COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

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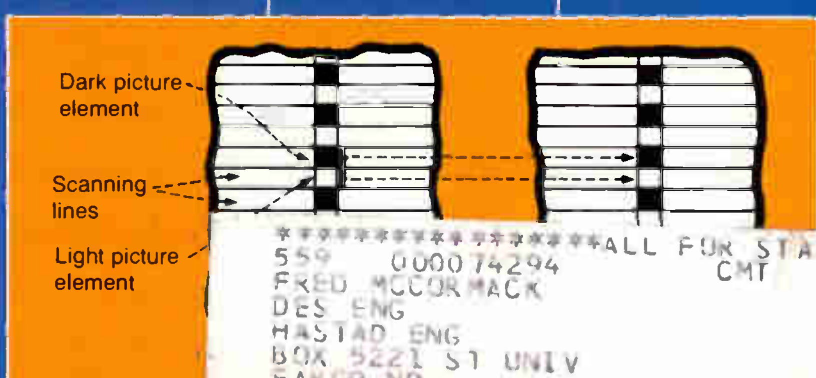
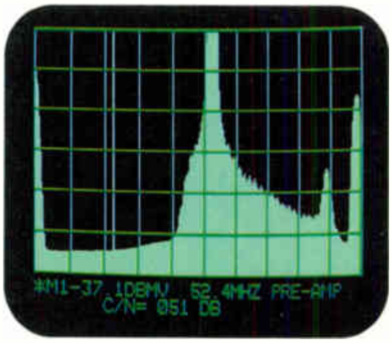
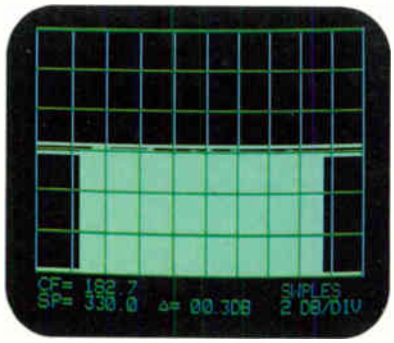


Calculating HDTV viewing distances

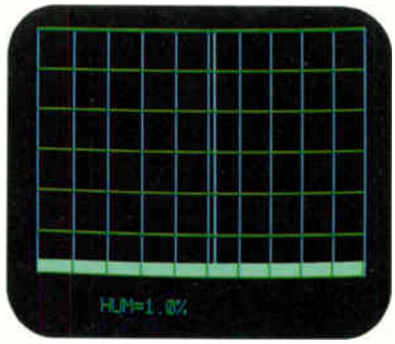
November 1987



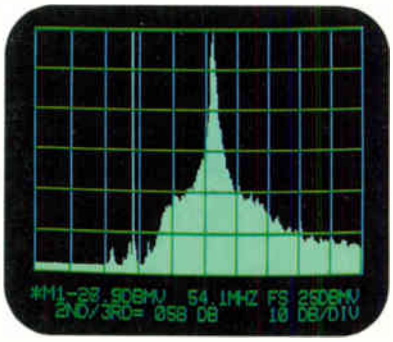
Improve picture quality.



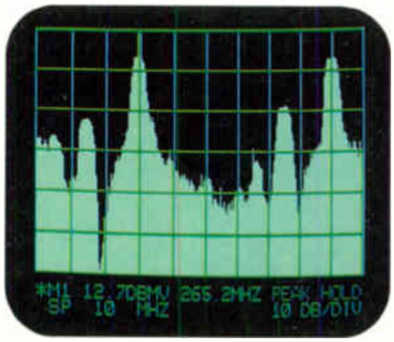
New Sweepless Sweep™ Analyzer for simple system balance.



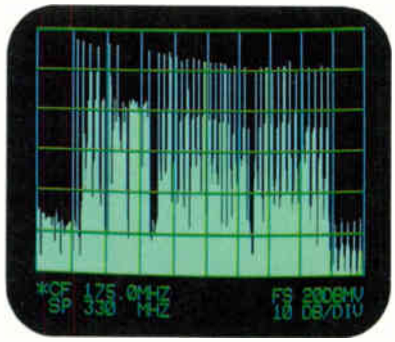
Minimize hum.



Pinpoint distortion problems.



Peak RMS of suppressed sync.



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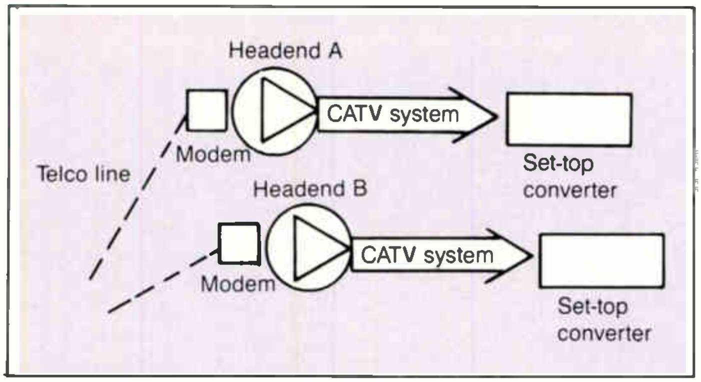

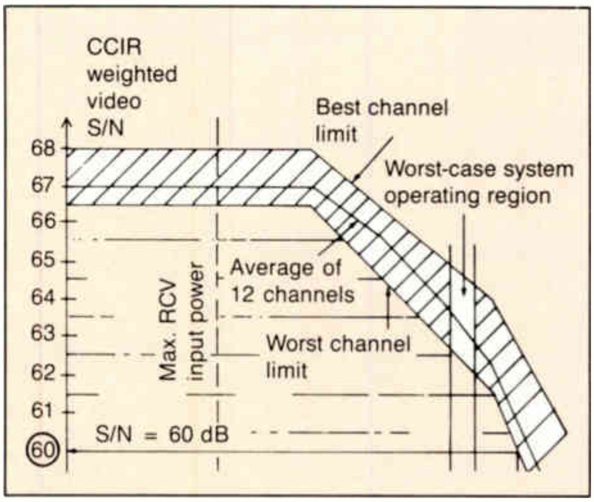

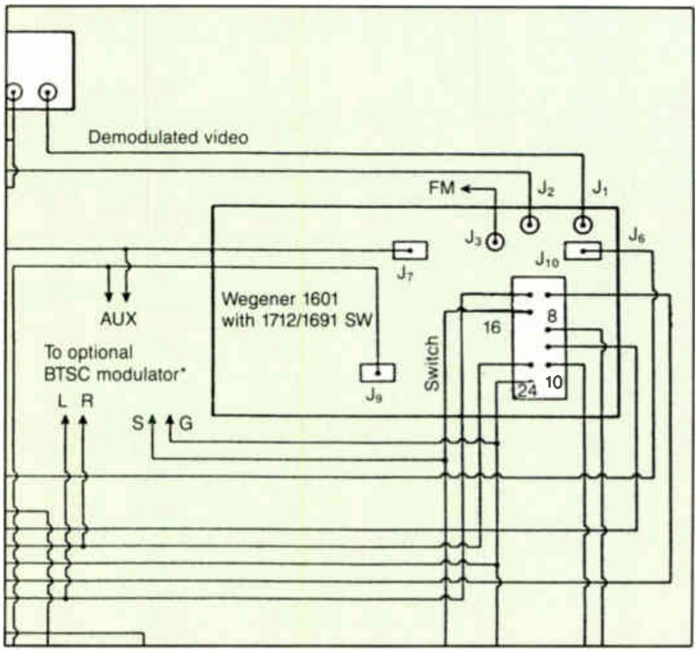

Features

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BEAUTY AND THE BTSC

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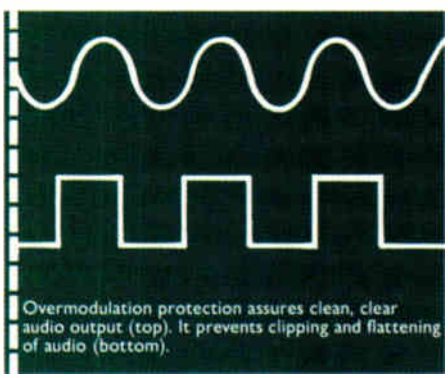
But that's not the only reason to install a Jerrold CMTS encoder. There's also the broad deviation range of the logarithmic LED metering which makes it easy for you to set—and maintain—correct audio levels. There's dramatically low power consumption. And, Jerrold is the only manufacturer to offer standard 41.25 MHz and 4.5 MHz output so that your encoder will work with almost anybody's modulator without modification.

Finally, when you're ready to upgrade to Second Audio Programming, the CMTS is ready. SAP is easily field-upgradable without adjustment.

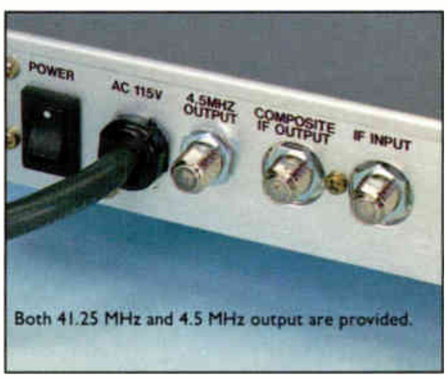
It's all there in one attractive package. The Jerrold COMMANDER MTS Stereo Encoder: your sound investment.

For more information on the Jerrold COMMANDER MTS Stereo Encoder contact your local Jerrold Account Representative or call or write Jerrold Division, General Instrument Corporation, 2200 Byberry Road, Hatboro, PA 19040 (215) 674-4800.



Overmodulation protection assures clean, clear audio output (top). It prevents clipping and flattening of audio (bottom).

Logarithmic parallel LED metering shows you sound separation at a glance.



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GENERAL INSTRUMENT

PUBLISHER'S LETTER

'We, the people...'

In conjunction with the celebration of the Constitution's 200th anniversary, I would like to take its opening words in a more personal—and personnel—way. I've rarely taken the spotlight, but it's time we, the *CT* people, were introduced to you, our readers. *Communications Technology* has been around for only 3½ years (a mere child, compared to a cable industry now 40 years old), but it has grown and improved, like cable technology itself.

However, there are three current staff members who appeared in our first masthead in March 1984: Toni Barnett, vice president of editorial; Wayne Lasley, managing editor; and Sharon Lasley, art director. Rob Stuehrk came aboard three months later as account executive. In July 1984 Marla Sullivan started as an artist and Mary Sharkey as director of computer operations. The following March, Geneva Hobza joined *CT* as assistant to the publisher. And in May 1986, Rikki Lee and Brad Hamilton became editorial assistant and artist, respectively.

In the ensuing years, there have been many changes at *CT*. Marla became production manager and Mary, circulation and data manager. Rob, who became national sales manager in June 1985, is (as of this issue) associate publisher. Also, Wayne recently became editor in chief and Rikki, managing editor. Recent additions to our staff are: Lu Ann Curtis and Neil Anderson, account executives; Karen Naiman, assistant editor; Shelley Bolin, editorial assistant; and Lil Pfaff, receptionist. One could not ask for a better team.

As I write this, Toni Barnett is recuperating from a recent illness. We wish her a speedy recovery.

Author, author

On page 71 you'll find our 1988 editorial calendar and a call for authors. This will give our readers an opportunity to submit articles for *CT* on these or other topics of interest to the CATV engineering community. There are many of you who have lots of ideas (and you know who you are) but just can't seem to put them down on paper. We want you to share with other readers your successes, failures, lessons learned, problems encountered and so on. Fill out the form at the bottom of the page or give us a call. And if you're still hesitant, we'll send you an author's kit to help you get started writing that future *CT* article.

Also, if you want to write a letter to the editor, please do so. We'd like to hear your comments, suggestions, questions, whatever. How can we better serve you, our readers? (We don't always do *everything* right.)

Speaking of articles, this issue contains our annual "white papers," the index of all features and columns appearing in *CT* from November 1986 through October 1987. We've categorized and cross-referenced them by topic, and an article may appear in more than one topic category. Also, articles are listed in reverse chronological order, so the most recent technology and information can be found at the beginning of each topic entry.

I'm sure you'll be referring to the index often. If you have a comment or suggestion about the index, please pass it along. If you see something of interest and wish to find out about back issues, don't hesitate to contact us.

Coming up Dec. 2-4 in Anaheim, Calif., is the Western Show. As usual, we plan to have our *CT Daily* there, bringing you up to date on the various technical workshops and action from the exhibit floor. If your company is unveiling a new product or will have an important announcement to make at the show, be sure to send out your press release immediately to: CT Daily, P.O. Box 3208, Englewood, CO 80155.

He's number one

Congratulations go to National SCTE Secretary and Region 2 Director Ron Hranac, corporate engineer with Jones Intercable, for being the first to complete all seven exams in the BCT/E Certification Program's technician level. He accomplished this feat Sept. 1, at the Eastern Show in Atlanta.

At the Atlantic Show last month, the BCT/E testing room was, as usual, filled to capacity. Hats off to Bill Riker and the SCTE for coordinating the BCT/E Program at the regional shows and local chapters and meeting groups. As you know by now, the certification program allows technicians and engineers to raise their professional status and competency level. If you're interested in taking an exam, call the SCTE at (215) 363-6888 or contact your local SCTE group.

Happy Thanksgiving!

Paul R. Levine

COMMUNICATIONS TECHNOLOGY

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IBN investigation launched by Columbia

NEW YORK—A two-year investigation of public policy issues raised by the emergence of integrated broadband networks (IBN) was launched by Columbia Business School's Center for Telecommunications and Information Studies under a $155,670 grant from the Markle Foundation.

IBN is a new network technology that integrates voice, data and video communications for transmission over a single optical fiber circuit. It is expected to radically change the cost and overall attractiveness of various business services, as well as make possible a number of new services to the home. Because it is a hybrid of telephone and television, it will raise complex regulatory issues; for example, questions of natural monopoly, rate regulation. network structure, interconnection and access and standards.

The Business School unit will collaborate with Columbia Engineering School's Center for Telecommunications Research on technological aspects of IBN.

LP Com to become Tektronix subsidiary

BEAVERTON, Ore.—Tektronix recently entered into an agreement with LP Com and its principal shareholders to acquire the company and operate it as a wholly owned subsidiary. LP Com is a manufacturer of telecommunications test equipment located in Mountain View, Calif. Existing Tektronix Communications Group businesses that focus on protocol, metallic fiber-optic test equipment and wideband switching and distribution equipment for the telecommunications industry will be closely linked with LP Com.

The proposed acquisition will enable LP Com to pursue worldwide distribution of its TC-2000 data system through the Tektronix sales force.

Cable Video Store offers IPPV support

HATBORO, Pa.—Jerrold's Cable Video Store (CVS) is now offering a package of four technical support services to cable operators implementing other impulse pay-per-view (IPPV) services. The first is launch support services, which include providing site surveys and assistance in resolving technical launch programs, as well as training cable system personnel in phone installation, addressable impulse control and customer service. The second, CVS control center monitoring, ensures that if operating problems develop, the control center diagnoses and corrects them at the cable system level. The third, field service, provides on-site assistance for operational difficulties that cannot be resolved by the CVS control center. Finally, the CVS control center downloading and administration retrieves data for each affiliate system to minimize operational tasks at the cable system level.

These technical support services can be bought either on an individual fee basis, as a total technical support package or as a complete package with CVS programming.

Jerrold announces new CATV seminar

HATBORO, Pa.—Cable professionals in nontechnical positions are being offered an in-depth explanation of the fundamentals of CATV technology in a seminar sponsored by the Jerrold Division of General Instrument Corp. "Cable Insights '87: Taking the Mystery Out of Cable Technology" is planned for Nov. 11-12 at Stouffer's Valley Forge Hotel in King of Prussia, Pa. The purpose of this seminar is to give professionals with the responsibility for the profitability and operation of cable-related businesses a working knowledge of cable TV technology. It will examine programming, equipment and services and offer advice on how they can best be utilized.

A roster of guest speakers drawn from all sectors of the industry will share knowledge and experience on such topics as regulatory issues, basic system design and equipment, picture quality, addressability, signal security, upgrades and rebuilds, interactive services and the system of the future.

For more information, contact Jerry McGlinchey, Seminar Administrator, Jerrold Division, General Instrument Corp., 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

● Midwest CATV, a division of Midwest Corp., announced that CWY Electronics will serve as the Central region in Midwest's national marketing campaign.

● Jones Intercable in Albuquerque recently relocated. The new address is: 4611 Montbel Pl. N.E., Albuquerque, N.M. 87107, (505) 761-6200. The mailing address is P.O. Box 27138, Albuquerque, N.M. 87125-7138.

● Sammons Communications of Vineland, N.J., began the initial phase of a major system reconstruction and improvement program in its Hammonton, Vineland, Millville and Bridgeton, N.J., cable TV coverage areas. This improvement is part of a planned multimillion dollar effort to upgrade Sammons' facilities in 30 New Jersey communities.

Hranac completes seven BCT/E exams

EXTON, Pa.—Ron Hranac recently became the first participant to complete the Society of Cable Television Engineers' Broadband Communications Technician/Engineer (BCT/E) Certification Program. On Sept. 1, during the Eastern Show in Atlanta, he finished the last of seven exams to become certified at the technician level. A 15-year veteran of the cable industry, Hranac is a corporate engineer at Jones Intercable in Englewood, Colo., as well as national SCTE secretary and Region 2 director.

The SCTE also announced plans to begin an Installer Certification Program. A committee will develop a training manual for installers who enroll, as well as make recommendations on the curriculum and means of evaluating candidates.

The BCT/E Program was created in 1984 to encourage personal development in CATV technology, recognize individuals for the demonstration of their knowledge and assist management in their hiring and promotion processes. Examinations are now available at both the technician and engineer levels for Categories I (Signal Processing Centers), II (Video and Audio Signals and Systems), III (Transportation Systems), IV (Distribution Systems), V (Data Networking and Architecture), VI (Terminal Devices) and VII (Engineering Management and Professionalism).

For more information on the BCT/E Certification Program, see this month's issue of *The Interval.*

● Joseph Gans Sr., president of Northeast Cable Co., and his wife, Irene, have given $50,000 to the National Museum of Cable Television at Pennsylvania State University. The museum, soon to be opened at the University Park campus, is designed to enhance the education of students preparing for careers in the cable industry and will be used in training programs for industry personnel.

● Penstock RF/Microwave distribution announced the addition of Weinschel Engineering Components to its product lines. Weinschel manufactures attenuators, terminators, adapters, connectors and other passive devices.

● Scientific-Atlanta was awarded a contract by Saudi Arabia's Ministry of Post, Telephone and Telegraph to upgrade and modify the country's domestic satellite network. The modifications will make the network fully compatible with Arabsat satellites. The contract is valued at $2 million. S-A also will engineer modifications to existing satellite earth station equipment to provide Arabsat compatibility, including adapted center frequencies and IF filtering.

● NCS Industries was appointed a service center by M/A COM Mac Inc. NCS will provide parts and service to users of M/A-COM Mac's satellite receivers.

Going, going, gone

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories Inc.

The catastrophic collapse of our domestic consumer electronics manufacturing should have pervaded the public and private senses with the same punch as the putrid stench of an animal slaughterhouse. More than 1 millicn blue-collar jobs faded toward the East as the sun set on what was once the world's leader in consumer electronics design and manufacturing. Yes, East became West and this time the cowboys bit the dust.

Yet no one has marched in the streets waving banners of protest against our loss of jobs, no public advocacy lawyers have appeared in courtrooms ready to pounce upon politicians for their lack of foresight and leadership in staunching the bleeding wounds of our stricken factories. What few speeches have been aired and what feeble bills have been uncertainly tendered mark the abysmal ignorance of our elected leaders in technical subjects and free-trade intrigues. One probably should expect no more from our legislators who are universally scientifically illiterate, narrowly educated in the practice of law and unaware of the ignominous status of our science education and product-oriented research.

I cannot resist the temptation to comment upon the effrontery of Princeton University to award a degree to Brooke Shields, who probably never spent a minute in unveiling the mysteries of science and mathematics. One must assume many other Princetonians are spewed out of the institution just as ill-prepared to cope with this modern age and fated to join the legions of parasites burdening the shrinking productive members of our society. Whatever became of the proud boast of a bachelor's degree from an Ivy League school that labeled the recipient as possessing a superior intellect, honed and sharpened by dedicated professors on all aspects of the human experience, ready to go forth and be capable of entering any profession, learning any trade and rising to the upper ranks of leadership wherever fate leads? Could Ms. Shields cope with a science career? (Perhaps Princeton should devote itself to staging plays at the MacArthur Theatre and leave the field of education to those who understand and possess the moral fiber to demand the ultimate in scholarship from their students.)

Sometimes our world is molded so gradually and relentlessly that a radical shift in our status can occur without an alarm sounding at a conscious level. I will illustrate this point by assembling a few statistics from the August 1987 issue of the *IEEE Transactions on Consumer Electronics*.

In years past, the authors were usually U.S. citizens employed by giant U.S. manufacturers trumpeting the patentable achievements of U.S. laboratories on saleable consumer electronics sold worldwide. Indeed, when I was employed in a GE radio plant, pre-World War II, there were several production lines spewing out shortwave radios for South America. Only the memories and ghosts remain today!

