. Select shorter or longer pulse widths as appropriate for other applications. To determine the correct range scale to be used, roughly estimate the distance from the OTDR that is of interest. Select the shortest range scale that is at least twice this distance.

6) When using an OTDR to troubleshoot a system, be sure to account for the excess fiber length in most cable designs when determining the location of fiber damage within a cable sheath. The excess fiber length is the OTDR-measured fiber length in a cable divided by the sheath distance of the same cable. This factor varies between 1 and 1.05 depending on the cable design.

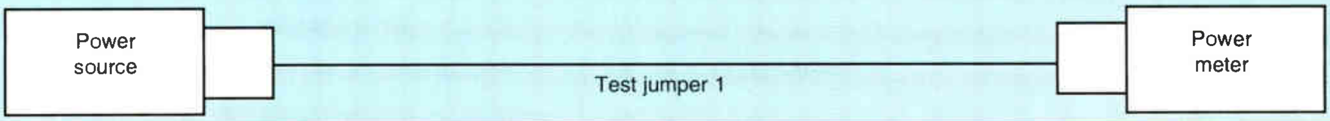
7) Use an access jumper longer than the dead zone of the OTDR when troubleshooting connectorized systems. Use an access pigtail longer than the dead zone of the OTDR when troubleshooting nonconnectorized cable systems. For nonconnectorized systems, temporarily fusion splice (or mechanically splice) the access pigtail to the bare fiber of the system under test.

8) When determining distance to a fault with an OTDR, expand the horizontal and vertical scales to improve accuracy of distance measurements. Normally a vertical scale of 1 dB/division and a horizontal scale of 10 m/division is sufficient for accurate distance measurements.

9) Calculate the fiber overlength correction factor:

• System records should provide the fiber length to a system feature or event (splice point, demarcation point, etc.). If these records are not available, locate a splice

Figure 1: P_{ref}



point with an OTDR and record the fiber distance.

• Measure the length to the splice point of one fiber in each of three different buffer tubes to obtain an average fiber length. If this cable is a high-density, dual-layer buffer tube design, use fibers in the same buffer tube layer. If the cable design incorporates fibers segregated by threads in a single tube, measure three fibers from the same thread grouping. If the cable design incorporates ribbon fibers in the same tube, measure three fibers from the same ribbon.

• System records or route diagrams should provide the cable meter mark at the splice point. Knowing this meter mark will allow the cable sheath distance to be determined.

• Calculate the fiber overlength correction factor: Correction factor = Cable sheath length/OTDR measured fiber length.

10) Next, locate the fiber fault with an OTDR. It is essential to establish landmarks when measuring fiber distance to a fault. Measure fiber distance to a fault from the nearest feature on the OTDR (splice point, demarcation point, connector peak, other fiber anomaly). This allows for a more accurate distance measurement than measuring the fiber distance from the beginning of the OTDR trace.

11) Calculate the cable sheath distance to the fiber fault: Cable sheath length = Fiber length x Correction factor.

12) Determine the cable sheath marking at the fault. Calculate the cable sheath marking at the fault location by adding or subtracting (as appropriate) the distance to the fault by the sheath mark at the chosen landmark location. Locate this cable sheath mark in the field and inspect the cable carefully in this vicinity for any signs of damage. When determining the cable sheath distance and cable sheath marking at the fault, remember to take into consideration any slack loops left during the initial cable installation. This consideration will assist crews in accessing the correct cable location.

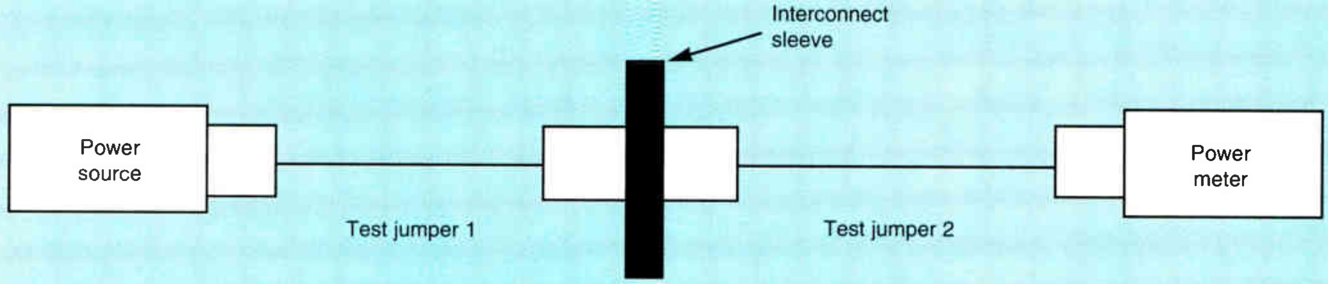
13) Here are general guidelines for minimum bend radius requirements in optical fiber systems:

• The minimum bend radius for single-mode fiber is 25 mm.