The IEEE volume contained 52 papers, attributed to the following countries: Japan, 21; Netherlands, 12; United States, 8; West Germany, 5; United Kingdom, 3; Italy, 2; and France, 1. Since many papers have multiple co-authors and collaborators, there is another ranking of number of engineers: Japan, 148; Netherlands, 15; West Germany, 14; Italy, 11; United States, 9; United Kingdom, 4; and France, 2. Each country has a different protocol for authorship, but I believe these numbers fairly represent the engineers involved and correspondingly the sizes of the research budgets.

Beyond mere numbers

Now to go beyond mere numbers—what about the quality and objectives of the researchers' efforts? At periodic intervals, some scientifically illiterate American politico will mount the podium, wave the flag and declare with absolute surety that the rest of the world is stealing our technology, running sweatshop factories and selling back our know-how at a price we can't match, and it is all an illegal scheme to defraud the American taxpayer. His remedy: protective tariffs and scientific censorship.

"Whatever became of the proud boast of a bachelor's degree... that labeled the recipient as possessing a superior intellect?"

Take a close look at the papers. If they were ever based on U.S. research, they are now mature independent engineering programs replete with original technology authored by scientists who have long outgrown their teachers.

I tried, as an individual experienced in patents, to note the number of patentable ideas and perhaps to find some differentiation in creativity between the countries of origin. But every researcher seemed able to propose an original solution to an old question. The principal difference between countries was in the number of scientists at work. Obviously, in this IEEE volume, there is a clear winner. In my view, the victory is the end product of an educational system that requires everyone to take an hour in hard math and one in hard science each school day and to advance scholastically only by passing tough qualifying exams for the next academic level.

Finally, there has to be a source of funds for product-oriented research. Here in the United States, our government agencies and most universities shy away from product and system engineering as if these were beneath their dignity and inferior to the academic psyche.

It seems as if all other countries believe product and standards research are worthy of first place in the science world and that factories are of the highest value in their society. Isn't it time we switched partners and started favoring the manufacturing—instead of the service—areas of our social fabric?

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Signal security and subscriber terminals

By Earl G. Langenberg
Director of Engineering and Technology
American Television and Communications Corp

> *"Pirates...in some cases have amassed a data base capable of cross-indexing ZIP code addresses to the type of security used by the local CATV system."*

Regardless of the type of subscriber converter being contemplated, the criteria used for selection is the same: picture quality, reliability, features, signal security and cost.

Picture quality—Select a device that least degrades pictures at both the minimum and maximum signal levels delivered to customers. Differences can be quite pronounced where baseband converters are involved.

Reliability—RF and baseband converters are available to choose from with combined annual field and out-of-box failure rates of 1.5 percent or better. No longer should a 12 percent to 24 percent annual failure rate be tolerated.

Features—Converter features are a matter of personal preference, influenced for the most part by cost.

Cost—Cost has an impact on all other selection criteria and is proportional to system complexity and inversely proportional to the quantity purchased.

Signal security—Of the criteria, signal security is by far the most difficult to quantify. Systems vary in complexity: On one extreme is the "honor system," where customers are advised not to watch services they are not paying for. At the other extreme is a system using the National Bureau of Standards DES (digital encryption standard) algorithm to secure audio and decode instructions for random video inversion. In between are a myriad systems from which to choose. Some of the more popular ones are listed in the accompanying table and for comparative purposes are ranked into low, medium and high security.

No trivial task

Classifying signal security into low, medium and high categories is not a trivial task. The ratings are an indication of the technology's resistance to defeat by manipulation of the RF signal or decode instructions being transmitted.

Low security systems include the honor system, positive traps, constant sync suppression and constant aural carrier offset schemes. These technologies keep honest customers from stealing services. Home-built traps and simple pirate devices defeat the system; they are plentiful and can be purchased for $30 to $50.

Medium security devices include dynamic level sync supression and video inversion where decode instructions are not encrypted. Pirate devices that defeat these technologies are more complex and in the $300 price range.

High security devices include negative traps, provided they are physically secure, frequency stable over time and temperature and audited regularly; video inversion where decode instructions are sent using encrypted data techniques; digitalized encrypted audio; and addressable off-premises taps. This level of technology is commercially impractical to defeat. Digital and encrypted audio systems deserve special mention, being the most secure.

The most difficult system to classify is random video inversion when the decode instructions are encrypted. This system has not been defeated to date; however, there are at least seven known approaches that can be used. After a great deal of study and experimentation, the conclusion is that this system cannot be reliably defeated by pirates working with the transmitted RF signal, and therefore qualifies as high security.

In addition to a pirate's manipulation of the RF signal or decode instructions, transmitted converters can be physically modified. Pirates, in all cases, can compromise system security by cloning addresses or by altering software, similar to the way VideoCipher II decoders have been compromised. For this defeat, a "pirate" is defined to be a funded team of professionals covering the field of microprocessing system design, television theory and semiconductor technology.

Even with strong theft-of-service legislation in effect, commercial pirate manufacturers seem to thrive. Advertising in popular electronics magazines, pirates have toll-free numbers and in some cases have amassed a data base capable of cross-indexing ZIP code addresses to the type of security used by the local CATV system. Theft-of-service percentages are difficult to determine. Conservative estimates for high security devices are less than 5 percent, low security is in the 10 percent to 30 percent range and medium security somewhere in between.

It appears that there will be a permanent place in our industry for both on-premises scrambling and off-premises addressable tap technologies. On-premises converter systems that decode scrambled signals will be needed where physical space requirements restrict use of the larger off-premises tap, or where system personnel cannot control portions of the outside cable plant. Examples of uncontrollable outside plant are the rooftop routing of cable in some cities like Manhattan, apartment complexes with long unsecured drop cable runs and underground areas using flush mount vaults that from a practical point of view cannot be secured. Aspects of consumer friendliness lost with scrambling can to some extent be regained using the universal IS-15 multiport decoder.

Off-premises addressable devices are desirable where system personnel have control of the outside plant and where physical space is available to accommodate the larger tap size. Unscrambled off-premises addressable taps provide to customers only those services they subscribe to; unauthorized services are securely eliminated through interdiction or active trapping techniques. In addition to inherent consumer friendliness, this technology has the potential to improve the overall operating efficiency of a cable system through reduced truck rolls in the areas of change of service, reconnects and disconnects. Short-term problems to be overcome are greater product availability, lower cost and proven reliability.

Some system operators feel that premium services not worth securing are not worth offering. Others feel that there is a trade-off between signal security and loss of premium revenue due to theft. Sound business decisions are made in both cases. Some see theft-of-service as an untenable situation, others as a cost of doing business. Where you stand on this issue will determine the level of security you require to provide peace of mind and sleep at night.

Types of security systems

Security	Level	Comments
"Honor system"	Low	
Negative traps	High	Must be audited regularly
Positive traps	Low	Vulnerable to pirate defeat
Sync suppression		
(a) Static	Low	Vulnerable to pirate defeat
(b) Dynamic level changing	Medium	
Random video inversion		
(a) With decode instructions sent unencrypted in data stream	Medium	
b) With decode instructions sent encrypted in data stream	High	Low end of high security
Constant aural carrier offset	Low	Requires only a tuned frequency FM receiver to defeat
Digitized audio encryption	High	State-of-the-art, most secure today
Off-premises addressable taps	High	Must be audited regularly

Addressability and microwave

By Steve Hubbard
Engineering Manager, Jones Intercable Inc.

In November 1986 Jones Intercable decided to improve its signal distribution in the Tucson, Ariz., area by developing a communications site on Tucson Mountain. Specifically, we planned to consolidate four stand-alone headends into one main facility using a high-powered amplitude modulated link (AML) microwave system. The project had several interesting aspects, such as developing an AML site at a remote location accessible only by four-wheel-drive vehicles, coordinating construction with several other site users and maintaining continuous operation of our addressable cable system before, during and after the transition to microwave.

Figure 1 illustrates our addressable system before the microwave was built. Set-top converters were addressed by data carried in the vertical blanking interval of a home channel (which carries global addressable data)—in our case, Channel 10—that instructed the converter to receive and decode authorized channels. Even while power to the converter was switched off, it continued to passively monitor the data on the home channel for global instructions.

"We planned an AML path from the transmitter on Tucson Mountain down to the office to provide. . . a test point."

Television channels were encoded with baseband encryption by headend video processors (HVPs), which could be turned on to encode a channel or off to operate the channel without encryption. A modem in each of our headends was connected via local phone lines back to a controller computer at our main office. It was fed data from a billing computer that instructed it to turn on individual channels for specific boxes or implement global commands to all converters in the field. The change-of-service orders were originated by CSRs (customer service reps) or by an automatic response unit.

We were quite satisfied with the operation of our converters insofar as addressability was concerned and wished to retain the equipment configuration in place, with the controller computer in our main office. It was initially suggested, however, that this computer be located at the new AML transmit site, some 10 miles from the office, with a modem connection via phone lines or a cellular phone system from an input keyboard


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Figure 1: Addressable system prior to microwave

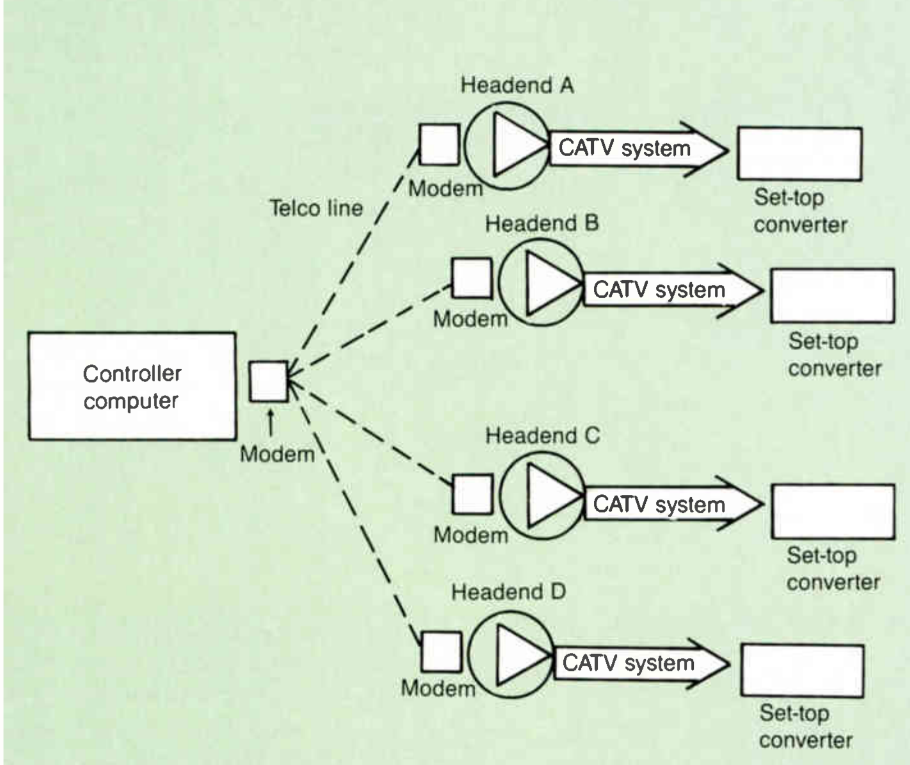
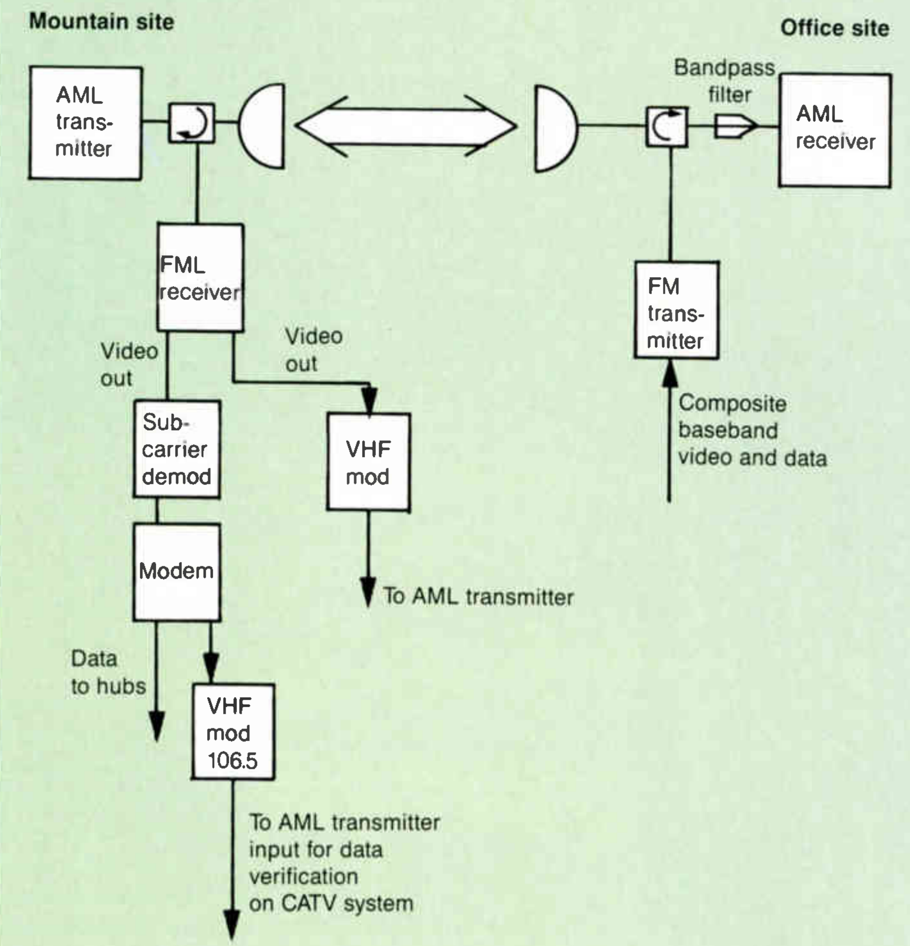


Figure 2: Two-way use of microwave path



at the office. The idea was to keep the CPU close to its associated HVPs.

FM video link

We decided to keep the controller computer at our main office by utilizing another feature of our planned microwave system: a frequency modulated link (FML) planned for transmission from the office to the new mountain transmitter site. This single-channel link was assigned to carry video information from a character generator or videocassette recorder located at the office up to the AML site for local origination or pay-per-view channel promotion.

Additionally, we planned an AML path from the transmitter on Tucson Mountain down to the office to provide television programming and a test point for monitoring microwave system performance. The office AML receiver also would be used as a spare receiver in case one of the other four receivers failed. Figure 2 shows how we used the same transmit and receive dishes for simultaneous use by the AML and FML systems. We added the controller computer data as a subcarrier to the video transmitted on the FML. It was received and demodulated at the hilltop headend and routed to each HVP and home channel.

To further improve system reliability we added more home channels so the set-tops could receive global data from several different channels instead of only Channel 10. This eliminated the chance that the entire addressable system would fail as a result of a single TV channel outage.

Because our office was located in System A (one of the CATV systems to be fed by the new microwave), we had another way to check microwave operation. We used the CATV drop as a test to verify that the AML path to System A was functioning as well as the path to the office. Further, we could verify the addressable system was working by sending a change of service instruction to a converter located in the office. If it changed decoding levels as instructed, we knew the System A microwave link was functional. If we switched the converter input from the System A CATV system to the office AML receiver output (an A/B switch was installed for this purpose), we also could verify that the addressable data was functional on two different AML paths and most likely the other paths as well.

This on-line testing capability was important. With it we could diagnose many technical problems, quickly ruling out microwave transmitter, receiver or other AML-related difficulties, and respond to system outages more efficiently.

While we were installing the AML equipment at the new transmitter site, we continued to operate the separate headends (as we had in the past). The AML was activated, aligned and proofed, and the FM transmitter was activated with character-generated video transmitted to the new headend site.

In July we completed the project. At each system headend we disconnected the CATV feed from the headend combiner output and plugged it into the AML receiver output. In System C we were unable to locate the receiver at the original headend because of lack of line-of-sight visibility to the AML transmitter. Instead, we found a suitable site about six trunk amplifiers away, however, and on cut-over night we reversed the direction of these amplifiers to accommodate the new location.

Completion

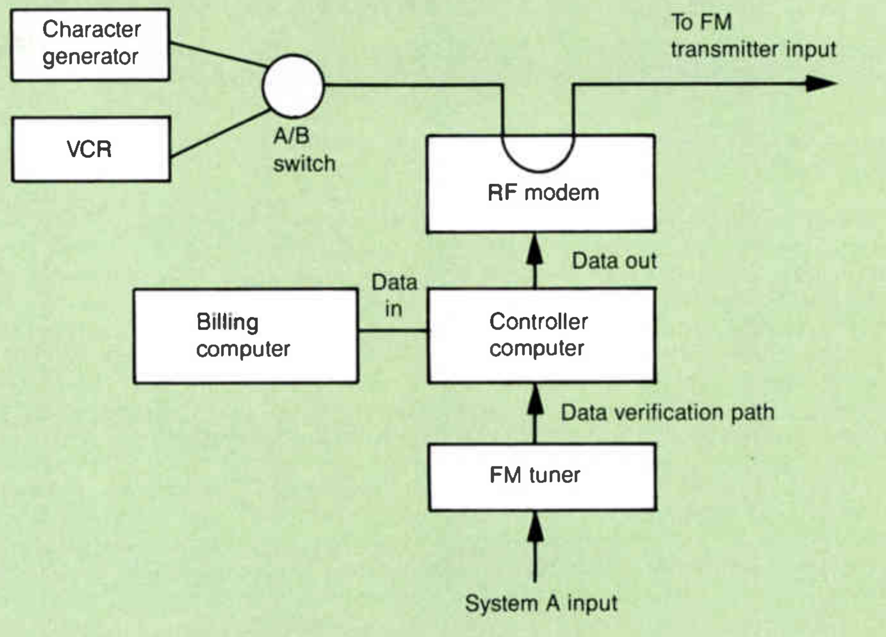
The system operated as planned. Some pieces of AML equipment, such as a solid-state source, experienced failures but were replaced by standby equipment while being repaired.

One interesting complication occurred a few days after the system was activated, when a number of set-top converters "timed out." That is, they stopped working when they lost data input and their battery-supported memory ran out after four days of operating without that input. It was found that the FML link to the transmit site wasn't transmitting data from the control computer correctly.

Figure 3 shows the configuration of the equipment. Two different sources of video can be input to the FML transmitter: character-generated messages, used most of the time; and a VCR videotape, used to promote current PPV (pay-per-view) offerings. The addressable data is transmitted at all times via a baseband subcarrier input. When the VCR supplied the video signal source, the addressable data feed was impaired, although the data was correct when a character-generated signal was used as the video source. Suspecting the time base of the video output of the VCR was unstable and affecting the adjacent subcarrier data, we borrowed a time base corrector (TBC) to stabilize it. In conjunction with upgrading the VCR to a capstan servo model, the TBC was effective in fixing this problem.

Now we had what we planned: a CATV system featuring both addressability and microwave distribution. With the flexibility of microwave to provide signals throughout Greater Tucson, combined with the sophistication of addressable converters, we can offer an attractive package of entertainment and information services to the community.

Figure 3: Inputs to FM transmitter



Considerations for integrating status monitoring and addressability

By Patrick K. McDonough
Corporate Chief Engineer, United Cable Television Corp.

The increase in the use of addressable converters has heralded a major change in the way some cable systems do business. These devices also present the operator with a new set of problems to deal with. One that becomes very important in the addressable domain is plant integrity. Not only is the FCC looking at RF leakage more critically, but a major new revenue source for cable—namely, pay-per-view—depends on the ability of the system to transmit and receive data reliably. On top of that, customers will not pay extra for a product that either does not arrive at the TV set or arrives with substandard quality.

In order to make addressability and PPV work, the system must be in good condition. As every technician knows, this means that a good deal of preventive maintenance will be needed. On-call and quick response procedures must be beefed up to protect the viability of the product. To the general manager this means that the cost advantages of using addressable boxes—and not having to roll a truck for a service change, for instance—could be negated by the increase in maintenance costs. Moreover, one way to increase the level of system reliability without increasing expenses is to install and use a status monitoring system.

The *potential* of status monitoring is probably more important a consideration than the available hardware. But in order to be truly a useful tool in an addressable system, the status monitoring computer must be coordinated to work with the converter control computer on a real-time basis.

Store-and-forward vs. real time

Let's assume a cable system is addressable and uses the RF return path to retrieve data from the converters. So now it is important to differentiate between store-and-forward and real-time systems. Store-and-forward converters retain their data until polled by the control computer, at which time the box responds by sending the information back over the cable plant. This can be done at any time, such as very early in the morning when the addressable computer is not busy. On the other hand, real-time converters respond to the computer as soon as they are polled.

The difference between these two approaches is much more pronounced than one might think. The size of the computer and data transmission requirements are a lot higher in real-time systems. Also, the total amount of data being transmitted at any one time is much higher.

In either real-time or store-and-forward, the converter is addressed by its logical ID number. This address has no relation whatsoever to the converters' real location, physically, within the cable plant. There is presently no method to determine the physical location of a converter merely by looking at its logical address. And herein lies the crux of the problem. The converters are addressed in sequence by their logical IDs but the responses are coming in from every part of the system. This can lead to timing errors with the return data as well as an increase in noise-related problems that could affect the validity of the upstream information.