• The minimum bend radius for 3 mm or smaller buffer tubes or transport tubes is 30 mm.

• The minimum bend radius for optical fiber cables is specified for each cable construction. In general, the mini-

Figure 2: P_c



mum bend radius for cables in storage is 10 times the cable diameter. The minimum bend radius when under tension of installation is 15 times the cable diameter.

Troubleshooting checklist

Begin the troubleshooting test procedures from one end of the system. If no problems are apparent, go to the other end and repeat the process. If system service was lost and no optical fiber problems can be found, troubleshoot the electronic equipment. If the problem is within the optical cable system, then use the following steps.

Step 1

Set up an OTDR with an access jumper longer than the OTDR's dead zone at one end of the fiber system. Select a short or medium pulse width and examine the connector and pigtail or splice losses at this end of the system. If high attenuation is present at this end of the system, perform the following until the problem is corrected:

1) Remove and clean both connectors mated in the patch panel interconnect sleeve. Ensure the connectors are properly mated in the sleeves.

2) Use another interconnect sleeve that is known to provide adequate results when mating other connector pairs. If the interconnect sleeve was the cause of high loss, clean and/or replace the sleeve.

3) Redo the pigtail splice.

4) Check for small bends or pinch points in the fiber splice trays or splice hardware.

5) Check for tight bends in cable subunits/buffer tubes within the hardware.

6) Inspect the cable terminated ends for damage. Inspect floor and wall penetrations for possible crushing forces on cables.

7) If available, examine the end-face of connectors with a microscope. Cracks, pits or scratches are indications of high loss caused by a damaged connector. Replace the connector or connectorized assembly if these problems exist and a high loss is measured.

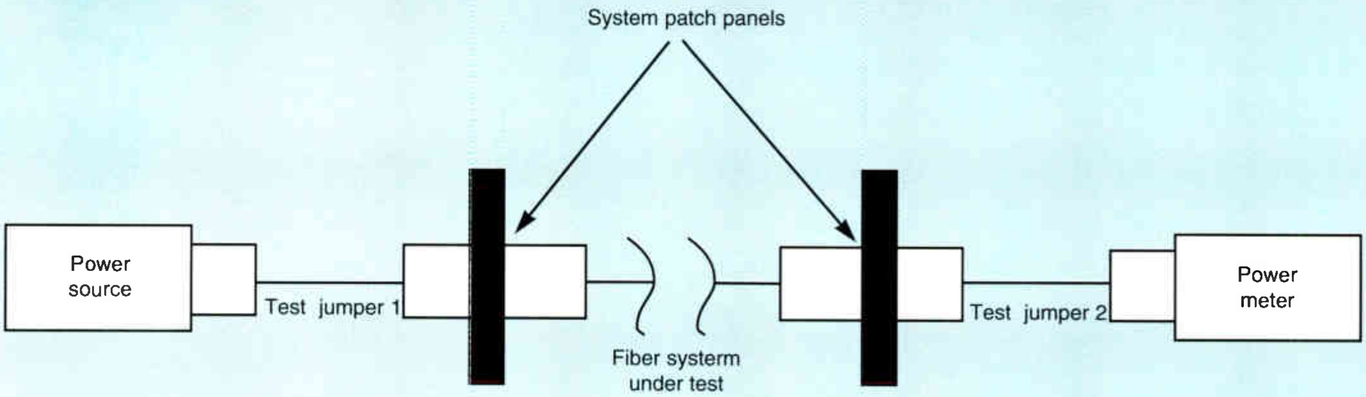
8) Splice a spare pigtail onto the fiber downstream of the connector at the pigtail splice point. Make sure that the fault is at the connector and not a broken fiber in the cable system by launching light into the spare pigtail with the OTDR and obtaining low loss. Replace the connector or connectorized assembly if found to be the source of high attenuation.

Step 2

If the source of high attenuation is in the cable outside the building, perform the following until the problem is corrected:

1) Determine the exact sheath mark at which the

Figure 3: P_{rec}



attenuation is occurring. Go to that sheath mark and carefully examine the cable for sheath damage or bends that are smaller than the specified minimum bend radius. Common locations or causes of attenuation include road bores, new construction along the cable route, cable plow stalls or reversals, gunshot damage and rodent damage.

Note that if the high attenuation is dispersed along the length of the fiber, this can be an indication of cable installation damage, use of a cable not designed for the environment, or cable manufacturing problems. In all cases, contact the cable manufacturer for assistance.

2) If the damage cannot be found, go to the nearest splice point and access one of the fibers with a pigtail longer than the dead zone of the OTDR. Calculate the exact sheath mark at which the high attenuation is occurring. Go to this sheath mark and carefully examine the cable sheath for damage or bends smaller than the specified bend radius. This step is taken to minimize errors caused by troubleshooting from long distances.

3) If the high attenuation is at a splice point, perform the following:

- Check slack storage near the splice point to ensure minimum bend radius has not been exceeded. If tight bends were the cause of attenuation, store cable slack again, taking care to prevent bends smaller than the required minimum bend radius (typically 10 times the cable's outer diameter).
- Open the splice closure and examine the internal assembly for tight bends in buffer tubes or transport tubes.
- Open the splice trays and examine for fiber tight bends or pinch points in the tray. Also check for fiber breaks.
- Redo the splice(s) exhibiting high loss.
- If a high loss still exists, use a pigtail longer than the OTDR dead zone and splice it onto the fibers exhibiting high loss. Launch in both directions to determine which cable contains the high loss. Fiber breaks sometimes occur when tubes are momentarily kinked, then straightened, during closure preparation. If the fiber is broken and cannot be salvaged, then redo the splice point.
- If no sheath damage can be found, contact the cable manufacturer for assistance.

Step 3

If no problems can be found from patch panel to receiver

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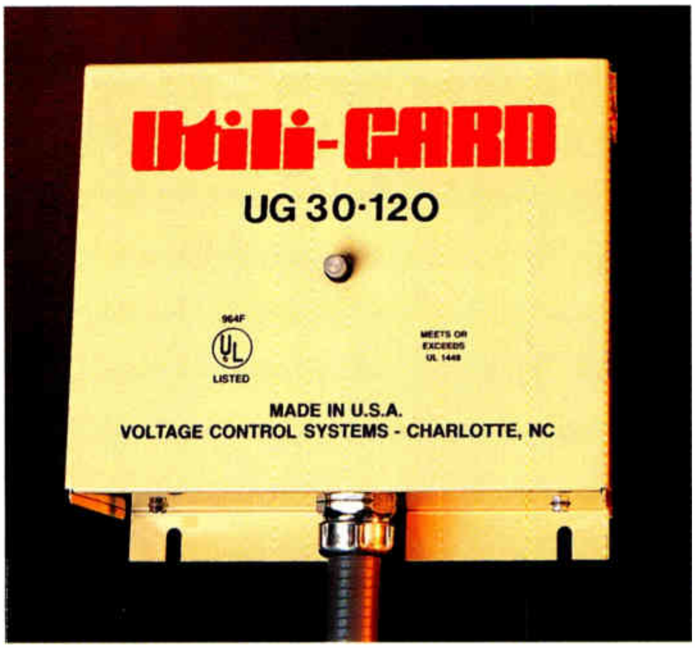

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Reader Service Number 106

node, use power meters and HeNe lasers to check performance of single- and multifiber jumpers used between the electronic equipment and the patch panels in the system.

1) Test the jumper with a one jumper reference, two jumper test procedure. Discard jumpers with high attenuation or replace bad connectors. Make sure all connectors and interconnect sleeves are clean prior to testing.

2) HeNe lasers can be used to help determine which connectors are at fault. In general, sources of high attenuation will glow very brightly (red or orange). HeNe lasers are best used when comparing known "good" fibers with fibers and connectors that are suspected to be bad.