Other problems can arise as well. A converter that turns on its return carrier and then won't shut off (known as a "babbling" box) can tie up the entire return path until located and turned off. A failure in the return path or intermittent problem in one of the amplifiers also can lead to headaches. These problems are sometimes quite difficult to troubleshoot and correct. Because data collection is often done in early morning hours, it can be some time before the problem is even noticed by system personnel. In these cases a status monitoring system would be helpful to quickly identify the source of the line problem or, by using the feeder disconnect features, to isolate the babbling box and shut off that return segment.

The problem now is that there is no way to coordinate between the addressable control system and the status monitor. This is complicated by the fact that the status monitor uses a logical ID for the amplifiers in the system, which in turn is keyed to the physical location. As stated before, the addressable computer uses only logical IDs with no reference to physical location.

Further exacerbating the problem is that there is almost always a third computer involved, the billing computer. It is generally linked by hard-wire connection to the addressable control computer. By far, the vast majority of addressable functions are entered via the billing system CRTs by customer service representatives.

It will be desirable in the future to be able to discretely address a group of converters in defined geographical areas for public opinion polling, home shopping and so on. The first job in integrating the computers will be to define the physical location of each converter. This is not just the subscriber address. To fully define the converter location the following information also must be included: hub number (if applicable); main trunk amp ID; sub trunk ID; feeder ID and in some cases the power supply ID. For line control purposes, identifying a box location to the feeder line level is all that is necessary. It might be useful to have a street address as well as the subscriber name and phone number, but this may be too much information to handle efficiently.

Ideally, the computers should function together when return data is requested from a box or group of boxes. The sequence of activities possibly could follow a scenario such as this:

1) the request is entered via the billing system terminal;
2) it is then sent to the addressable control computer over the hard-wire link;
3) the request is transmitted to the converters over the system;
4) simultaneously, the converter physical ID is sent to the status monitor computer;
5) the status monitor computer identifies the return path needed, based on converter physical location, and opens and closes the appropriate feeder switches to isolate the necessary return path.

"The potential of status monitoring is probably more important a consideration than the available hardware."

Power needs

How much computer power must be dedicated to these functions? The answer is not known at this point, but it will obviously vary from system to system depending on size, number of amplifiers and the type and number of converters installed. The speed of the data moving through the computers also must be determined so that an integrated system does not significantly impact normal operations. The physical configuration of the wire link, buffer size and dedicated CPU operations may impose limitations on the viability of tying the computers together. The ability of the various components to be expanded in the future also must be considered.

The last item to consider is the need for the integrated system to document the activity that has taken place. An immediate confirmation of the order passthrough should be presented on the CRT screen. Various standard messages, such as "implementation in progress," "order confirmed," etc., can be programmed. A graphic display of the return path, shown on the status monitor's CRT, also would be helpful. Naturally, a hard-copy printout of the return data is necessary for billing purposes. This information must be placed in the subscriber data base as well.

This is the direction status monitoring should be moving before it can become a truly useful tool in the cable industry. While this may be a minority opinion, it is presented in the hope that other operators will see the merit of an integrated approach.

A holistic approach to ad insertion

By John Kienast
Senior Systems Analyst
Grumman Electronics Systems Division

Over the past few years, advances in computer technology have virtually changed the form of the way business is conducted. Through a barrage of electronics firms and a myriad of software applications the world has come to expect the impossible from the mysterious silicon chip.

Nowhere have these changes been more pronounced than in the arena of small desktop computers. Businesses today are utilizing networks of personal computer stations to manage their information flow in some very creative ways. Low-cost modems provide a window to the outside world and allow data transfer between affiliate business sites, clients and vendors. Graphics and display software have taken full advantage of this and have transformed the mundane world of reporting to the art of information processing.

Surprisingly, this type of integrated technology has not moved its way into the management of a cable television operation. A series of separate piecemeal computer systems that address individualized functions of the ad insertion process has evolved in the industry.

What is truly needed is a holistic global approach to tying together all of the activities of a cable company wishing to offer the sale of local commercials. Why do we need such a system? Well, in addition to bringing our operations into the 20th century, let's get more pragmatic: How about increasing ad sales and decreasing the control room work load, for starters?

So, how do we create such a system? By taking two separate computers—one for centralized sales and billing, the other for studio control—and tying them together with a common interface.

Increased programming demands and the desire to maximize revenue by airing commercials on a local or regional basis, coupled with the need to reduce overall operational costs, have presented computer design engineers with a very real challenge. Nevertheless, the fact is that using today's existing technology, all the pieces are in place to provide a cohesive approach to the needs of CATV. A state-of-the-art insertion system will link up the facets of sales order entry, scheduling, machine control, accounting and management reporting. The required system can be created by software, interfacing each of these facets to bring about the desired effect.

A day in the life

Let's look at a day in the life of an insertion operation. We'll examine the players, what their needs are and a how a properly designed automated insertion system can put it all together.

Central to the harmony between a sales organization and effective automation is the concept of flexibility. Quota-oriented salespeople in many walks of life have often been at odds with well-meaning but short-sighted computer programmers. A state-of-the-art order entry system is one totally designed by people familiar with the somewhat chaotic buying habits of the CATV client. It orients itself to the demands of the sales force. Rather than restricting their mobility, it opens up the avenues of scheduling a single order across several networks, selecting dayparts or program types and even choosing the headends that will air particular spots.

Additionally, it provides the staff with reports involving sales history, sales projections, avails and other information. For the really aggressive marketeer who stays in the field for extended periods of time, a laptop computer with off-the-shelf terminal emulation software can dial up the central computer from a remote site and obtain the latest information. Using a typical multitasking, multiuser operating system such as Xenix or Unix on a network driven by an ordinary PC AT computer, all of these things can take place. A series of low-cost terminals tied to a network card in the PC provide additional users access to the various features in the system.

To create a true traffic and billing atmosphere the order entry programs are part of a sequence of modules that will directly pass data to the accounting portion of the system. Scheduling algorithms must be able to accommodate ad copy rotation, priority spot assignment and network avail irregularities. The traffic and billing manager's role soon becomes one of providing information to the sales staff, rather than belaboring them with restrictions on their ability to conduct business.

Data that is useful to the accountants and salespeople also can be directed to the master control room. This is where software interfacing comes into play. An agreed-upon format for transmitting files to the control room computer will allow the schedule logs to become an integral part of the control room data base.

Using standard multitasking operating system software, the central traffic system computer can communicate with the control room in a manner that will allow each system to continue its respective jobs. If the master control room is within reasonable proximity to the traffic computer, the data link may be a direct serial connection using RS232 (or RS422) communications protocol. Should the two systems be remote from one another, a modem link can be employed.

The Xenix- or Unix-based computer system contains a standard interprocessor communications package in the UUCP (universal unilateral communications protocol) directory. The applications programs simply make low-level system calls to these procedures and provide a user-friendly interface for the operator.

A properly designed master control room computer system will contain integration procedures that will cross-reference the incoming

"Using today's existing technology, all the pieces are in place to provide a cohesive approach to the needs of CATV."

schedule log with an existing tape library data base. Operators will be adequately warned as to what new spots should be included on the master tape set. In addition, a full series of screen displays and printed reports will be available for examination of advanced scheduling, tape libraries and spot identification.

Above all, the control room computer must be capable of accurately handling the tape machines. By using SMPTE time codes, the applications software can position to the exact starting point of any ad on the tape. Furthermore, a directory structure held in memory provides positive identification of each spot. A clearly defined status display on the master console will inform the operator in sufficient time if the correct tapes have been loaded.

By using a system that allows full random access to any spot on a cassette and has the ability to share machines among channels, fewer tape changes will have to be made throughout the day.

Computerphobia

Returning to our notion of flexibility, the same requirement exists in the control room as it does in the order entry world. Last-minute schedule changes need to be entered into the system in a simple manner. Operators will then learn to use the keyboard as an effective work tool rather than hiding behind "computerphobia."

From an engineering standpoint, certain important system controls should be accessible to handle day-to-day configuration changes. Switcher routing changes and tape machine assignments must be easily managed to accommodate maintenance schedules or equipment downtime. To further enhance system controls, diagnostic tests should be an integral part of the software provided. If this is accompanied by a viable maintenance agreement, much of the anxiety surrounding the use of modern computer control systems disappears.

Finally, to come full circle, each commercial spot managed by the control room should be logged to a disk file and later transmitted back to the central billing site. Instead of manually recording the time that each spot has aired, software routines should automatically retrieve this information from the verification data and pass it through the billing cycle.

Using this unified approach to automated commercial insertion will effectively deliver a product using a well-planned design methodology to fulfill the industry's needs.

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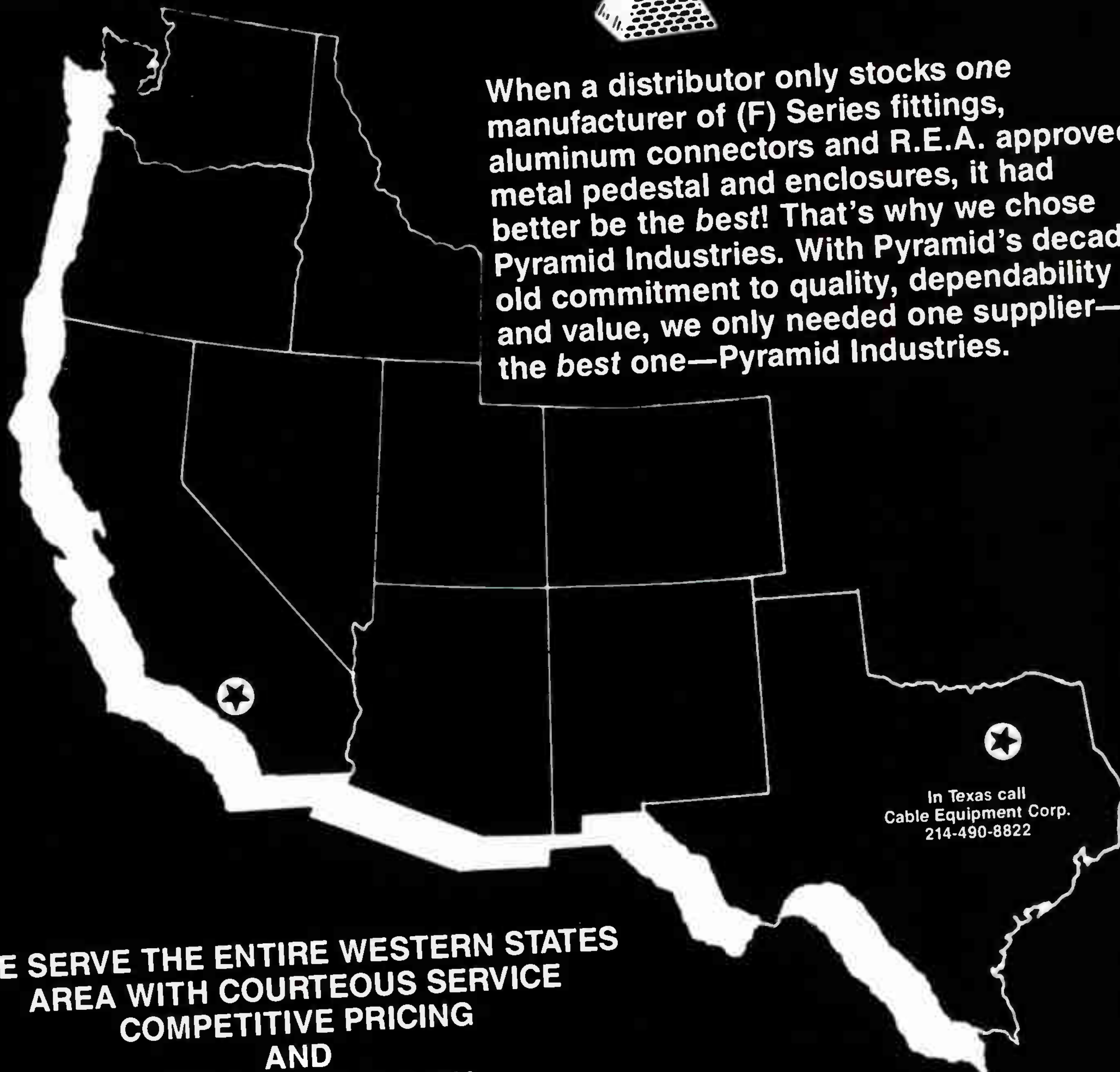

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Engineering the interconnect

By John Fitzpatrick
Chief Engineer, Northwest Cable Interconnect

If your cable system is contemplating becoming part of an interconnect, be aware from the beginning that there is no formula solution for success. Each interconnect will be unique because of the particular combination of management objectives, existing headend equipment, physical location and method of interconnection you choose. The engineer has the challenge and opportunity to bring together in functional form these various components. Consequently, learning to adapt to different working environments (systems) is a must.

For example, Northwest Cable Interconnect (NCI) consists of four separate cable systems located in the state of Washington.

Viacom and TCI West each have one system in Seattle and another 36 miles south in Tacoma. The Tacoma systems have one ad insertion site that they share; this is accomplished by way of a dedicated two-way FM trunk line. In Seattle, TCI's ad insertion site and its headend are physically separated by about eight miles; hence, as in Tacoma, a dedicated trunk line is employed.

The other people

Now, then, how does a staff of one engineer handle such a system? The answer is simple: You rely on other people. These "other people" consist of the different systems' technical managers and supervisors, headend technicians, the interconnect's managers and supervisors, and the ad insertion operators. Each person involved plays a critical role in keeping the engineering department in a healthy condition.

The ad insertion operators are perhaps the vanguard of the engineering department. Constant communication with them is vital for a consistent operational system. Training the operators in minor technical repairs will reduce downtime and enhance their self-esteem. Some technicians may weaken at the knees at the thought of equipment operators getting their hands into a machine. However, with proper training operators can and will save the engineer valuable time, heighten their system awareness and help with their employment retention.

An analogy of a house and these "other people" can be applied here. The foundation rests upon engineering having an effective preventive maintenance plan. The walls represent the operators who rely on a solid (equipment) foundation. The door resembles the headend technicians who can keep you in or out. The roof comprises the managers and supervisors who, through inspiration and guidance, keep the "house" sheltered. The key to this house, in regard to engineering, is through communication and time management.

Engineering's responsibilities are to help keep the house in order. Not unlike the house's windows, the engineer must have a crystal-clear plan and procedures to follow. A preventive maintenance program is one of the most important services engineering has to offer. (The engineering department that sidesteps this belief is seeding the house with termites!) Establishing and applying an effective PM program contributes to a consistent on-air look and ensures less downtime.

Clearly defined engineering procedures help develop proper time management. These procedures are prioritized as follows:

1) Ad insertion on-air technical difficulties demand instant, top priority service and repair.
2) "Equipment condition status" is scheduled for repair on a priority basis.
3) PM program applied.
4) Documentation of equipment repaired.
5) Replenishment of parts inventory.
6) Re-evaluate system design and modify as required. Update the existing system's block diagrams and schematics.
7) Frequent meetings with department managers, production personnel and equipment operators in order to coordinate technical support and to update management on technical status.
8) Research new technologies as applicable for advanced system design.

Part II: Fiber-optic broadband systems

This is the second of two parts. Part I provided an analysis of fiber-based supertrunks and the fiber medium.

By Mircho A. Davidov
Catel Telecommunications Inc.

The principal light sources used for fiber-optic communication applications are laser diodes and light-emitting diodes (LEDs). These devices are suitable for fiber transmission systems because they have adequate output power for a wide range of applications; they can be directly modulated by varying the input current to the device, they can have high efficiency and their dimensional characteristics are compatible with those of the optical fiber. A major difference between LEDs and laser diodes is that the optical output from an LED is incoherent, whereas the laser diode output is coherent.

Laser sources generate the optical energy in an optical cavity. The resulting output is highly monochromatic (single wavelength) and the light beam is very directional (the output has high spatial and temporal coherency). The emission spectrum of lasers is narrow (typically 4 nm), they have modulation capabilities of up to 1 GHz and their radiance is high (1-2 mw coupled into the fiber).

In an incoherent LED source no optical cavity exists for wavelength selectivity and the output radiation has a broad spectral width (typically 50 nm) and has modulation capabilities up to 200 MHz. In addition, the incoherent optical energy is emitted into the hemisphere according to a cosine power distribution and has a large beam divergence.

The spatially directed coherent optical output from a laser diode can be coupled into either single-mode or multimode fibers. However, sufficiently large incoherent optical power for it to be useful (10-50 μw) from an LED can only be coupled into multimode fibers.

Figure 1 shows the effect of resultant fiber-optic plant bandwidth as a function of the light source spectral width. It can be seen that very wide bandwidths are possible if precise control over the optical source spectral width and wavelength can be effectively accomplished.

An important factor to consider in the application of laser diodes is the temperature dependence of the threshold current as shown in Figure 2. Consequently, if constant optical power and undistorted signal outputs are to be maintained with time, it is necessary to use precise DC bias and temperature control techniques.

For broadband supertrunking applications, intensity modulation of the laser diodes is carried out by making its drive current above threshold vary about the bias point in proportion to the modulation signal (Figure 3). A requirement for this modulation scheme is that a linear region exist between the light output and the current input. Signal degradations resulting from the non-linearities in the transfer characteristic of the laser diodes make the implementation of the analog intensity modulation susceptible to both intermodulation and cross modulation effects if not accounted for.

Methods of compensation for the non-linearity of the optical sources include different linearization techniques (complementary distortion, negative feedback quasi-feedforward compensations) or use of modulation schemes less sensitive to those distortions such as pulse position modulation (PPM) or wide deviation FM.

Optical detectors

At the receiving end of an optical transmission line there must be a receiving device that interprets the information contained in the optical signal. The first element of this receiver is a photodetector. Of the semiconductor-based photodetectors, the photodiode is used almost exclusively for fiber-optic systems. The two types of photodiodes used are the PIN photodetector and the avalanche photodiode (APD).

The PIN photodiode generates electrical current in response to incident light. Two important characteristics of a photodiode are its quantum efficiency and its response speed. The quantum efficiency η can be defined as:

$$\eta = \frac{I_p/q}{P_o/h_\nu} \tag{1}$$

Here I_p is the average photocurrent generated by a steady-state average optical power P_o incident on the photodetector, q is the electron charge and h_ν is the photon energy. In practice, 100 photons will create between 30 and 95 hole-electron pairs, thus yielding quantum efficiency ranging from 30 to 95 percent.

The performance of a photodiode is often characterized by its responsivity R. This is related to the quantum efficiency by:

$$R = \frac{I_p}{P_o} \tag{2}$$

This parameter is quite useful since it specifies the photocurrent generated per unit of optical power. Typical PIN photodiode responsivities as a function of the wavelength can be seen in Figure 4.

PIN diodes are simple to use and they have low dark currents. However, the PIN diode receivers have low sensitivity and low dynamic range too.

The avalanche photodiode internally multiplies the primary photocurrent before it enters the input circuitry of the following amplifier. This increases the receiver sensitivity since the photocurrent is multiplied before encountering the thermal noise associated with the receiver circuitry. In order for current multiplication to take place, the photogenerated carriers must traverse a region where a very high electric field is present. The photogenerated electrons can now gain enough energy to ionize forward-bound electrons before colliding with them. The newly created carriers are also accelerated by the high electric field, thus gaining enough energy to cause further impact ionization. This phenomena is the avalanche effect.

The APDs require high bias voltages (silicon 300 V, germanium 30 V), the multiplication factors are statistical and can be temperature-dependent. APD devices also tend to have high dark currents and excess noise for long-wavelength devices. However, they permit the receiver to have high sensitivity and dynamic range.

Carrier-to-noise ratio of optical photodetector output signals

As shown in Figure 3, analog modulation of the laser diodes is used for broadband super-trunking applications. In this scheme the time-varying electrical signal s(t) is used to directly modulate the laser diode about some bias point I_b.