Attenuation testing procedure

Installed cables must be tested for optical power loss (attenuation). An end-to-end insertion loss test must be performed on each terminated fiber span at the required wavelengths. All tests can be performed in one or both directions with the optical test source located in the hub of the network. The test procedure is described as follows.

Cleaning procedure

All connectors and interconnect sleeves must be free of all dirt particles prior to testing. Connector tips should be cleaned with denatured (99% isopropyl) alcohol and a lint-free tissue or cotton swab. There should be no alcohol left on the connectors or in the interconnect sleeves for the test to be accurate and repeatable.

Reference measurement procedure

The following procedure should be used to establish a reference value. This value represents the absolute optical power output of the source:

1) Assemble the equipment as shown in Figure 1 (page 83) and record the reading on the meter in dBm (decibels relative to 1 milliwatt of optical input power). This is the reference power reading (P_{ref}). Do not remove the test connector from the power source once P_{ref} has been established.

2) Remove the test connector from the power meter, assemble the equipment as shown in Figure 2 (page 84) and record the reading on the meter in dBm. This is the check power level (P_c). The difference between P_c and P_{ref} should be ≤1 dB. If P_c has decreased by more than 1 dB, then check the test jumpers and connections for defects. Do not proceed to the next step until this criteria has been met. Do not remove test connectors from the source or meter once P_c has been established.

Test measurement procedure

1) Remove the interconnect sleeve, assemble the equipment as shown in Figure 3 (page 86) and note the reading on the meter in dBm. This is the received power level (P_{rec}).

2) Subtract the received power level (P_{rec}) from the reference power level (P_{ref}) to obtain the end-to-end attenuation.

An example is where: P_{ref} = -20 dB; P_c = -20.5 dBm; and P_{rec} = -21.5 dBm.

• Test equipment check:

P_{ref} - P_c = -20 dBm - (-20.5 dBm)
= -20 dBm + 20.5 dBm
= 0.5 dB

• System calculation:

System attenuation = P_{ref} - P_{rec}
= -20 dB - (-21.5 dBm)
= -20 dBm + 21.5 dBm
= 1.5 dB @ 850 nm

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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

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31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Supps. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?
53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
57. ___ Fiber-Optic Amplifiers
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditure?
66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?
70. ___ Audio Test Equipment
71. ___ Cable Fault Locators
72. ___ Fiber Optics Test Equipment
73. ___ Leakage Detection
74. ___ OTDRs
75. ___ Power Meters
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
80. ___ TDRs
81. ___ Video Test Equipment

I. What is your annual cable test & measurement equipment expenditure?
82. ___ up to $50,000
83. ___ $50,001 to $100,000
84. ___ $100,001 to $250,000
85. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?
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88. ___ Repair Services
89. ___ Technical Services/ Eng. Design
90. ___ Training Services

K. What is your annual cable services expenditure?
91. ___ up to $50,000
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L. Do you plan to rebuild/ upgrade your system in:
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96. ___ more than 2 years

M. How many miles of plant are you upgrading/ rebuilding?
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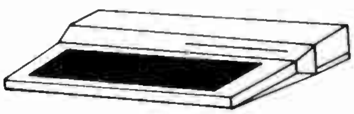

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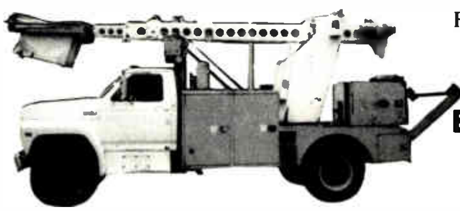

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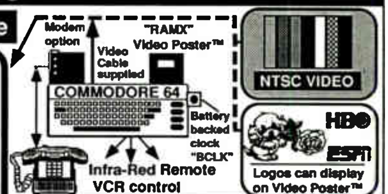

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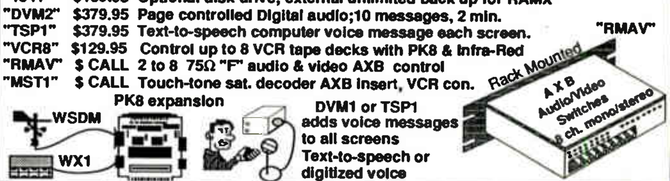

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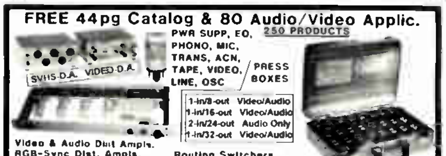

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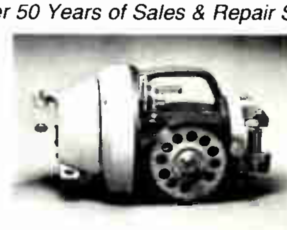

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David Cheeseman

During the Annual Membership Meeting held at Cable-Tec Expo '92 in San Antonio, the national board and staff learned the importance of the development of new training programs to the membership. As a result, the Society of Cable Television Engineers 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 textbook, the videotapes provide a comprehensive treatment of the basics of CATV design and operation. These tapes (#T-1121 to T-1134) are available by mail order through the SCTE. The videotape listed below was designed to be integrated into the "Cable Television" training videotapes series. The price listed is for SCTE members only. Nonmembers must add 20% when ordering.

☛ *System Sweep* — This program provides the viewer with the most thorough treatment of the theory and application of sweep ever presented at one time. It also provides detailed instructions on the operation of the CaLan 1776/1777, Hewlett-Packard 8591C and Tektronix 2722A/2721A.

This tape covers passband, frequency response theory/analysis, the definition of a sweep and how it works and is used, resolution/scan loss, potential interference, basic TV scan theory, high-level sweeps, low- and no-level sweeps, CATV transmission techniques, recognizing amplifier signatures, standing wave analysis and calculations. The SCTE is grateful to CaLan, Hewlett-Packard and Tektronix for co-sponsoring the development of this program. (105 min.) #T-1149, $22.

Note: Videotapes are in color and available in the 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.

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 or book. 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.

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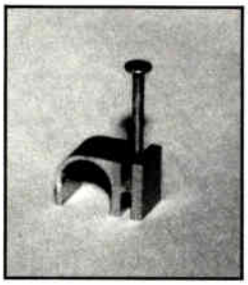
Listings of other publications and videotapes available from the SCTE are included in the April 1994 issue of the Society newsletter, "Interval."



CALENDAR

July

10-13: New England Cable Show, Newport, RI. Contact (617) 843-3418.

11-14: OSHA voluntary compliance safety and health course, Columbus, OH. Contact Safety Consulting & Training Inc., (319) 498-4517.

12: Hewlett-Packard 1994 Broadband Integrated Services Digital Network Seminar, Austin, TX. Contact Pauline Hale, (403) 462-4545, ext. 310.

12: SCTE Chattahoochee Chapter seminar, Atlanta. Contact Mark Williams, (912) 784-5104.

12: SCTE Desert Chapter seminar, distribution systems, San Goronio Inn, Banning, CA. Contact Greg Williams, (619) 340-1312, ext. 277.

12: SCTE Magnolia Chapter meeting. Contact Robert Marsh, (601) 932-3172.

12: SCTE Piedmont Chapter seminar, basic cable system architectures and operations, Cablevision of Raleigh, N.C. Contact (919) 220-3889.

13: SCTE Heart of America Chapter seminar, Kansas City, MO. Contact Dave Clark, (913) 599-5900.

13: SCTE South Jersey Chapter "Gone Fishing" social event. Contact Mike Pieson, (609) 967-3011.

13-17: Colorado Cable Show, Vail, CO. Contact (303) 863-0084.

14: Society of Cable Television Engineers Satellite Tele-Seminar Program to be shown on Galaxy I, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

14: SCTE Central Indiana Chapter seminar, fiber-optic architectures and applications, Holiday Inn North, Indianapolis, IN. Contact Al Orpurt, (317) 825-8551.

14: SCTE Greater Chicago Chapter seminar, digital basics, Centel Videopath, Chicago. Contact Bill Whicher, (708) 362-6110.

17-19: SCTE Rocky Mountain Cable Expo, Keystone, CO. Contact Leslie Ellis, (303) 393-7449.

18-21: Siecor fiber-optic training course, fiber-optic installation, splicing, maintenance and restoration for cable TV applications, Hickory, NC. Contact 1-800-SIECOR1, ext. 5539.

19: SCTE Floribama Meeting Group seminar, Crestview, FL. Contact Rylan Bishop, (205) 476-2190.