The transmitted optical power P(t) is therefore of the form:

$$P(t) = P_t[1 + m \times s(t)] \tag{3}$$

where P_t is the DC optical power, s(t) represents the combined analog FM signals and m is the modulation index defined as:

$$m = \frac{\Delta I}{I_b - I_{th}} \tag{4}$$

Link budget for 16-channel CATV supertrunk

Transmitter	
Minimum optical power	−1.5 dBm
Connector loss	0.8 dB
Launch power	−2.3 dBm
Receiver	
Receiver sensitivity	−26.0 dBm
Degradation allowance	1.0 dB
Minimum input power	−25.0 dBm
Fiber link loss	
Fiber loss (0.4 dB/km)	16.0 dB
Splice loss (0.3 dB/km)	3.3 dB
Total link loss	19.3 dB
System	
System gain	22.7 dB
System margin	3.4 dB

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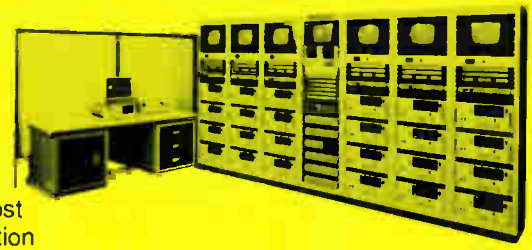

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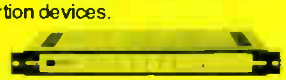

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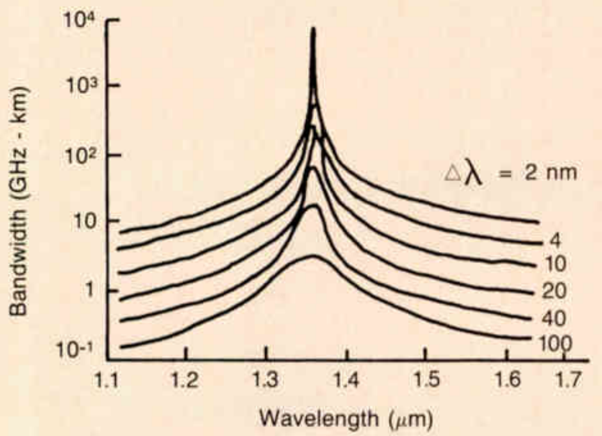
Figure 1: Effects of source spectral width and wavelength deviations



where ΔI is the peak modulating signal and I_{th} is the threshold current.

At the receving end the photocurrent generated by the intensity modulated optical signal is given by:

$$i_s(t) = I_p \times G[1 + m \times s(t)] \qquad (5)$$

where G is the photodetector gain and I_p again is the (unmultiplied) photocurrent generated.

If s(t) is a sum of N sinosoidally frequency-modulated signals, then the mean square signal current is:

$$[i_s(t)] = \tfrac{1}{2}(G \times m \times I_p/N)^2 \qquad \textbf{(6)}$$

It can be shown (Reference 1) that the mean square noise current for a photodiode receiver is the sum of the mean square quantum noise current, the equivalent resistance thermal noise current, the dark noise current and the surface leakage noise current. Therefore, the total mean square noise current $[i_N(t)]$ is given by:

$$[I_N(t)] = 2 \times q(I_p + I_D) \times G^2 \times F(G) \times B + 2 \times q \times I_L \times B + (4 \times K_b \times T \times B) \times F_t/R_{eq} \qquad \textbf{(7)}$$

where F(G) is the excess photodiode noise factor $= G^x$ $(0 < x < 1)$, B is the equivalent noise bandwidth of the detector, R_{eq} is the equivalent resistance of the photodetector load and amplifier, F_t is the noise figure of the low-noise preamplifier, I_D is the (unmultiplied) dark current, I_L is the surface leakage current, T is the equivalent noise temperature of the preamplifier and K_b is the Boltzmann constant.

The carrier-to-noise ratio of the frequency-modulated analog signals at the output of an optical detector (and before FM demodulation) is given by:

$$C/N = [i_s(t)] / [i_N(t)] \qquad \textbf{(8)}$$

The term $(4 \times K_b T \times B) \times F_t/R_{eq}$ represents the circuit noise and the term $2q\,(I_p + I_D) \times G^2 \times F(G) \times B$ the quantum noise (and dark current) associated with a photodetector.

When an avalanche photodiode is employed at low signal levels, and with low values of G, the circuit noise term dominates. At a fixed low level, as the gain is increased from a low value, the C/N increases with the gain until the quantum noise becomes comparable to the circuit noise. As the gain is increased further, the C/N decreases as $F(G)^{-1}$. Thus, for a given set of operating conditions, there exists an optimum value of the avalanche gain for which the C/N is maximum. Since an avalanche photodiode improves the C/N for small optical signals, it is the preferred photodetector for this situation.

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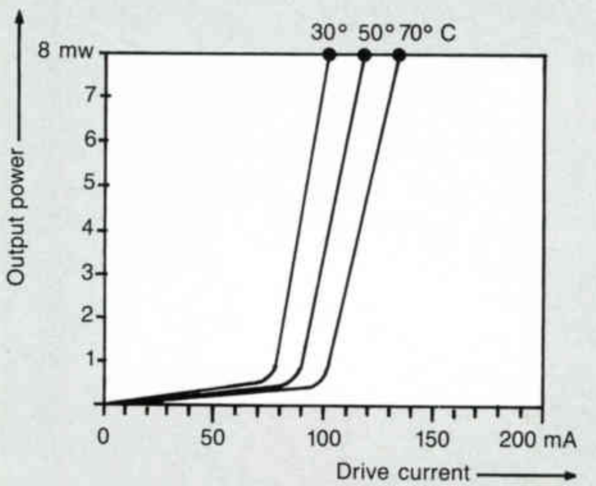
Figure 2: Temperature effects on lasers



For very large optical signals the quantum noise dominates the receiver noise. In this case the avalanche photodiode can decrease the C/N of the received signals if the gain is not decreased or optical attentuation inserted.

FM system performance in fiber-optic supertrunks

If analog frequency modulation is used to transmit video, we can define the weighted output $(S/N)_{ow}$ (Reference 2) of a video-modulated carrier as a function of the input $(C/N)_{IF}$, the modulation index β, the IF bandwidth B_{if}, and the highest baseband video frequency F_m as follows:

$$(S/N)_{ow} = [3 \times \beta^2 B_{if} / (2.F_m)] + (C/N)_{IF} + W \qquad (9)$$

where $(C/N)_{IF}$ is measured in the IF bandwidth and

$$B_{if} = 2 \times (\Delta F + F_m) \qquad (10)$$

B_{if} is the Carson's rule bandwidth and the modulation index is:

$$\beta = \Delta F / F_m \qquad (11)$$

where ΔF is the peak deviation of the video carrier and W is the video weighting improvement resulting from using pre-emphasis and de-emphasis (3.6 dB with CCIR-405-1 characteristic), CCIR noise weighting (11.5 dB) and P-P/RMS conversion (9 dB).

Note that ΔF is the peak deviation of the carrier by a sinusoidal signal with no pre-emphasis included. Other deviation definitions, used by equipment manufacturers, include sync tip to peak white deviation $\Delta F_{st\text{-}pw}$. It can be shown (Reference 4) that the two deviation definitions are related as follows:

$$\Delta F = \Delta F_{st\text{-}pw} / (2 \times 0.3) \qquad (12)$$

If we refer the noise generated by the receiving equipment to the input, the carrier-to-noise ratio becomes:

$$(C/N)_{IF} = P_r / (K_b T^{\circ}_{eq} \times B_{if}) \qquad (13)$$

where K_b is the Boltzmann constant, T°_{eq} is the equivalent noise temperature given by:

$$T^{\circ}_{eq} = T^{\circ}_0 \times (F-1) \qquad (14)$$

in which T°_0 is the ambient noise temperature (300°K) and F is the noise figure of the receiver.

To estimate the theoretical achievable performance of a multichannel FM video modulation system, the $(S/N)_{ow}$ will be calculated with the following assumptions:

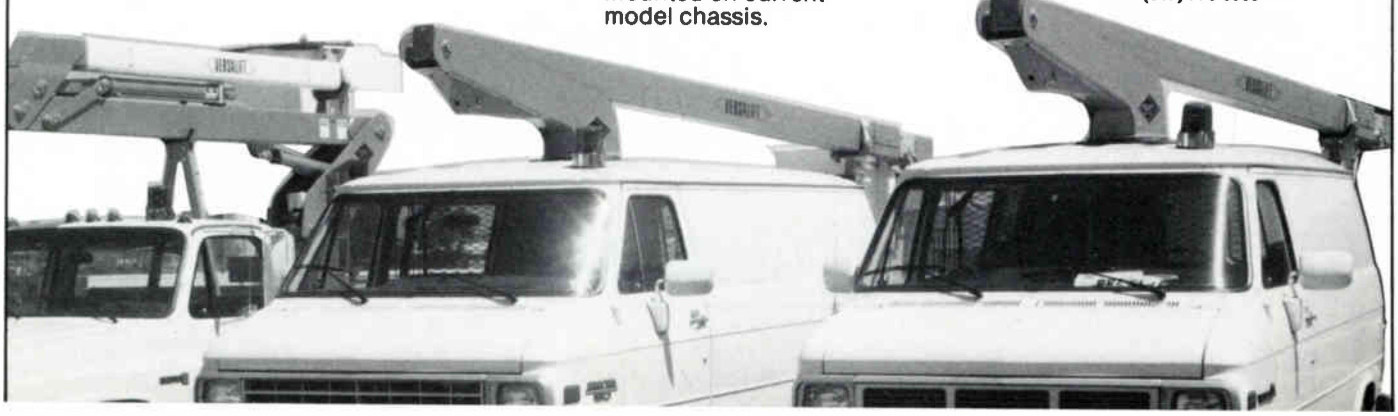


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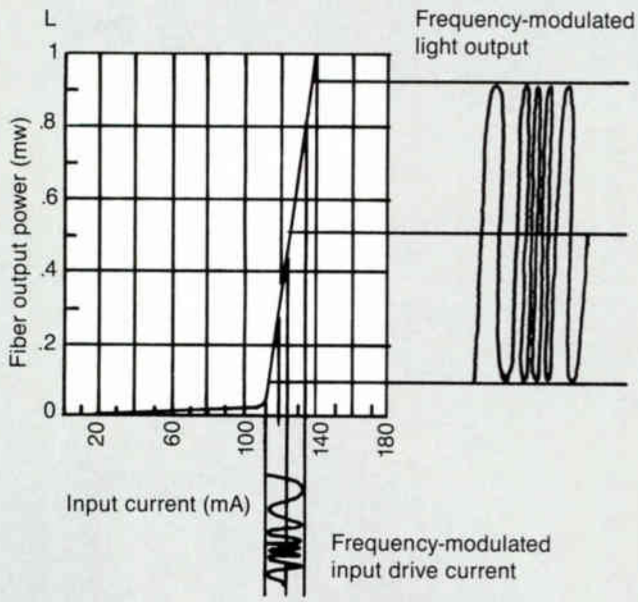
Figure 3: Linear modulation of a laser diode



Carrier deviations:

$\Delta F_{st\text{-}pw}$ = 4 MHz, 6 MHz (corresponding to ΔF = 6.67 MHz, 10 MHz).

IF bandwidth B_{if} = 30 MHz, 40 MHz.
Worst case NF: 20 dB (to account for multichannel operation).
Worst received power: −26 dBm (from the optical link power budget).

Substituting in Equations 9 to 14, the $(S/N)_{ow}$ becomes:

For $F_{st\text{-}pw}$ = 4 MHz and IF bandwidth = 30 MHz, $(S/N)_{ow}$ = 72 dB.
For $F_{st\text{-}pw}$ = 6 MHz and IF bandwidth = 40 MHz, $(S/N)_{ow}$ = 75 dB.

Although not shown in the analysis, it has been demonstrated that FM can reject interference from other sources including adjacent FM channels, intermods, cross mods and any other interference not coherent with the in-channel video. This feature permits the system designer to select the modulation to cost-effectively design high performance multichannel video FM systems over broadband supertrunks.

Early multichannel FM video systems using a peak carrier deviation of 1.6 MHz and an RF bandwidth of 16 MHz have been used in coaxial cable supertrunks and achieved S/N_0 improvement factors at 10 dB over the C/N_i.

Link budget for analog FM video fiber-optic system

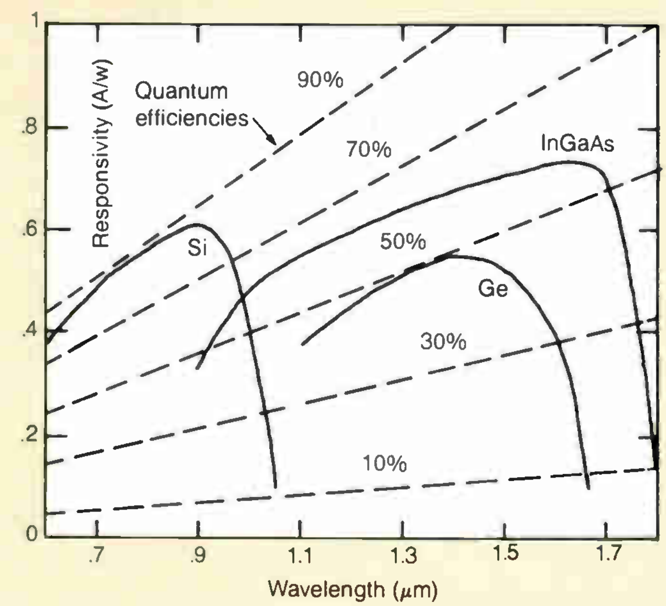
A typical link budget for a 16-channel CATV supertrunk is given in the table on page 30. The laser transmitter average optical power is −1.5 dBm. Up to 0.8 dB can be lost in the connector, resulting in total launched power of −2.3 dBm.

The receiver sensitivity is defined as the average input power at the receiver that yields a weighted video signal-to-noise ratio of 60 dB with full 12-channel loading. From the previous section and allowing for multichannel derating, this input power is −26 dBm. An allowance of 1 dB is allocated to degradations due to temperature and aging, resulting in required input power of −25 dBm.

A fiber trunk of 25 miles (40 km) long, using 0.4 dB/km and cable sections each 4 kilometers (splicing loss of 0.3 dB/splice, 11 splices) will result in 19.3 dB of optical attenuation and will yield a system margin of 3.4 dB.

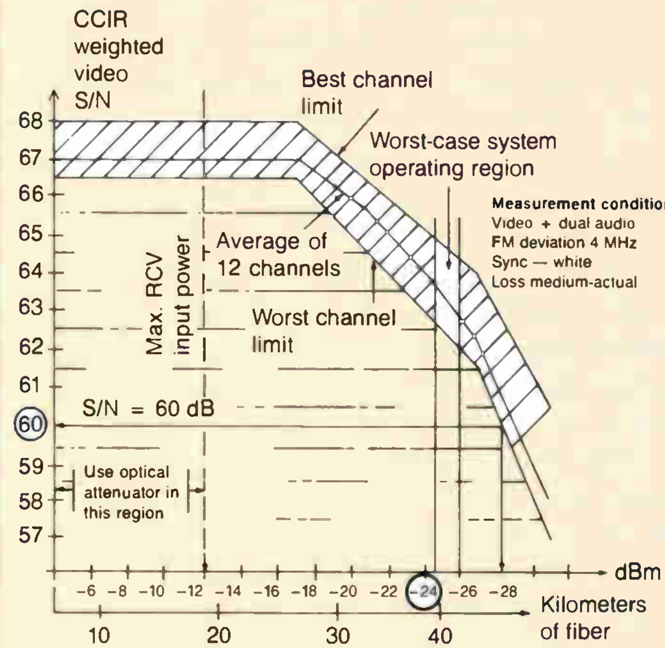
An example of present state-of-the-art high performance wide deviation video FM systems is shown in Figure 5. The system is carrying 12 channels, each 40 MHz wide with multiple subcarriers at a distance to 40 km and achieving more than 65 dB video S/N_0 per channel. The figure shows that worst case of 60 dB S/N_0 per channel at 40 km distance can be

Figure 4: Responsivities of typical detectors



achieved with worst-case received power of −28 dBm and dual audio channels.

Figure 5: S/N_0 of a 12-channel FM system over a single-mode fiber media



Flexibility and future directions of fiber

In addition to its high performance, a video FM system also can be quite flexible.

For example, the system can be easily adapted to transmit data. Since multilevel pulse code-modulated (PCM) data is a video-like signal, PCM multiplexers can be readily interfaced (as shown in Figure 6) with the FM modulator and demodulator permitting high data rate signals to be transmitted over broadband networks.

(Continued on page 52)

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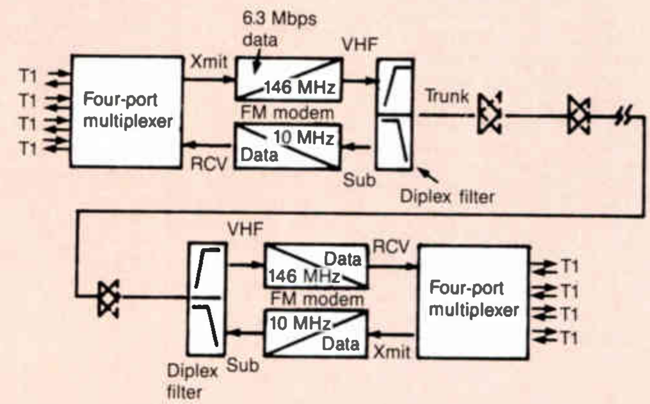
(Continued from page 38)

Other types of complex signals (such as BTSC stereo audio signals) can be conveniently and efficiently carried as subcarriers above the audio subcarrier signals.

What direction fiber-optic systems will take depends mainly on the applications being developed today. For long-haul analog or digital data transmission, 1,550 nm seems a natural extension of the present 1,300 nm systems.

For the local loop application, it seems that low-cost repeaters and fiber optic-to-coax cable converters would be very desirable. Future development of the laser transmitters/receivers allowing direct frequency modulation of the light beam would help lower the cost and increase the performance. Finally, development of coherent demodulation methods for lightwave signals will extend the range of the transmissions by several orders of magnitude.

Figure 6: PCM multiplexer interfaced to an FM system



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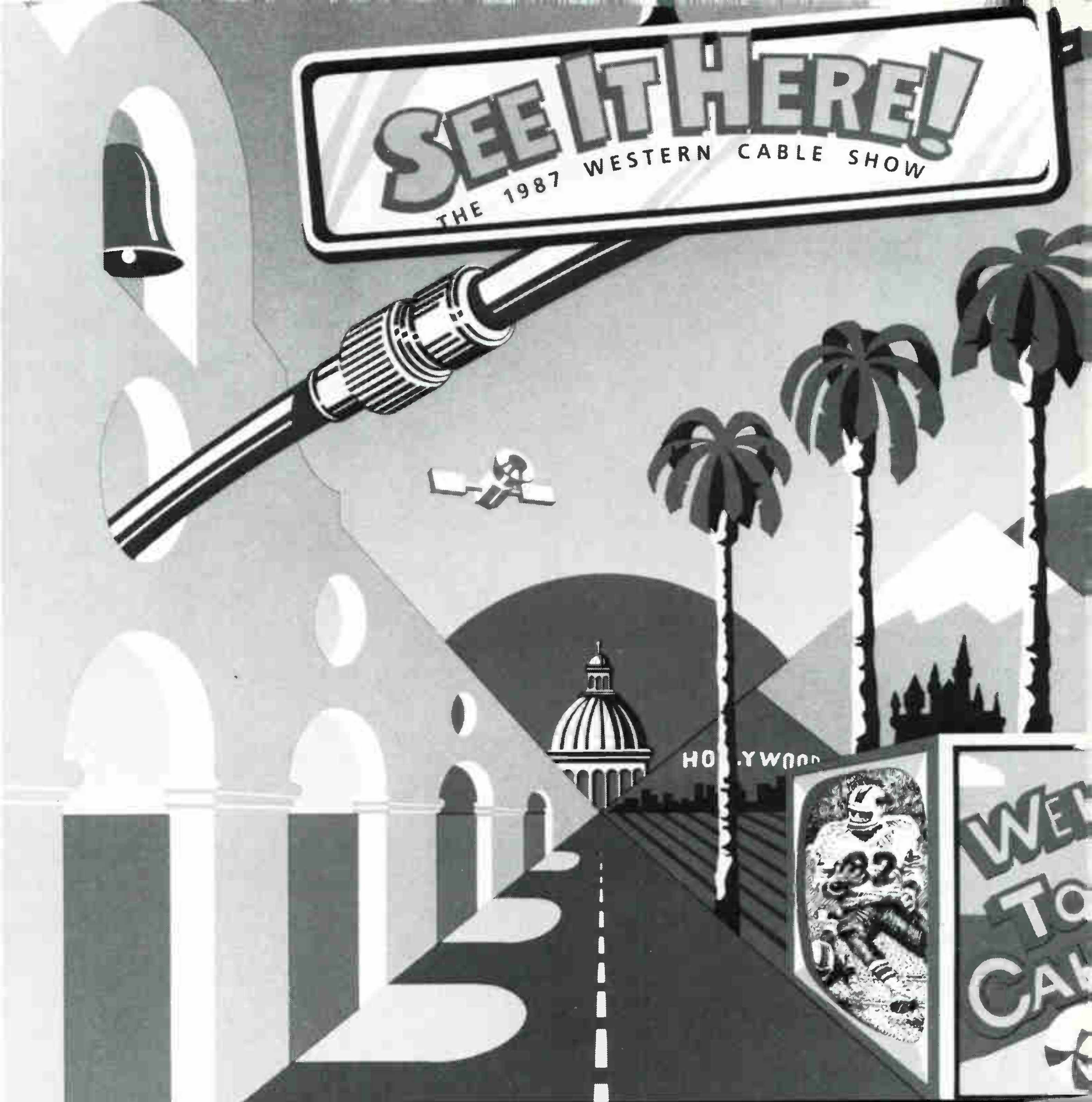
Dr. Davidov received his Ph.D. in 1981 from the University of Southern California and M.S. and B.S. in 1976 and 1974 respectively from Tel Aviv University. Davidov presently directs all of the engineering activities at Catel Telecommunications, developing products in the areas of FM modulators and demodulators for video transmission, VSB-AM modulators and demodulators, FDM-FM fiber-optics transmitters and receivers, and frequency translators for LAN data signals.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Key

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It's a team effort, Rick Cole, Indianapolis Cablevision, February 1987, 69.