19: SCTE Oklahoma Chapter seminar, Oklahoma City. Contact Rick Martin, (405) 525-2771.

19: SCTE Pocono Mountain Chapter seminar, Holiday Inn, Hazelton, PA. Contact Anthony Brophy, (717) 462-1911.

20: Hewlett-Packard CATV Measurements Course, Valley Forge, PA. Contact 1-800-472-5277.

20: SCTE Dixie Chapter seminar, Birmingham, AL. Contact Charles Hill, (205) 880-1673.

20: SCTE Great Lakes Chapter seminar, distribution systems, Holiday Inn, Livonia, MI. Contact Jim Kuhns, (810) 578-9437.

21: SCTE Lake Michigan Chapter seminar, digital compression, Days Inn, Grand Rapids, MI. Contact Karen Briggs, (616) 941-3783.

21: SCTE Southern California Chapter seminar, headends: satellite systems, off-air and LO signals, Alhambra, CA. Contact Tom Colegrove, (805) 252-6177.

21: SCTE Wheat State Chapter seminar, Wichita, KS. Contact Jim Fronk, (316) 792-2574.

Planning ahead

Sept. 18-23: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.
Oct. 5-7: Atlantic Cable Show, Atlantic City, NJ. Contact (609) 848-1000.
Oct. 11-13: Mid-America Cable Show, Kansas City, MO. Contact (913) 841-9241.
Nov. 13-15: Private Cable Show, Atlanta. Contact (713) 342-9826.
Nov. 30-Dec. 2: Western Cable Show, Anaheim, CA. Contact (510) 428-2225.

23: SCTE Big Sky Chapter seminar, Big Sky Resort, Big Sky, MT. Contact Marla DeShaw, (406) 632-4300.
23: SCTE Chaparral Chapter seminar, HDTV. Contact Scott Phillips, (505) 761-6253.
24: SCTE Old Dominion Chapter social event. Contact Maggie Fitzgerald, (703) 248-3400.
25-28: Fotec Fiber Optic Installers' Conference, Sheraton Hotel, Long Beach, CA. Contact 1-800-50-FIBER.
26: SCTE Desert Chapter meeting, BCT/E and Installer certification exams to be administered. Contact Greg Williams, (619) 340-1312, ext. 277.
28: SCTE New England Chapter seminar. Contact Tom Garcia, (508) 562-1675.
29: SCTE North Country Chapter seminar, drop wire characteristics, installation procedures, safety, direct burial services, customer service, Sheraton Midway Hotel, St. Paul, MN. Contact Bill Davis, (612) 646-8755.
29: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

Letters

(Continued from page 12)

he owned the system and had obligations to the banks, his investors, programmers and other service providers? Would he pay $500 for an amplifier when an exact equivalent was available for $300? The idea that higher pay means better qualified people that turn over less and perform better work is ludicrous. The high wage union people in Detroit nearly killed the American automobile business a few short years ago. This was not the fault of the union folks. They only asked for more money. The fault was with management not demanding reciprocity in productivity and quality.

When I have talked with telephone company managers, they have been amazed at what we have accomplished and how little we pay for building and operating our systems. This efficiency will serve us well. Between rate regulation and competition, our margins are being squeezed. The phone companies that pay very high wages with no more productivity and quality will have a harder time competing.

Don't read me wrong. I do not begrudge anyone being paid a decent wage for a decent day's work. We all have to understand that we compete in a marketplace that has the same laws of supply and demand for labor as it does for amplifiers. If there are hundreds of people capable and willing to do a job but only a few openings, the wage rate will be low. Conversely if there is only one person capable of doing the job and dozens of companies wanting to employ that person, the person will live in a nice house and drive a nice car. The lesson here can be stated in one word: EDUCATION!

If you are one of the $7/hour installers and you have a desire to make a lot more money, then get an education and move yourself up the ladder. If you have any doubts about whether this approach works, ask Mr. Hranac. It seems to have worked for him! — *From Colorado*

Your "Editor's Letter" was biased and inflammatory. Because of it, there is now a rift in my system operations personnel. I have always made it a habit to leave cable trade magazines where my employees could have free access to them so that at their leisure they could learn more about the changing industry that employs them. Now, because of your article, this policy may have to change.

With the Federal Communications Commission playing IRS, the regional Bell operating companies (RBOCs) flexing their muscles, and technology changing by the minute, this was not the time for an article of this type to be published.

First, let's talk about the woman you mentioned who had just come off of welfare and was now working for starting wages. Blue collar starting wages are just that — a place to start and prove yourself to your employer. Why don't we talk about the free training she is getting, or the medical, dental and fringe benefits her family is now receiving that our tax dollars no longer support?

As for your friend who "wouldn't even think of climbing a pole for less than $11 an hour," I have a file cabinet full of applications from people who would do back flips just for the chance to receive the starting wages my company offers.

I have great respect for you and the contributions you have made to the cable industry over the years, but in my opinion, the subject matter of this article and the timing of its publication borders on a lack of good sense. — *From Georgia*

Ongoing system reliability

If future cable TV services such as video-on-demand are to be truly interactive, cable TV operators must act today and re-evaluate their reliability requirements. System upgrades have improved reliability and changed cable TV architectures from all-coaxial to fiber-intensive trunks and feeder. But there's more to do in order to match the reliability requirements established by other service providers.

This month our fiber expert will address this issue and answer the question of how to improve system reliability continuously.

By Doug Wolfe
Senior Applications Engineer, Corning Inc.

☛ How can cable operators continue to build reliability into system performance?

The key to improved system reliability lies in network redundancy. One way to accomplish this is through the use of redundant electrical powering systems. These systems, which deploy battery backup power throughout the cable plant, offer substantial and immediate increases in network reliability. In addition, the systems help reduce downtime for customers who may be evaluating the cable TV operator as a potential alternate access service provider.

Network redundancy will become even more important as cable TV operators continue to upgrade their networks with fiber and increase the number of services carried to subscribers.

To accommodate these new services, operators are taking alternate paths to and from the headend, regional hub and subscriber node.

• *Headend redundancy* — As one of the first steps to increased network reliability, headend redundancy can be achieved by interconnecting headends within a system. It can provide an alternate source of programming in the event that one headend suffers a catastrophic loss.

A similar, albeit more complex concept, is the collaboration of neighboring cable TV companies. By interconnecting headends located within different franchise areas, cable TV companies can reduce their operating costs and share the large investments needed for headend equipment. This also helps to ensure alternate programming sources.

• *Regional hub redundancy* — It is estimated that more than 80% of fiber failure rates are attributed to cable cuts. That's why it's important to offer diverse fiber links from the headend to regional hubs. This allows cable operators to build reliability into the system to prevent cable cuts from contributing to catastrophic downtimes. When large numbers of subscribers are served over regionally interconnected networks, regional hub redundancy is essential in order to maintain a high degree of reliability.

As an added benefit, the same fiber rings that provide improved network reliability usually pass or interconnect major customer serving areas or hubs and can be used to carry other, nontraditional cable TV services.

• *Subscriber node redundancy* — Some visionaries in the cable TV industry are looking ahead to the ultimate in network redundancy — when physically diverse fiber routes are constructed to fiber nodes serving 500 or fewer homes. Although this level of reliability may not be the most cost-effective approach for the delivery of typical subscriber services, it may be necessary for certain business and interactive applications. **CT**

Readers with fiber-related questions can send them to: Ask a Fiber Expert, c/o Communications Technology, 1900 Grant St., Suite 720, Denver, CO 80203; fax (303) 839-1564.

Field Operations Award provides "tech tips"

By Bill Riker
President, Society of Cable Television Engineers

In last month's "President's Message" I reviewed the results of our annual membership survey and the comments members made when responding to the survey. I discussed a request from a member for SCTE to print "Tech tips — real-life applications of troubleshooting, new ideas, etc." in our monthly newsletter, *Interval*.

My answer was that while it is not officially billed as "tech tips," our Field Operations Award Program has served this purpose since it was established in 1991. This program provides SCTE with a means of soliciting and subsequently publishing innovative CATV technical practices and problem-solving techniques that are entered in this competition.

Kudos for techs

As the competition's title implies, entries are based on techniques and devices developed in the field — actual working conditions. This contest is not an intellectual exercise, but rather a way for SCTE to congratulate the backbone of the CATV industry, the men and women in the field, for their frequently unsung on-the-job excellence.