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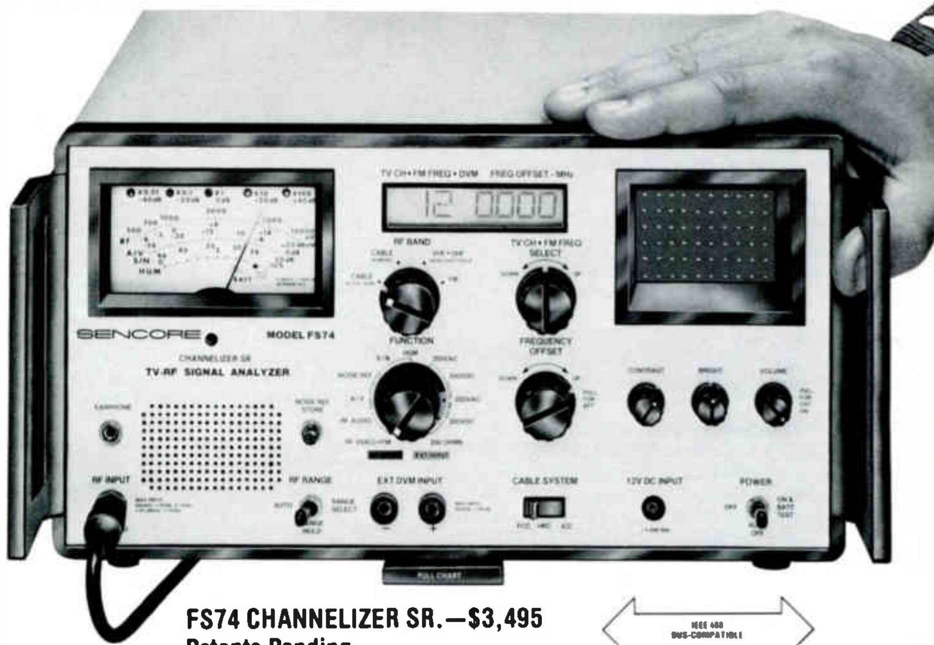

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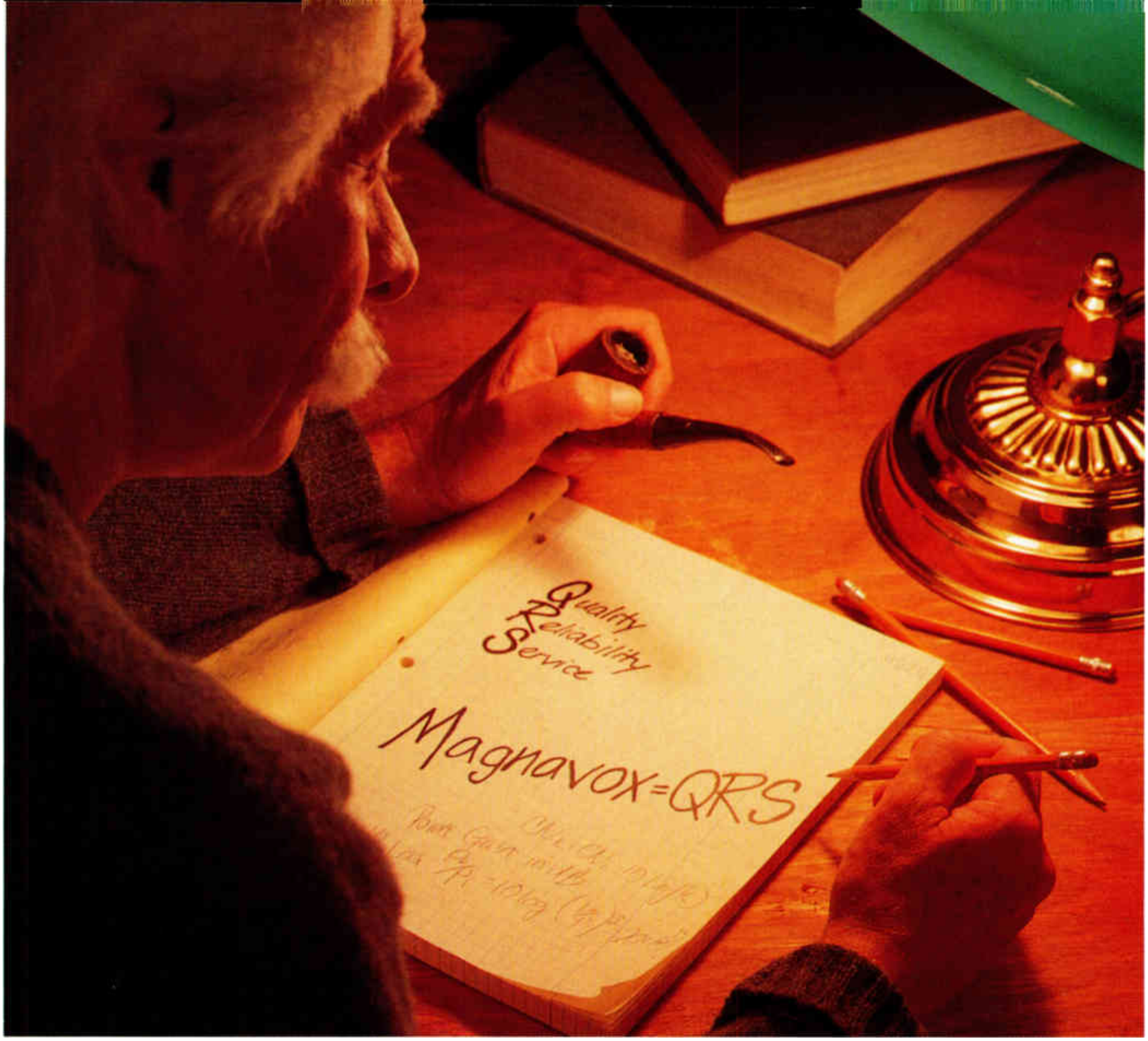

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The scientific method of headend maintenance

By Thomas P. Saylor
Staff Engineer, Columbia Telecommunications

The scientific method. It sounds suspiciously like another quick-fix fad diet. But just think back to your high school science days. Your instructor no doubt drummed experimental methodology into your mind. You were to determine the objective, plan the experiment, look for the anticipated result and summarize your findings. So why should a preventive maintenance plan be any different? (And you thought you'd never use that high school stuff in real life!)

On the surface, a comprehensive maintenance program for today's complex headends is a mammoth beast. Don't kid yourself; it will take a commitment to quality and a clever approach. It also can be scaled down into its constituent parts. By doing that and being conservative in the scope of your objectives, the task will simplify itself. Wisely using your resources of people, time and equipment will contribute to its success.

Why bother to do it in the first place? After all, things are running just fine as they are. But are you sure your plant currently meets your company's in-house standards? And how about the old FCC standards? If no company specs exist, dig out your copy of Part 76.605 and expand on these. Just because these tests are no longer federally mandated doesn't mean you shouldn't do them. This document is a good starting point for figuring out what to do.

Beyond the technical compliance argument, other reasons surface, mainly economic and management related. Reducing headend outages and degradations will result in fewer complaints from your status monitoring department. And a savings in overtime costs will result by heading off problems before they put the after-hour bite on your staff.

Also, protecting your company's franchise privileges has a far-reaching effect. Local government, investors, upper management and other interested parties hate surprises that jeopardize the status quo. Showing evidence of a good-faith effort to keep quality up goes a long way during renewal hearings, rate increases and other public scrutiny.

If your equipment could talk, it would thank you for extending its life through routine checkups. In today's cash flow-oriented cable system, heroes are born when repair expenses resulting from benign neglect drop noticeably.

Positive management concern is shown when your technical staff becomes directly involved with a PM program. An atmosphere of participation, job enhancement, training and increased self-worth yields a motivated and promotable work force. When handing out PM assignments, let the lowest possible level complete the task. This means the person at the lowest level *capable* of the task, not the lowliest employee; a certain level of ability is required.

Where to start

Determining what to do is amazingly straightforward. First, make a list of all the major headend equipment by type. For example: Jerrold modulator, Scientific-Atlanta satellite receiver, Oak scrambler and so on. (This will result in a fairly large list.) Next, break down your list into groups of equipment that have a similar function or are part of a larger subsystem. Some examples of this might be: TVRO, modulators/demodulators, processors, stereo/FM, standby power, microwave, transportation trunk, tower/antenna, video (tape decks, character generators, switchers)

Table 1: Headend maintenance summary

Description	Interval
1) TVRO equipment	
Receiver audio/video level and quality	Weekly
Heliax pressurization	Weekly
LNC power supply voltage	Monthly
Earth station structure visual inspection	Semiannually
2) Modulators/demodulators	
RF output level	Weekly
RF frequency	Monthly
Video frequency response	Annually
Carrier-to-noise/interference	Annually
3) Physical plant	
Air conditioning	Monthly
Halon system	Annually
General cleaning	Monthly
Building and grounds inspection	Monthly

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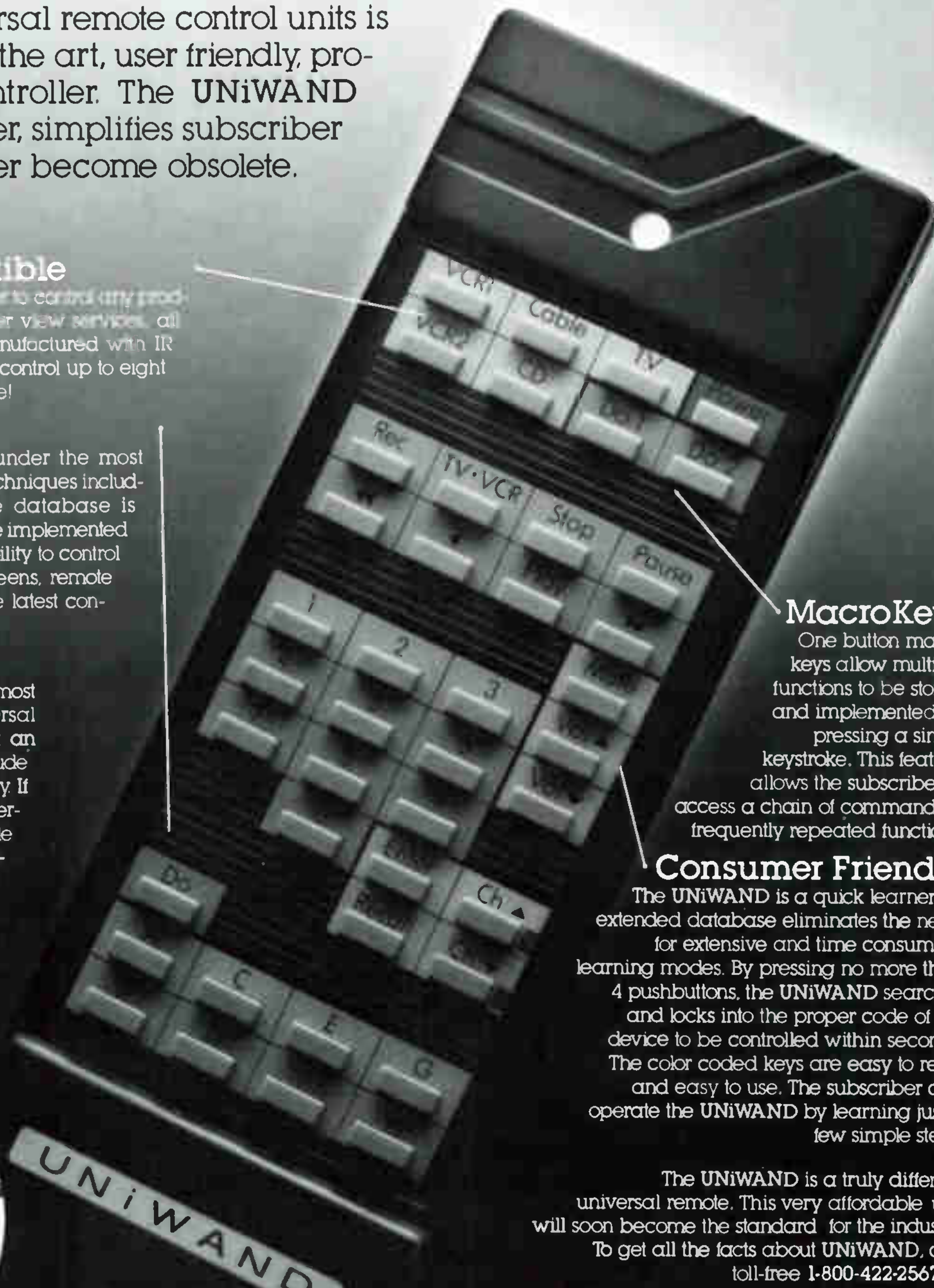

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Table 2: LNC power supply check

Purpose
To ensure LNC is receiving proper DC voltage.
Required equipment
Digital multimeter
Procedure
1) Inspect power supply for loose connections. Tighten any found.
2) Set multimeter to 200 VDC range.
3) Measure voltage across output terminals. Spec: 24 VDC ± 1 VDC.
4) Set multimeter to 200 mVAC range to measure ripple voltage. Spec: <1 mVAC

and physical plant (air conditioning, fire suppression, alarms, enclosures and buildings). This will distill your previous list into a more workable lump of related parts.

Now the fun begins. Break out the manufacturer's documentation, your copy of Part 76 and a good portion of common sense. Determine what you want to test for and jot it down within the respective equipment's category. Some ideas might include: RF levels (in and out), video quality and levels, audio quality and levels, RF frequencies, frequency response, receiver AGC/AFC voltage, power supply voltages, microwave frequencies, scrambler and encoder adjustments, physical tower condition, antenna connectors and standby generator operation.

A good source for these ideas is the manufacturer's literature. You're attempting to document things that, like a barometer, show a performance trend. Levels and frequencies are the best examples of this. A complete "stem to stern" investigation of each piece of equipment isn't necessary. Think about things that often get overlooked: loose or poor connections, a failing power supply, a rising AGC voltage or a bone-dry standby generator starter battery. Keep it as simple and direct as possible.

The next step is to decide how often to do each test. Use the longest interval you can comfortably afford. It makes poor sense to check monthly each modulator's frequency response. Annually would be a better choice, twice yearly if you're ambitious. Check levels weekly at the least. Daily put the eyeball test on all your signals. Use easily tracked intervals like daily, weekly, monthly, semiannually and annually. Or every Tuesday, June and December, or last thing of the day. Again, the manufacturer's documentation may have some suggestions for each unit.

At this point you should have generated a test matrix similar to Table 1. Whether it's arranged by equipment category, as the example, or by test interval (all daily, weekly and so on grouped together), it is the single document summarizing your program.

Test procedures

Three notes of caution before you begin. First, make sure you have the appropriate, working and calibrated test equipment necessary for each test. Equipment like a signal level meter, oscilloscope, voltmeter and sweep generator/detector setup may be all you need to conduct the majority of your tests. Most systems today own or have access to a spectrum analyzer, frequency counter, waveform monitor, video sweep generator or return loss bridge. Don't specify a test you can't do and/or can probably get along without.

Second, keep the procedure simple. It should not be a how-to manual giving the novice a complete rundown. Rather, it should be a memory jogger for the person who has done the test at least once under your direction and needs a quick reference. This will greatly speed your writing.

Third, do the test and write the procedure as you go, preferably with the technician who will actually do the test. If that tech happens to be you, invite another to watch and assist. This allows your procedure to fit the real world instead of taking an ivory-tower document and forcing it to match the field environment. Each test should occupy a page of its own with any necessary diagrams. Doing this will let you update your document easily as needs change.

Remember the scientific method? Now's the time to dust it off. Table 2 gives an example of what a simple test might look like. Notice the main parts of the test: title, purpose or objective, required equipment, procedure (memory-jogging instructions) and highlighted nominal specifications. Test equipment settings are very important, easily forgotten and should be in the body of the procedure. Think about adding a sentence about what to do if the gadget under test is out of spec. Provide a path of accountability for results.

Having drafted the procedure, do the test again using the finished document and time the tester. You'll need to know how long an experienced tech takes to do each procedure so you can realistically determine overall manpower needs.

You should have a feel for baseline conditions within your plant. How many hours of headend outage time occur each month? How many single-channel service calls come in from customers? How often does commercial power quit and the generator fail to fire up? How many "gremlins" are floating around inside your headend racks ruining picture quality? How often do things mysteriously give up at the worst time?

Validate your effort

Within six months of getting your plan into action, headend problems will occur less and less frequently. Continue to track them to show a steady improvement, validating your effort as a true money and sweat saver. Collect and analyze test results to spot trends before they "rise up to smite thee."

Don't be afraid to pat yourself firmly on the back for a well-done job. Lay your documented results squarely in front of your superiors on a regular basis and thank your high school chemistry instructor. The scientific method *does* have universal applications.

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Commercial insertion and cue tones

By Allen M. Kirby
Executive Vice President
Falcone International Inc.

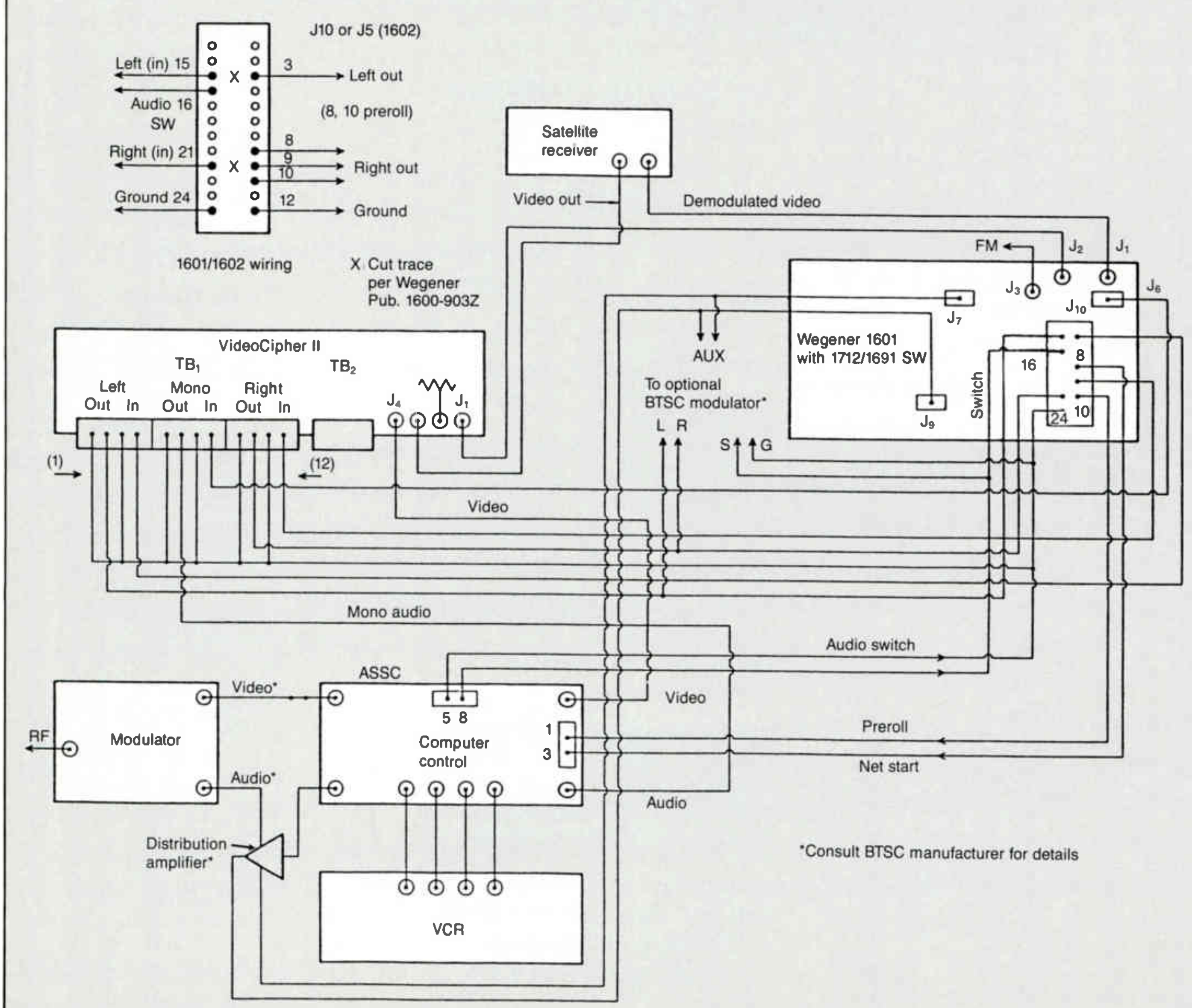
Today it seems that system engineers, chief technicians or headend technicians must spend most of their time in the headend installing new equipment such as FM processors, VideoCipher II (VCII), VCIIC, 6.2 demodulation boards and BTSC stereo equipment. They are most likely not to understand audio/video switching equipment utilized for commercial insertion.

Some cable networks that are used today for ad insertion are: ESPN, CNN, USA, MTV, TNN and CBN. Some of the networks send down audible DTMF (dual tone multiple frequency) tones on the program audio.

Other networks send down the DTMF tone on a subcarrier such as USA (6.2 subcarrer). The 674*/# MTV cue is accomplished by turning off the 19 kHz stereo pilot eight seconds prior to the break. It remains *off* for the entire duration of the break. In order to turn off the 19 kHz pilot, the insertion equipment must receive a contact closure from an external stereo processor. (See Figure 1 for installation wiring.)

CBN in the past has sent down cue tones on program audio (6.8 subcarrier). Since CBN started full-time scrambling, no DTMF cue tones will be present in the program audio except during 11 a.m. and 9 p.m. (ET) breaks. All cue tones

Figure 1: Wegener processor descrambler and commercial insertion for MTV



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will be present on the 6.8 MHz subcarrier audio only. No cue tones will be transmitted on the encoded, scrambled audio channels.

If the local avail insertion equipment must be bridged across the 6.8 MHz demod, the termination resistors should be disabled. Alternatives include a second demod or a passive or active distribution amplifier (Figures 2 and 3).

For more information on local commercial insertion equipment interfacing, see the "Editor's Letter" in the August and September issues of CT.

Figure 2: Local avail generator with low impedance cue input

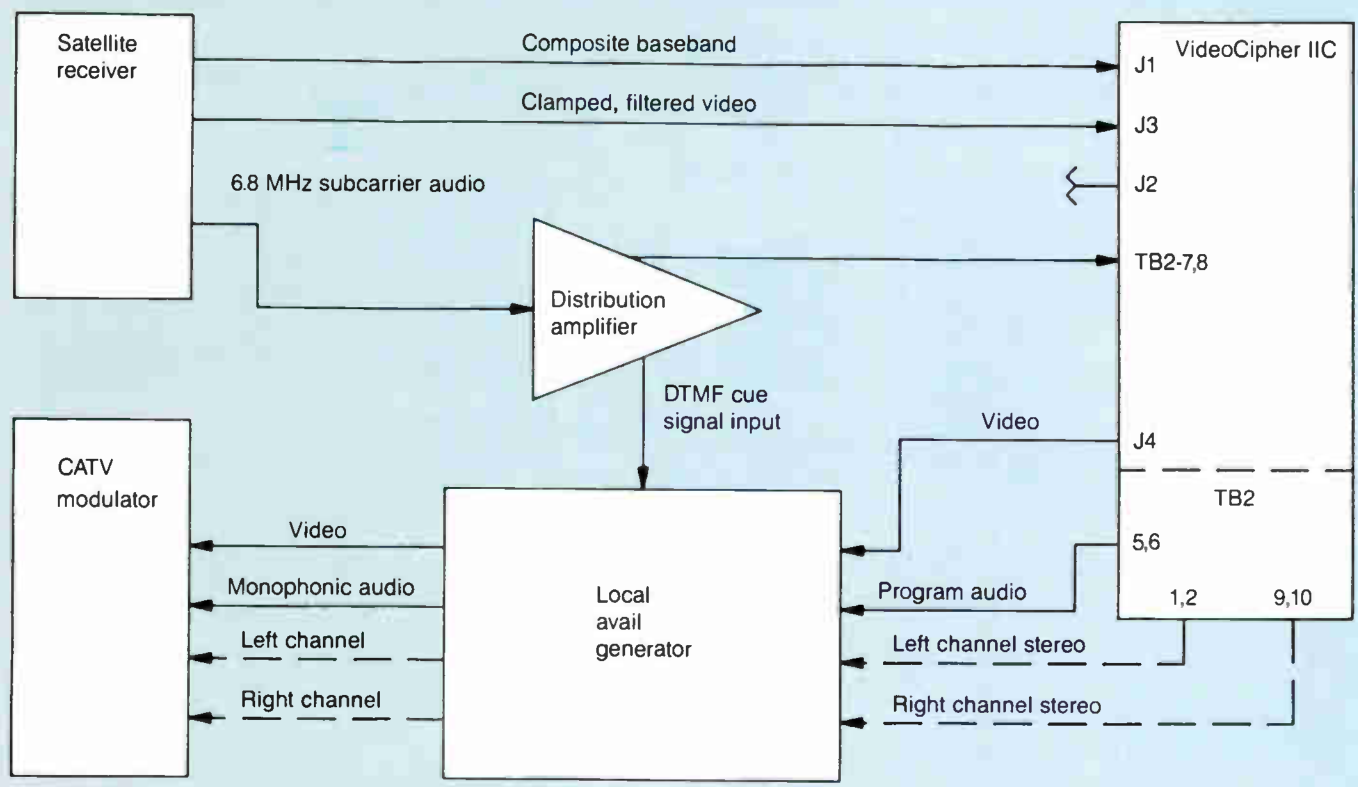
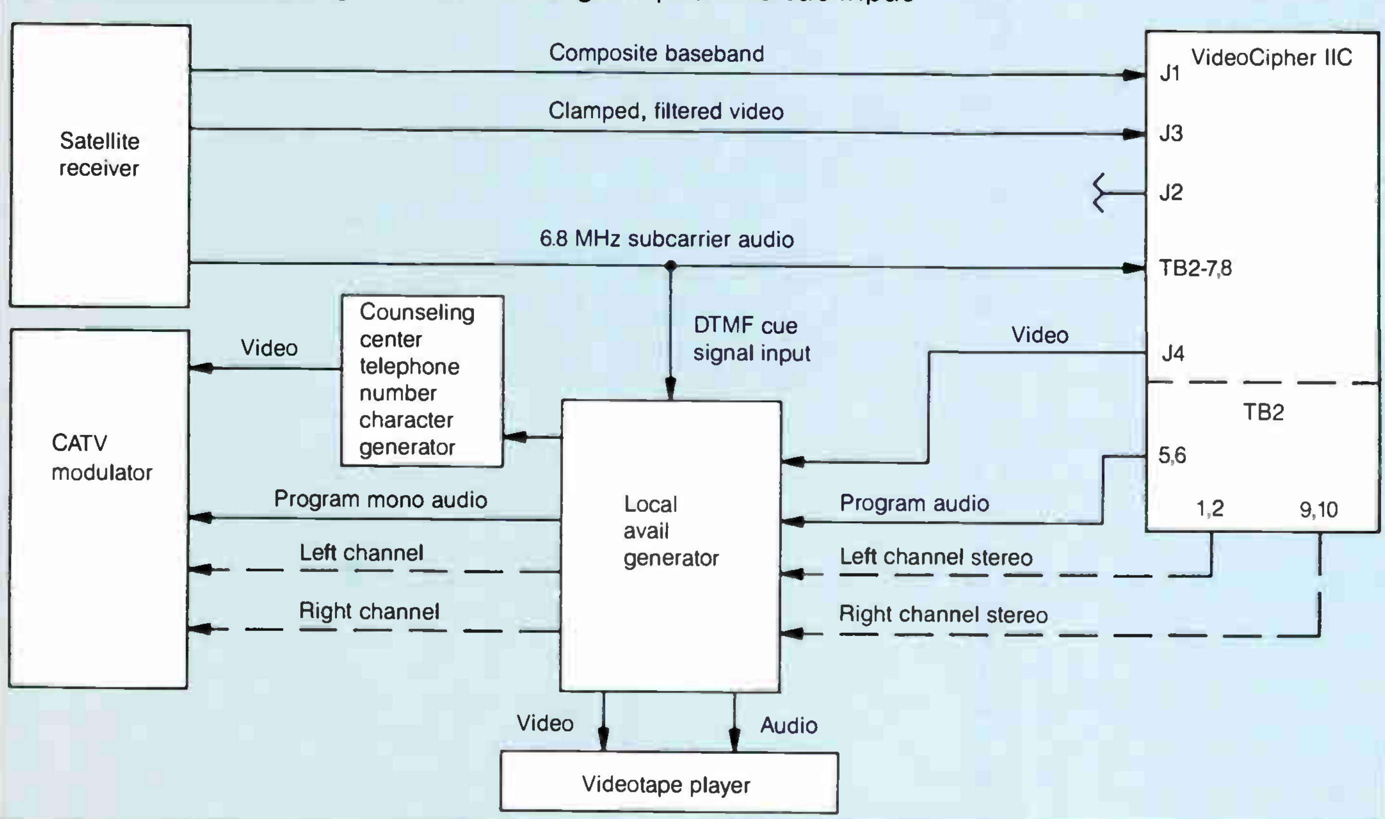


Figure 3: Local avail generator with high impedance cue input



HDTV viewing distance

In this article a minimum viewing distance for a given scan line rate will be determined theoretically. It will be compared with the average viewing distance that both experiments and experience has shown that viewers prefer.

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

To determine the viewing distance requires use of the measured value of the "acuity" of the human eye—its ability to perceive detail. For scenes of sufficient brightness and contrast this value, on average, is approximately one minute of arc (see Figure 1).

To determine S/H (ratio of viewing distance to picture height) in order to be able to just resolve the raster scanning lines:

$$H/L_s = S(R_1)$$

where:
L_s = number of active scan lines
R_1 = radian value of arc minute
= 290.888×10^{-6}

Figure 1: Image with resolving detail of one arc minute

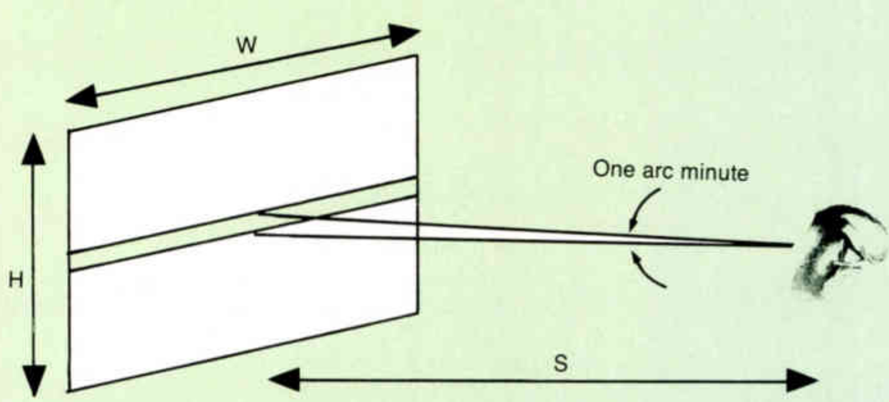


Figure 2: Relationship of active scanning lines to vertical resolution

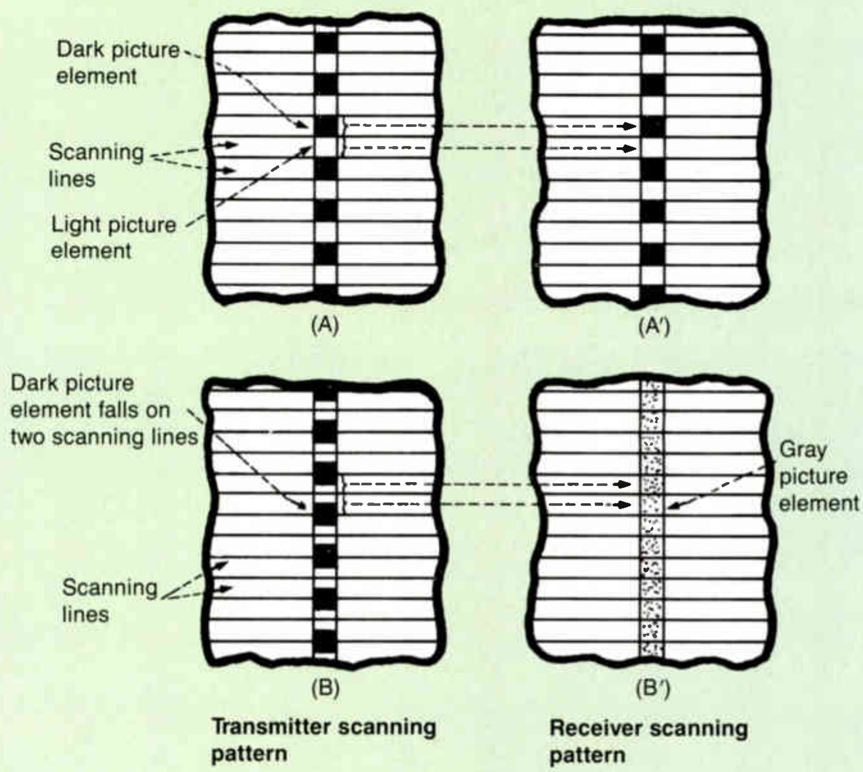


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Table 1: S/H vs. active scan lines for three different resolution conditions

Ls (active scan lines)	100	200	400	600	800	1,000	1,200
Engstrom observations	18.0	9.5	5.0	3.5	2.8	2.3	1.9
Scan line resolution	34.4	17.19	8.6	5.7	4.3	3.44	2.9
Image resolution	91.7	45.8	22.9	15.3	11.5	9.2	7.6

"Average home viewers will probably use HDTV at the same distance as their present NTSC set."

so

$$S/H = \frac{1}{L_s(R_1)} = 3.438 \times 10^3 (L_s)^{-1} \quad (1)$$

To determine the S/H in order to be able to just resolve details in an *image* painted by these scanning lines, several factors must be considered. First, since the resolution of a TV image is generally treated under conditions where the horizontal and vertical resolution are made equal, the analysis here will be of the vertical resolution only. Second to determine—or resolve—a black point from a white point vertically will require *two* scan lines. And lastly the Kell factor must be considered. This factor is named after one of the early experimenters who measured the degradation caused by the scanning process itself. Not all of the active scanning lines are capable of representing separate resolution lines. In the worst case, in fact, the scanning lines may fail to reproduce any resolution line whatever. (See Figure 2.)

Here the object to be televised is a vertical bar containing alternate black and white segments (picture elements) the heights of which are just equal to the thickness of the scanning lines. Consider first the case shown at A in the figure. Here the vertical bar is so positioned with respect to the transmitter scanning pattern that the scanning lines just pass over the respective picture elements. The receiver scanning lines then produce each picture element separately; this is the best possible case. But if, as shown at B, the picture elements are so positioned that each falls equally under two scanning lines, the light perceived by the transmitting scanning spot is a gray intermediate between black and white; this gray tone is reproduced by the receiver scanning spot. The same condition then exists for all the other picture elements on the vertical bar and as a result the segmented bar is reproduced as a bar of uniform gray tone.

In practice, of course, the picture elements are not arranged as equally spaced segments but have random positions depending on the particular details, shape and boundaries in the scene. Then the number of picture elements resolved in the vertical dimension has some intermediate value between the full number of active scanning lines (the best cases) and zero (the worst case). The value determined experimentally by Kell and others is about 75 percent.

Now the S/H for vertical image resolution is found:

$$H/L_r = S(R_1)$$

where:

L_r = image vertical resolution and

$$L_r = (K)\frac{L_s}{2}$$

K = Kell factor (taken here as 0.75)

so

$$S/H = \frac{1}{L_r R_1} = \frac{2}{K(L_s)(R_1)}$$

$$= 9.167 \times 10^3 (L_s)^{-1} \quad (2)$$

Experimental measurements of viewer's choice of S/H

One of the early pioneers of television, E. W. Engstrom, made tests to determine the empirical choice of S/H by a number of viewers[1]. In these tests an ingenious arrangement was set up for projecting motion-picture film through a multiple-

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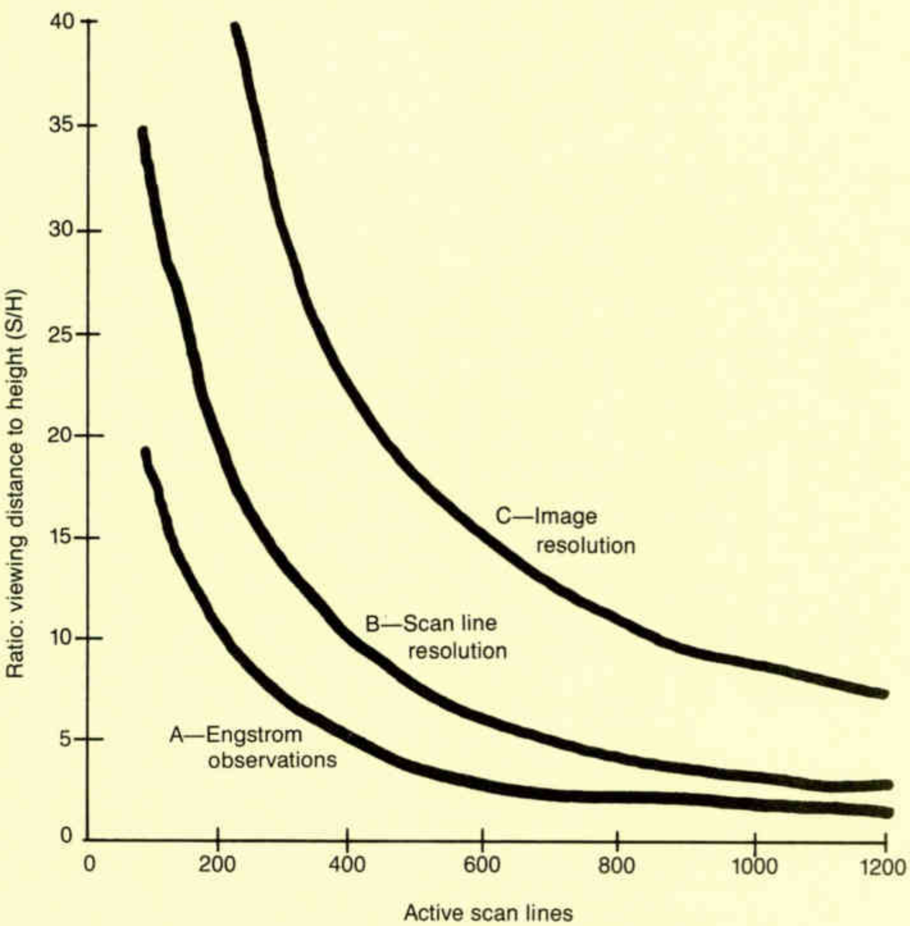
Table 2: Angles of view vs. active scan lines for three different resolution conditions

L_s (active scan lines)		500	600	800	1,000	1,200
	V	13°19′	16°22′	20°46′	24°54′	30°09′
Engstrom	H 4:3	18°04′	21°49′	27°42′	33°13′	40°12′
observations	H 16:9	24°05′	29°32′	36°56′	44°17′	53°36′
	V	8°20′	10°	13°20′	16°40′	20°
Scan line	H 4:3	11°07′	13°20′	17°45′	22°13′	26°40′
resolution	H 16:9	14°49′	17°47′	23°42′	29°38′	35°33′
	V	3°08′	3°45′	5°	6°15′	7°30′
Image	H 4:3	4°10′	5°	6°40′	8°20′	10°
resolution	H 16:9	5°33′	6°40′	8°53′	11°07′	13°20′

Figure 3: S/H vs. active scan lines for three different resolution conditions



lens system of embossed celluloid in such a way that the images appeared to have a line structure similar to that of television images. The results of his experiments are summarized in Table 1 and plotted in Figure 3. Figure 3 also has plots of the theoretical results from Equations 1 and 2.

As can be seen from Equation 2, Table 1 and Figure 3, a normal eye should be able to resolve picture elements in an NTSC 525-line (483 active lines) system if the picture is viewed at any distance less than approximately 20 times picture height. But practical experience shows that this is not the case. In fact, the picture elements (depending on the scene and quality of the monitor) can scarcely be resolved by a normal eye at any distance much greater than four times the picture height. This contradiction of theory is explained by a combination of factors. For instance, in the theoretical approach a high brightness and a high contrast are assumed, neither of which is always the case in the TV image. In addition the "sharpness" or change from black to white (MTF—modulation transfer function) is assumed to be perfect (a square wave) in theory but in real life it is not, since the scanning beam in the camera and the scanning beam in the receiver both introduce "aperture distortions." Also, the electronically reproduced images are not completely stationary even when the scene is static.

Engstrom's experiments show that the picture elements can be resolved at about four times the picture height for an NTSC system of 525 lines (483 active scanning lines). This value agrees closely with the observed habits of television viewers, who usually sit at distances from three to eight times the picture height, with a marked preference for a position at about five times the height.

In early work on high resolution visual systems used for the Apollo astronauts' trainers, TV systems of 1,200 scan lines were used in combination with highly complex optical display systems[2,3]. After significant effort, the overall resolution through the TV/optical system was finally achieved at about 10 arc minutes, which proved more than satisfactory for training for the first lunar landing. (At that time a successful development produced a working 2,000-line TV system[4].)