SCTE is not alone in its regard for this section of the CATV world. Telecrafter Products has been very active with the Field Operations Award, participating through financial support since the program's inception. Former Region 7 Director Vic Gates of Metrovision serves as chairman of the Society's Field Operations Award Subcommittee, which also consists of Peter Mangone of Telecrafter; former Region 12 Director Bob Price of NC II Inc.; former Region 6 Director Bill Kohrt of Kohrt Communications; and current At-Large Director Wendell Woody of Sprint.

This subcommittee is charged with evaluating the entries (solicited through advertisements in *Communications Technology* and *Interval*) and selecting first, second and third place winners. The first prize awarded each year is a paid registration to SCTE's Cable-Tec Expo, paid transportation to the Expo (up to $500), paid hotel accommodations at the Expo, $1,000 cash and a plaque presented at the Expo. A $300 cash prize is awarded for second place, and $200 for third place.

In this year's competition, entries were received from the following: Walter Bannon, Americable International-Miami; Peter Carr, DuCom Inc.; Paul Harris, Ventura County Cablevision; Dave Heyrend, United Video Cable; James Madarena, Cox Cable; Sandy McKnight, Capitol Cablevision; Maximo Morales, Cable Television Laboratories Inc.; Bill Watson, Continental Cablevision; and 1993 winner Mel Welch, Genesis Cable of North Carolina.

After an intensive decision-making process among the members of the Field Operations Award Subcommittee, the winners were chosen. First place was awarded to Sandy McKnight for his entry, "Remote Test Aid," with second place going to Mel Welch for "Broadcast Cable Converter Box — No Outages" and third place awarded to Paul Harris for his "Testing Cart."

Of the winner, Gates states, "The subcommittee felt that his entry showed a tremendous insight into the problems faced by our technical community. His entry took into consideration not only technical efficiency but also subscriber impact. Each cable TV system is faced with the task of performing proofs every six months and thereby causing a drain on field people and causing our customers' pictures to go off. It is through the effort of field personnel that technical people across the country will be able to take advantage of the sound, tried and true 'Remote Test Aid.'

"As in the past," Gates continues, "we've had another very successful group of entries to chose from. This year's entries continued to demonstrate the value of this program. All of the members of the subcommittee can be proud of a program dedicated to the field operation people in our industry, with special thanks to Peter Mangone and Telecrafter Products for their continued support."

Publication of entries

Each of the 10 entries to this year's competition, including all submitted photos, illustrations and diagrams, will be

published in this month's special issue of *Interval* as a way to provide this valuable technical information and methodology to the Society's membership for use in their local workplaces.

We encourage each of you to enter in next year's competition. Any new concept or improvement that enhances the area of field operations for cable TV systems may be entered. It must be an original idea to be considered for the award. The idea must be checked for its ability to work correctly, and should be well-documented with descriptions, diagrams and illustrations or photographs (if available).

Any field operation, such as installation, troubleshooting, construction, vehicle enhancement, or tool or equipment design, will be considered for the award. If in doubt, send in your idea. The deadline for next year's competition will be March 1, 1995, so start developing and testing your entry now.

All cable TV personnel doing any type of field operations, either system employees or contractors, are eligible for consideration for the award.

Watch these pages for the official entry form, or contact SCTE national headquarters at (610) 363-6888 for further information. **CT**

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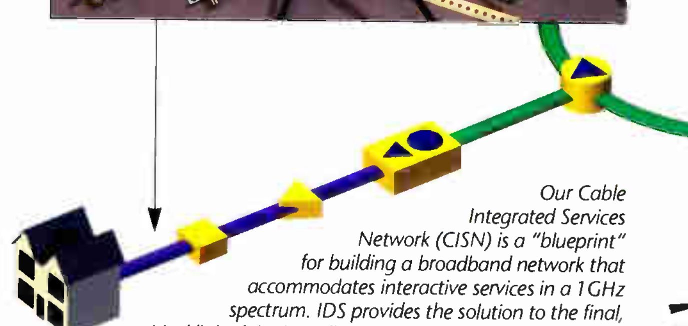

Our Cable Integrated Services Network (CISN) is a "blueprint" for building a broadband network that accommodates interactive services in a 1GHz spectrum. IDS provides the solution to the final, critical link of the broadband network, the subscriber drop.

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