Viewing angles

To determine the horizontal and vertical angles of view vs. the active scan lines for the two theoretical resolution conditions:

Scan line resolution:

$$H/S = L_s R_1 = 290.889 \times 10^{-6} (L_s)$$

Angle of view: vertical

$$H/S \times \frac{4}{3} = 387.851 \times 10^{-6} (L_s)$$

Angle of view: horizontal/4:3

$$H/S \times \frac{16}{9} = 517.135 \times 10^{-6} (L_s)$$

Angle of view: horizontal/16:9

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Figure 4: Angles of view vs. active scan lines for three different resolution conditions

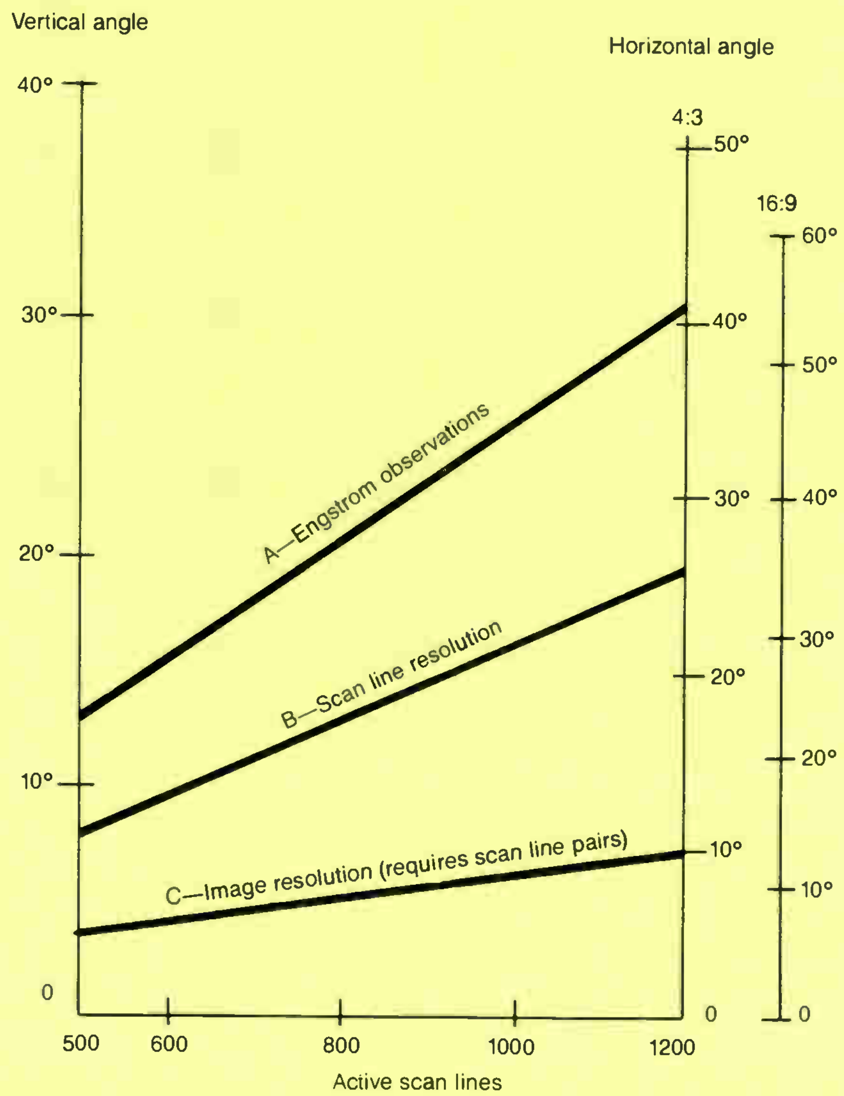


Image resolution

$$H/S = \frac{L_s}{2}(K)(R_1) = 109.083 \times 10^{-6}(L_s)$$

Angle of view: vertical

$$H/S \times \frac{4}{3} = 145.444 \times 10^{-6}(L_s)$$

Angle of view: horizontal/4:3

$$H/S \times \frac{16}{9} = 193.926 \times 10^{-6}(L_s)$$

Angle of view: horizontal/16:9

The values for various angles of view vs. the active scan lines for the three different resolution conditions are shown in Table 2 and plotted in Figure 4.

Recent tests on viewer's responses

In the following observations, the widely used NHK (Japan Broadcasting Corp.) standard will be used: 1,125-line scan with a 16:9 aspect ratio. Dr. Takashi Fujio, director of research for NHK, was in charge of its developmental research on HDTV. He has reported on experiments regarding human visual response at high resolutions and wide aspect ratios[5,6]. In essence, much of this is a more sophisticated update of Engstrom's work.

The optimum number of scanning lines and corresponding viewing distance requirements were determined by a number of picture-quality evaluation tests using an experimental high-resolution monochrome TV system operating with variable scanning lines and interlace ratios and, subsequently, an experimental high-definition color TV system. These tests confirmed that the TV system with 1,125 scanning lines and luminance signal bandwidth of 20 MHz (aspect ratio 16:9) is fully acceptable at a viewing distance of 3H.

A subjective evaluation test relating to picture size and aspect ratio was performed by projecting large color transparencies onto a screen (Figure 5).

We know from experience that a movie gives us a powerful feeling of actuality with fine detailed pictures on a large screen in a theater, but it loses its impression and powerfulness on a small TV screen. In general the tests showed that an aspect ratio of 16:9 is more desirable than 4:3 and, as the picture grows larger, the 16:9 ratio

TV bandwidth

There are a number of "cookbook" formulas relating scan line rate, image resolution and bandwidth available from many sources. However, these conventional formulas relate only to an NTSC signal format, i.e., 525/4:3. The following formulas have been derived to provide these relations with any line rate and any aspect ratio. These formulas should prove valuable, particularly when used in conjunction with the viewing distance formulas in a total systems evaluation.

Under the following conditions (from Fink Handbook):

Frame rate is 30 FPS
Horizontal blanking is .18 H
Vertical blanking is .08 V
Kell factor taken as 0.7

"Resolution in a television system is expressed in terms of the maximum number of lines (black and white) which can be seen in a distance across the face of the receiver tube equal to the *tube height*" and where:

Aspect ratio = W/H
Lines/frame = L_F
Image resolution = L_R

- The system bandwidth (BW) for *maximum image resolution* (under the condition where the resolution in the horizontal direction and in the vertical direction are equal) is:

$$BW = (L_F - .08\,L_F)(.7)(W/H)(1 + .18)(.5)(30L_F)$$

$$BW = 11.3988\,L_F^2\,(W/H)$$

$$L_F = .29619\,(BW)^{.5}\,(H/W)^{.5}$$

- The system bandwidth for a *given image resolution* (L_R) is:

$$BW = L_R(W/H)(1 + .18)(.5)(30L_F)$$

$$BW = 17.7\,L_R\,L_F\,(W/H)$$

$$L_R = 56.5 \times 10^{-3}\,L_F^{-1}\,(BW)(H/W)$$

- The number of pixels (TV lines of resolution) from the top to the bottom of an image (L_V) and the number from the left to the right of a horizontal scan line (L_H) are:

$$L_V = L_F(1 - .08)(.7) = .644\,L_F$$

$$L_H = L_R\,(W/H)$$

becomes more effective. It also was concluded from these tests that the visual display with horizontal viewing angles of 20° to 30° begins to produce the psychological effects that gives a sensation of reality.

Using a horizontal viewing angle of 30°, then the vertical viewing angle is 16.875°, so:

$$H/S = 294.524 \times 10^{-3}$$

and

$$S/H = 3.4$$

It is interesting to note (from Table 1 and Figure 3) that this NHK S/H is only slightly larger for the HDTV rates than that from the early tests by Engstrom. From this we can determine formulas for image dimensions vs. viewing distance for both the empirical conditions determined by the NHK experiments and the theoretical values obtained from Equation 2.

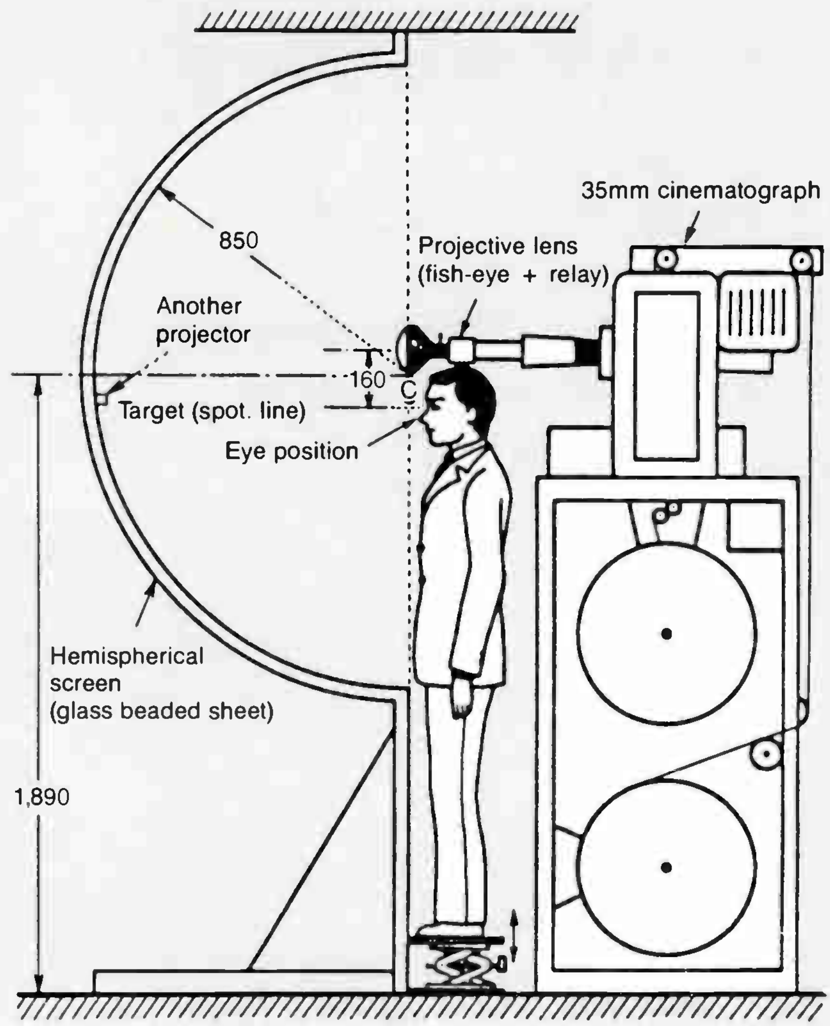
They are:

NHK:
Height = 294.524×10^{-3} (S)
Width = 523.6×10^{-3} (S)
Diagonal = 600.75×10^{-3} (S)

Theoretical:
Height = 112.901×10^{-3} (S)
Width = 200.71×10^{-3} (S)
Diagonal = 230.293×10^{-3} (S)

From this data it is apparent that HDTV at the NHK S/H is really yielding an effective resolution of about 2.5 arc minutes rather than the theoretical limit of one arc minute. The predicted resolution at the HDTV rate from Engstrom's observations is about 3.85 arc minutes, but the NHK experimental results are closer to the theoretical results for the scan line resolution condition.

Figure 5: Apparatus creating an experimental visual wide-field display



Conclusions

The ratio of the viewing distance to the picture height (S/H) for HDTV is different than that for NTSC. Experimental observations and tests show that the S/H for HDTV is about 3.4, and experience shows that the S/H for NTSC is about 5. Applying these results to the average home viewer's circumstances reveals an interesting conclusion. Obviously at a constant viewing distance, HDTV will require a larger picture than that for NTSC. Average home viewers will probably use HDTV at the same distance as their present NTSC set. After all, the living room, den or whatever TV set location (and its other furniture) is already there and will unlikely be changed much, if at all, for the new TV set.

If the 16:9 ratio were used at the NTSC 525-line (483 active lines) rate, the S/H for NTSC would apply (yielding a much smaller horizontal viewing angle than the one from the HDTV S/H) and the psychological sensation of reality determined by the NHK experiments (which requires horizontal viewing angles of 20° to 30°) would be greatly reduced. If the viewing distance were reduced so that the S/H in these circumstances were made that of HDTV (~3.4) so that the horizontal viewing angle increased to the 20° to 30° determined by the NHK experiments necessary for the psychological sensation of reality, then the vertical resolution would be inadequate. Viewed at the NTSC S/H, as would be required, the psychological value of the wider picture would be an improvement over the NTSC 4:3 aspect ratio but short of the psychological sensation of reality determined both by the NHK experiments and experience with movies in theaters. There is no free lunch. To obtain the full feeling of actuality, both the 16:9 aspect ratio *and* the definition produced by the high line rate are required. The higher resolution of the HDTV high line rate is required to obtain the reduced S/H, which in turn permits the wider angle view required for the full feeling of actuality.

Applying some typical figures to the previous equations for image dimensions in the NHK example yields the following:

If the current TV set is a 25" diagonal (with a mask yielding an H of 16") then at an S/H of 5 the viewing distance would be just under 7 feet (80"). At the same distance for an HDTV the H is 23.5" and the diagonal is 48". These larger values reflect the direction that the size of the home screen is going—that is, people are interested in and buying TV sets with larger and larger screens. Hence it follows that the HDTV requirements for a larger screen than that required for NTSC at the same viewing distance is going to fulfill the requirements that are being imposed by the direction of the market.

References

[1] "A Study of Television Image Characteristics," E.W. Engstrom, *Proceedings of the IRE*, Part I, December 1933, Part II, April 1935.

[2] "Apollo Mission Simulation with Visual Presentation," R.D. McCafferty and L.W. Lockwood, SMPTE, February 1970.

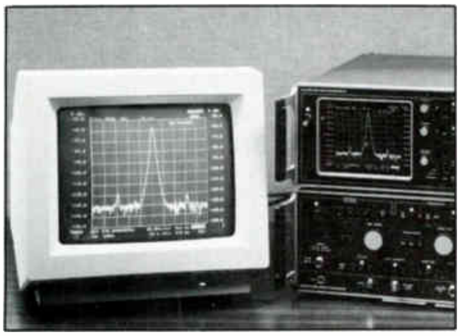
[3] "Visual Simulation in the Lunar Module Mission Simulator," L.W. Lockwood and R.D. McCafferty, ISA, October 1969.

[4] "Very-High-Resolution Television for Visual Simulation," L.W. Lockwood and M.L. Noble, SMPTE, April 1970.

[5] "The NHK High-Resolution Wide-Screen Television System," T. Fujio, *Television Technology in the '80s*, SMPTE, 1981.

[6] "High-Definition Television Systems," T. Fujio, *Proceedings of the IEEE*, April 1985.

[7] "The Kell Factor: Past and Present," S.C. Hsu, SMPTE, February 1986.



Color monitor

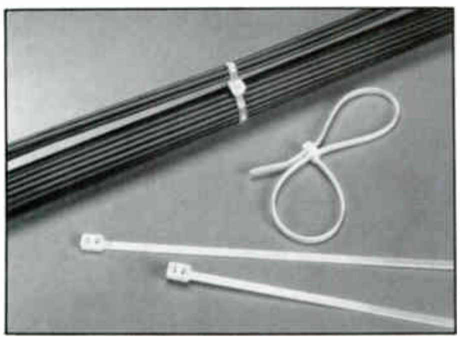
Marconi Instruments announced the availability of a color monitor option for its Model 2382 spectrum analyzer. The 13-inch monitor is a high-resolution CRT with a 0.3 mm dot pitch and features a self-convergence in-line gun to eliminate convergence adjustment, low power consumption and a high-voltage stabilizer.

For more details, contact Marconi Instruments, 3 Pearl Ct., Allendale, N.J. 07401, (201) 934-9050; or circle #106 on the reader service card.

Application notes

Leader Instruments is offering its series of six Teleproduction Test application notes, designed to augment available technical information in the application of video test equipment. Basic concepts and routine test procedures are explained, and shortcuts to complex VCR and video camera alignment procedures are offered. The notes are a free service to the video industry in order to explain in a comprehensive manner the use and various applications of video test equipment.

For further information, contact Leader Instruments, 380 Oser Ave., Hauppauge, N.Y. 11788, (516) 231-6900; or circle #103 on the reader service card.



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Panduit is offering its new line of Pan-Ty double loop cable ties for securing and separating multiple wire bundles, cables or tubing. Two sizes are available for up to a maximum combined bundle diameter of 3.8 inches; the ties have a minimum loop tensile strength of 50 pounds.

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Test software

Monarch Communications is offering its computer-aided test and analysis system. It is capable of performing all cable-related test functions using a basic Lap computer, a Sencore signal analyzer and a computer interface module. All required system test parameters (including video and audio levels, audio/video ratio, signal-to-noise, hum, composite triple beat, FCC frequency offset and graphics) can be performed either automatically or manually.

In the automatic mode, up to 60 channels can be scanned, recording all pertinent data and storing it for later use; each channel is tested within 30 seconds. Also, the system can be tested remotely via phone modem.

For more information, contact Monarch Communications, 2009 Sherman St., Simi Valley, Calif. 93065, (805) 254-8470 or (805) 584-9567; or circle #123 on the reader service card.

Character generator

Dickel Communications introduced its Model CMS-1 character generator, a modified Radio Shack computer with 64K memory designed to present custom information and/or advertising messages on any TV screen. Features include 60 pages, four character sizes, 12 color options, variable page sequence, variable dwell time crawl lines, splash lines, battery backup and remote communications.

For more details, contact Dickel Communications, 2458 Lomita Blvd., Suite 223, Lomita, Calif. 90717, (213) 327-7649; or circle #95 on the reader service card.

Converter

The VX Series V-7472 from Universal Security Instruments is said to add wireless remote control of channel selection, fine tuning, volume control and on/off power to any TV. Other features include: a 90-minute sleep timer, 72-channel capability, ability to add stereo and remote control to Channels 2-65 and automatic MTS/mono audio sensing and secondary audio programming.

For more information, contact Universal Security Instruments, 10324 S. Dolfield Rd., Owings Mills, Md. 21117, (301) 363-3000; or circle #88 on the reader service card.

Bandpass filter

Microwave Filter Co. is offering its Model 5276 bandpass filter, designed to reduce spurious signals from a LAN translator. Its center frequency is 267.2 MHz with a 3 dB bandwidth of 1.5 MHz.

For more information, contact Microwave Filter, 6743 Kinne St., East Syracuse, N.Y. 13057, (315) 437-3953; or circle #101 on the reader service card.

Commercial inserter

Texscan MSI is offering its ComSerter 192 commercial inserter. The product incorporates all of the features of its ComSerter 92, plus has full stereo VCR capabilities, CMOS non-volatile memory and tape marking. It also provides auxiliary source input (graphic and character generators and satellite inputs), and preview-before-air of inputs.

According to the company, the product implements improved FSK tape marking capabilities, which enables multiple dubbing without degradation of data. The use of time base correctors is possible through an external processor loop.

For further information, contact Texscan MSI, 124 N. Charles Lindbergh Dr., Salt Lake City, Utah 84116, (801) 359-0077; or circle #89 on the reader service card.

Signal level meter

According to Wavetek, its new MicroSAM signal level meter allows installers to more accurately check all connections at hookup. The meter measures digitally accurate signal levels to ±1.0 dB with 0.1 dB resolution and has three frequencies to test signal levels. Installers may set their own channels to 550 MHz.

To set the channels on the meter, the user must first remove the input connector, pry up the black snap rivet and remove the programming switch access cover. The user can then refer to the programming switch table, select the desired channels and position the switches. The final step is to replace the front access cover and input connector.

For more information, contact Wavetek RF Products Inc., 5808 Churchman Bypass, Indianapolis, Ind. 46203-6109, (317) 788-9351; or circle #86 on the reader service card.

Video distribution

The Model VDS-1 multiple video distribution system from Pico Macom combines the RF signals from an off-air antenna with those of two other sources into one signal. The sources can be either a cable TV system, satellite receiver or VCR. The combined signal is then amplified and distributed via two outputs throughout the home. The product allows simultaneous viewing and recording of programs from the various sources to multiple locations within the home.

For more information, contact Pico Macom, 12500 Foothill Blvd., Lakeview Terrace, Calif. 91342, (818) 897-0028; or circle #127 on the reader service card.

Cable knife

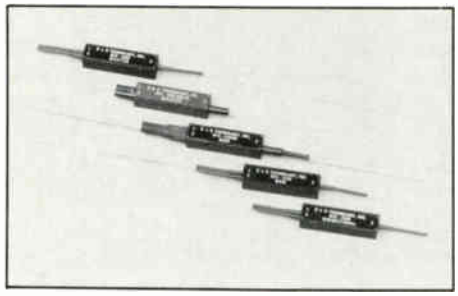
Cable Buddy from American Safety Knife is designed to allow a technician to remove the polyethylene jacket from a coaxial cable and the dielectric from around the center conductor without scoring or scratching the aluminum sheath. It also can be used when preparing a drop cable for removal of the PVC jacket and the dielectric around the center conductor.

For more information, contact American Safety Knife, P.O. Box 381816, Duncanville, Texas 75138-1816; or circle #100 on the reader service card.

RF amplifier

TIW Systems introduced its Model VHP-05 high-power RF amplifier, said to be ideal for CATV distribution networks, local area network repeater sites and last mile distribution of any video or broadband signal. The product features a 40 to 400 MHz bandwidth, 1 watt continuous output and 34 dB nominal gain. Thermal packaging allows the amp to work at 50°C with convection cooling. It comes with 75-ohm input and output impedance and a choice of BNC, SMA or F connectors.

For more details, contact TIW Systems, 1284 Geneva Dr., Sunnyvale, Calif. 94089, (408) 734-3900; or circle #109 on the reader service card.



FO couplers

G & H Technology is offering its bidirectional couplers for use in fiber-optic data communications. The couplers are based on expanded beam technology, using graded index lenses, beam splitters and dichroic mirrors. According to the company, they have rugged, molded plastic housings filled with optical-quality epoxy for superior performance in hostile environments.

For further information, contact G & H Technology, 750 W. Ventura Blvd., Camarillo, Calif. 93010, (805) 484-0543; or circle #118 on the reader service card.

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Hartnett

Scientific-Atlanta appointed **Raymond Hartnett** corporate senior vice president and chief financial officer. Previously, he was senior vice president of finance with Copeland Corp. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

The **National Cable Television Association** named **Decker Anstrom** as its executive vice president. He is currently president of Public Strategies, a Washington D.C.-based public policy consulting firm.

Brenda Fox, general counsel, added the title of vice president for special policy projects. **Phylis Eagle**, executive director for administrative services, became a vice president.

Jim Allen was appointed director of the Office of Cable Signal Theft and executive director of the Coalition Opposing Signal Theft Advisory Board. He was formerly director of security for United Cable's Connecticut operations.

Megan Stevens Hookey was named director of industry communications. Prior to this, she was corporate manager of training with Harron Communications in Paoli, Pa. Contact: 1724 Massachusetts Ave., N.W., Washington, D.C. 20036, (202) 775-3629.

MacKenzie Leathurby was appointed audio product manager for **FOR-A Corp.** Most recently, he served as sales representative for LaSalle Audio Systems and Music.

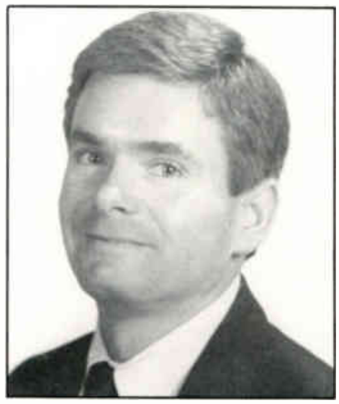
Don Marr was named Central region sales manager. Prior to this, he was a sales representative in the Midwest for Ikegami Electronics. Contact: Nonantum Office Park, 320 Nevada St., Newton, Mass. 02160, (617) 244-3223.

Chyron Corp. appointed **Mary Ahern** Northeastern regional sales manager for its Video Products division. She has been with the company since January 1985 in sales and graphic design.

Andrea Geiger was appointed Central and Southeastern regional sales manager for the division. Prior to this, she was a sales representative for the division. Contact: 265 Spagnoli Rd., Melville, N.Y. 11747, (516) 694-7137.

Centro Corp. named **John Harris** executive vice president/general manager. He was previously with Sony Broadcast and Sony Communications Products.

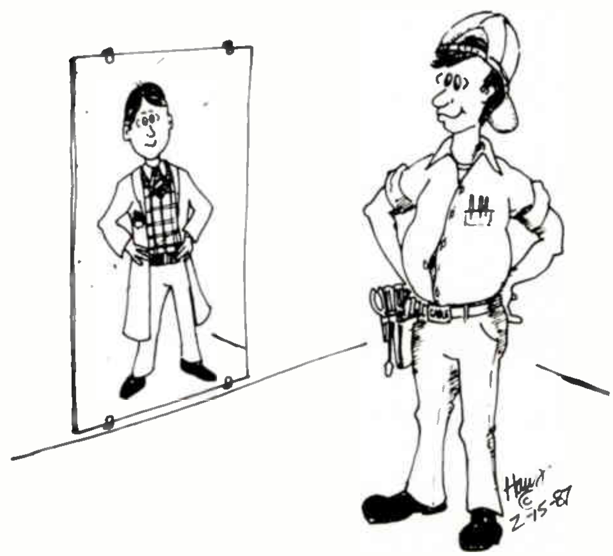
Curtis Chan was appointed vice president of marketing and product development. Formerly, he was product manager at Sony Communications Products Co. Contact: 369 Billy Mitchell Rd., Salt Lake City, Utah 84116, (801) 537-7779.



Nicholas

Pioneer Communications of America appointed **David Nicholas** as national sales manager for its Cable Television division. Previously, he was national sales manager for the CATV Group at Panasonic. Contact: Sherbrooke Office Centre, 600 E. Crescent Ave., Upper Saddle River, N.J. 07458-1827, (201) 327-6400.

the O.K. BULL CORRAL



REFLECTIONS.. HOW THE INSTALLER SEES HIMSELF

Courtesy Parallex

Power addition

By Ron Hranac and Pam King
Jones Intercable Inc.

Combining unlike carrier-to-noise (C/N) ratios is accomplished using a technique known as *power addition*. For example, determining the final C/N ratio of a 30 amplifier trunk cascade, bridger and line extender would be done using power addition. One way to do this is with the following chart; another way is to work through the standard power addition formula. Examples of each are shown on the next page.

dB diff.	.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	3.0103	2.9606	2.9115	2.8629	2.8149	2.7675	2.7207	2.6744	2.6287	2.5836
1	2.5390	2.4836	2.4287	2.3744	2.3207	2.2675	2.2149	2.1629	2.1115	2.0606
2	2.1244	2.0860	2.0481	2.0108	1.9740	1.9378	1.9020	1.8668	1.8322	1.7980
3	1.7643	1.7312	1.6986	1.6665	1.6349	1.6037	1.5731	1.5430	1.5133	1.4841
4	1.4554	1.4272	1.3994	1.3721	1.3452	1.3188	1.2928	1.2673	1.2422	1.2175
5	1.1933	1.1695	1.1461	1.1231	1.1005	1.0783	1.0565	1.0351	1.0141	0.9935
6	0.9732	0.9533	0.9338	0.9146	0.8958	0.8774	0.8592	0.8415	0.8240	0.8069
7	0.7901	0.7736	0.7575	0.7416	0.7261	0.7108	0.6959	0.6812	0.6668	0.6527
8	0.6389	0.6254	0.6121	0.5991	0.5863	0.5738	0.5616	0.5496	0.5378	0.5263
9	0.5150	0.5039	0.4931	0.4824	0.4720	0.4618	0.4519	0.4421	0.4325	0.4231
10	0.4139	0.4049	0.3961	0.3875	0.3790	0.3708	0.3627	0.3548	0.3470	0.3394
11	0.3320	0.3247	0.3175	0.3106	0.3037	0.2971	0.2905	0.2841	0.2779	0.2717
12	0.2657	0.2599	0.2541	0.2485	0.2430	0.2376	0.2323	0.2272	0.2221	0.2172
13	0.2124	0.2077	0.2030	0.1985	0.1941	0.1898	0.1856	0.1814	0.1774	0.1734
14	0.1695	0.1658	0.1621	0.1584	0.1549	0.1514	0.1480	0.1447	0.1415	0.1383
15	0.1352	0.1322	0.1292	0.1263	0.1235	0.1207	0.1180	0.1153	0.1128	0.1102
16	0.1077	0.1053	0.1030	0.1006	0.0984	0.0962	0.0940	0.0919	0.0898	0.0878
17	0.0858	0.0839	0.0820	0.0801	0.0783	0.0766	0.0748	0.0731	0.0715	0.0699
18	0.0683	0.0667	0.0652	0.0638	0.0623	0.0609	0.0595	0.0582	0.0569	0.0556
19	0.0543	0.0531	0.0519	0.0507	0.0496	0.0485	0.0474	0.0463	0.0452	0.0442
20	0.0432	0.0422	0.0413	0.0403	0.0394	0.0385	0.0377	0.0368	0.0360	0.0352
21	0.0344	0.0336	0.0328	0.0321	0.0313	0.0306	0.0299	0.0293	0.0286	0.0280
22	0.0273	0.0267	0.0261	0.0255	0.0249	0.0244	0.0238	0.0233	0.0227	0.0222
23	0.0217	0.0212	0.0207	0.0203	0.0198	0.0194	0.0189	0.0185	0.0181	0.0177
24	0.0173	0.0169	0.0165	0.0161	0.0157	0.0154	0.0150	0.0147	0.0144	0.0140
25	0.0137	0.0134	0.0131	0.0128	0.0125	0.0122	0.0119	0.0117	0.0114	0.0111
26	0.0109	0.0106	0.0104	0.0102	0.0099	0.0097	0.0095	0.0093	0.0091	0.0089
27	0.0087	0.0085	0.0083	0.0081	0.0079	0.0077	0.0075	0.0074	0.0072	0.0070
28	0.0069	0.0067	0.0066	0.0064	0.0063	0.0061	0.0060	0.0059	0.0057	0.0056
29	0.0055	0.0053	0.0052	0.0051	0.0050	0.0049	0.0048	0.0047	0.0045	0.0044
30	0.0043	0.0042	0.0041	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036	0.0035

Examples

Problem
What is the combined carrier-to-noise ratio of a trunk cascade and single bridger amplifier, assuming the following conditions?

Trunk cascade C/N ratio = 50.0 dB
Single bridger amplifier C/N ratio = 62.0 dB

Solution
First, calculate the difference between the two ratios (62.0 − 50.0 = 12.0). Locate "12" in the left column of the chart, and ".0" in the top row; moving acrosss and down from these numbers you will find 0.2657. Next, subtract 0.2657 from the *lower* of the two C/N ratios (50.0 − 0.2657 = 49.7343). The combined C/N ratio of the trunk cascade and bridger amplifier is 49.7 dB.

Problem
What is the total C/N ratio of the above trunk cascade and bridger, plus a line extender whose C/N ratio is 57.0 dB?

Solution
Calculate the difference between the two ratios (57.0 − 49.7 = 7.3). Locate "7" in the left column of the chart and "0.3" in the top row; moving across and down from these two numbers you will find 0.7416. Subtract 0.7416 from the *lower* of the two ratios (49.73 − 0.7416 = 48.99). The total combined C/N ratio of the trunk cascade, bridger and line extender is 48.9 dB.

Problem
Calculate the total combined C/N ratio of the above trunk cascade, bridger and line extender using the standard power addition formula.

Solution
Use the formula

$$\begin{aligned}
C/N_{TOTAL} &= -10\log_{10}\left(10^{\frac{-C/N_1}{10}} + 10^{\frac{-C/N_2}{10}} + 10^{\frac{-C/N_3}{10}}\right) \\
&= -10\log_{10}\left(10^{\frac{-50.0}{10}} + 10^{\frac{-62.0}{10}} + 10^{\frac{-57.0}{10}}\right) \\
&= -10\log_{10}\left(10^{-5} + 10^{-6.2} + 10^{-5.7}\right) \\
&= -10\log_{10}(0.00001 + 0.000000631 + 0.000002) \\
&= -10\log_{10}(0.0000126) \\
&= -10(-4.899) \\
&= 48.99 \text{ dB}
\end{aligned}$$

AD INDEX

CALENDAR

November

Nov. 12: SCTE Cactus Chapter seminar on emerging technology with emphasis on feedforward, Republic Cable, Glendale, Ariz. Contact Chris Radicke, (602) 938-0777.

Nov. 12: SCTE Upstate New York Meeting Group technical seminar. Contact Ed Pickett, (716) 325-1111.

Nov. 17-19: C-COR Electronics technical seminar, Houston. Contact Shelley Parker, (814) 238-2461.

Nov. 17-20: Jerrold technical seminar on applying problem-solving technology in hands-on sessions, George Washington Motor Lodge, Willow Grove, Pa. Contact Jerry McGlinchey, (215) 674-4800.

Nov. 18-19: The first convention of Great Britain's **Cable Television Association** will be held in London. Contact CTA, 01-4370549 or 01-4370983.

Nov. 24: SCTE Satellite Tele-Seminar Program, "Interference elimination with antennas and antenna arrays," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

Planning ahead

Dec. 2-4: Western Show, Convention Center, Anaheim, Calif.
Feb. 17-19: Texas Show, Convention Center, San Antonio, Texas.
April 30-May 2: NCTA Show, Convention Center, Los Angeles.
June 16-19: SCTE Cable-Tec Expo, Hilton Hotel, San Francisco.

December

Dec. 2-4: Western Show, Anaheim Convention Center, Anaheim, Calif. Contact Rhonda Gibson, (415) 428-2225.

Dec. 5: SCTE Cactus Chapter BCT/E review course and testing on Category IV-Distribution Systems. Contact Chris Radicke, (602) 938-0777.

Dec. 9: SCTE Chattahoochee Chapter technical seminar. Contact Guy Lee, (404) 451-4788.

Business Directory

What ISDN means for cable

By Walter S. Ciciora, Ph.D.
Vice President of Strategy and Planning
American Television and Communications Corp.

In the last couple of columns I've discussed digital delivery of video and the impact of digital technology on consumer products. This month I'd like to take a look at the role of digital technology in the business of an important potential competitor, the telephone industry. I want to speculate a *bit* (excuse the pun) on what this may mean for cable.

ISDN, integrated services digital network, is the telephone industry's technical standard intended to significantly increase the breadth of services the telcos provide. There are two major layers to ISDN. The first is *narrowband ISDN*, which is usually referred to as simply "ISDN." The second layer is *broadband ISDN* or B-ISDN. While it's the second layer that causes the most concern for cable because it is video-capable, the first layer is presently being implemented and paves the way for B-ISDN. The telcos hope to use ISDN to deliver most of the non-video services cable tried over the last decade.

It's fun to create deprecating twists to acronyms. Some that have come up for ISDN include: "Innovations Subscribers Don't Need" and "I Still Don't kNow." But it's important to seriously consider ISDN after we have our chuckle and not let the humor bring us to a head-in-the-sand attitude.

ISDN is intended to provide high-featured digital service to residential and business customers over ordinary copper twisted pairs. The data rate delivered is 144 kilobits per second (kbps). The data is partitioned into three streams: two channels of data at 64 kbps and one of control information at 16 kbps. The data channels are "B channels" while the control channel is a "D channel." The combination is called a (2B + D) basic rate service.

B channels can carry digitized voice or data. Having the capacity to handle two B channels means that two simultaneous voice circuits can be implemented on the same copper twisted pair. The D channel contains signaling information used to set up the phone call through the telephone network and to facilitate a wide variety of enhanced services. For the large business customer, a primary rate service is defined as (23B + D), with a much higher capacity of 1.544 megabits per second (Mbps).

So who needs it? Well, first off, the business customer will be able to use the two phone "line" capability for each desk. For a large number of locations, the second B channel will allow simultaneous voice and access to the mainframe computer or to other personal computers. But the signaling features will pay for ISDN all by themselves.

In the average company, 15 percent of its employees move every year. Additionally, 10 percent of whole facilities move each year. These rearrangements involve extensive reconnecting costs and delays in service. With ISDN, phone subscribers will be able to unplug the phone, move it to a new location (inside the same facility or to another building), punch in a few simple codes and they're immediately in business with the old phone number. Since the D channel carries information about the calling party, the called party knows who is calling.

This permits a number of interesting features. The subscriber can create lists of callers who will receive different responses. Distinctive phone rings alert the subscriber to priority calls; non-priority calls can be given prearranged messages. Another feature has been called "reject-a-jerk"; non-recognized or specified numbers can be given busy signals anytime they call! (The impact on telemarketing may be severe.) All the usual enhanced features such as conference calling, speed number lists, last call dialed, periodic redialing of busy numbers, lowest-cost call routing for long distance, etc., also will be available.

For the residential customer, the primary attractions of ISDN are dual phone lines, new services and, in some cases, work-at-home personal computer links to the office. The proposed new services include those that cable tried over the last decade: residential security, medical and fire department automated calling, emergency alert, home banking, home shopping, the ordering part of pay-per-view, some form of videotext, etc. The cable industry is not alone in having a penetration issue. For the telephone industry, the penetration issue is increasing the number of second phone lines into homes. ISDN is a cost-effective way of accomplishing this growth objective.

Direct competition

So what's this got to do with cable? Copper twisted pairs cannot practically deliver entertainment-quality video. That much is clear. The direct competition from ISDN to cable is only in those areas cable has tried and abandoned. It will be interesting to see if the telcos can find success where cable found disappointment. If there is success, an analysis of the differences between the cable and the telco experience will be very instructive. Was cable simply too early? Was the technology not ready? Was the culture not yet able to accept these services? Was the price too high?

It still may be possible for cable to jump in and compete if a successful path is found. But perhaps telcos will find out again what cable has learned: The subscriber is extremely value-conscious. Most of these "new" services cost more to deliver than subscribers believe they are worth.

"The direct competition from ISDN to cable is only in those areas cable has tried and abandoned."

But narrowband ISDN is not really the source of significant concern; broadband ISDN is where the anxiety builds. B-ISDN is video-capable because of its extremely high data carrying capacity. Data capacities of at least 600 Mbps to the home are under consideration. Eventual capacities in the gigabit-per-second range are possible. Video will be delivered digitally.

While it is important to be concerned about B-ISDN and to prepare for it, there is definitely no cause for panic. There are major bottlenecks to B-ISDN implementation. First, the B-ISDN standards are still under development. It will take several more years before they are firmed up. Also, this work is complicated by its international character. National rivalries slow the process considerably. Second, the electronics for the digital delivery of video must be developed and their cost reduced. Cable is a cost-efficient medium for video delivery. There is a long way to go before digital techniques can be cost-competitive.

And third, B-ISDN must be delivered by fiber optics rather than copper twisted pairs. While fiber will first be used in new construction, the vast majority of existing residences are served by copper twisted pairs. It will take decades to replace the copper plant. But decades have a way of slipping away. We must not squander the time we have to prepare. The best defense is cost-effective, highly penetrated cable service with video quality that can't be beat.

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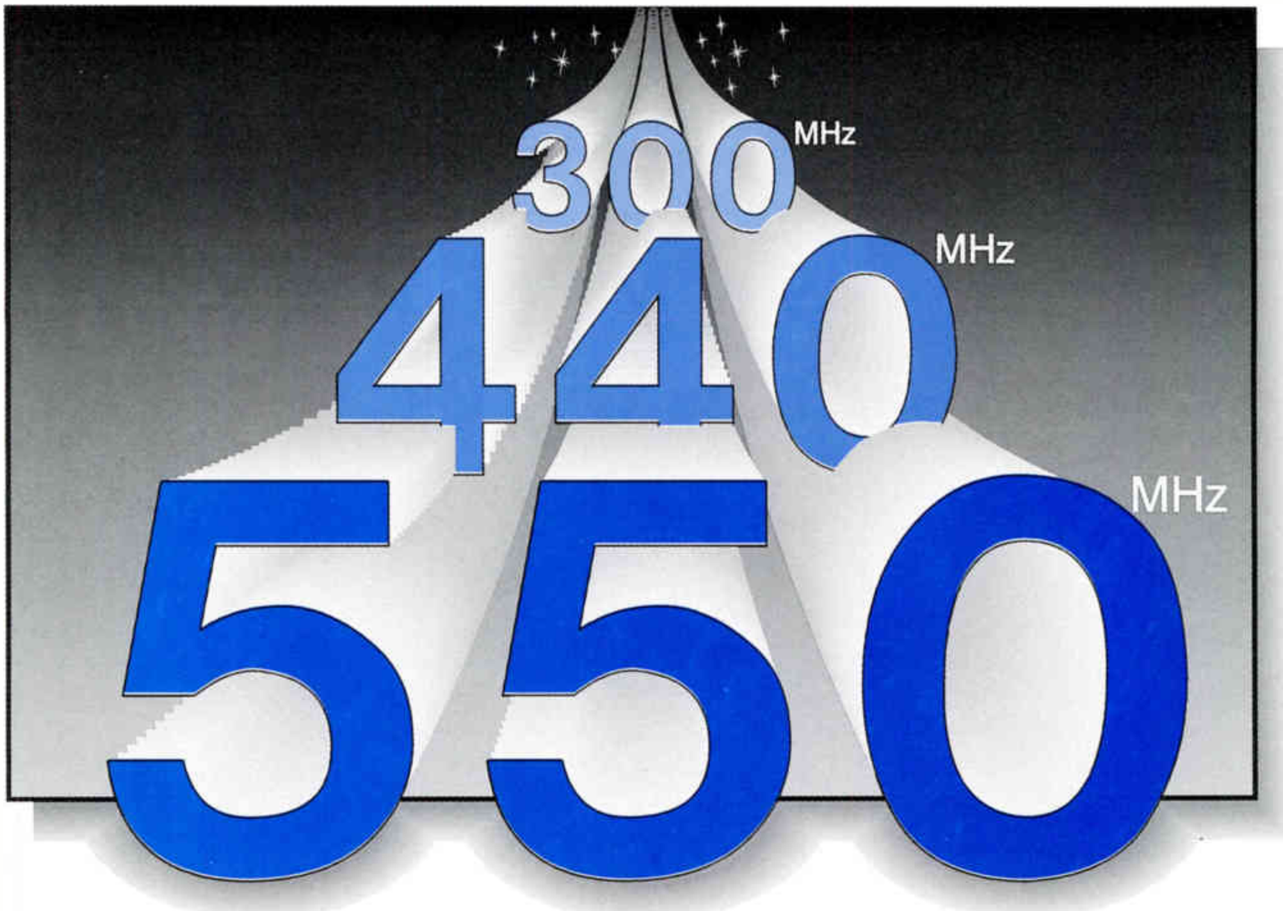

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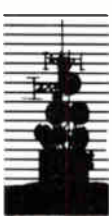

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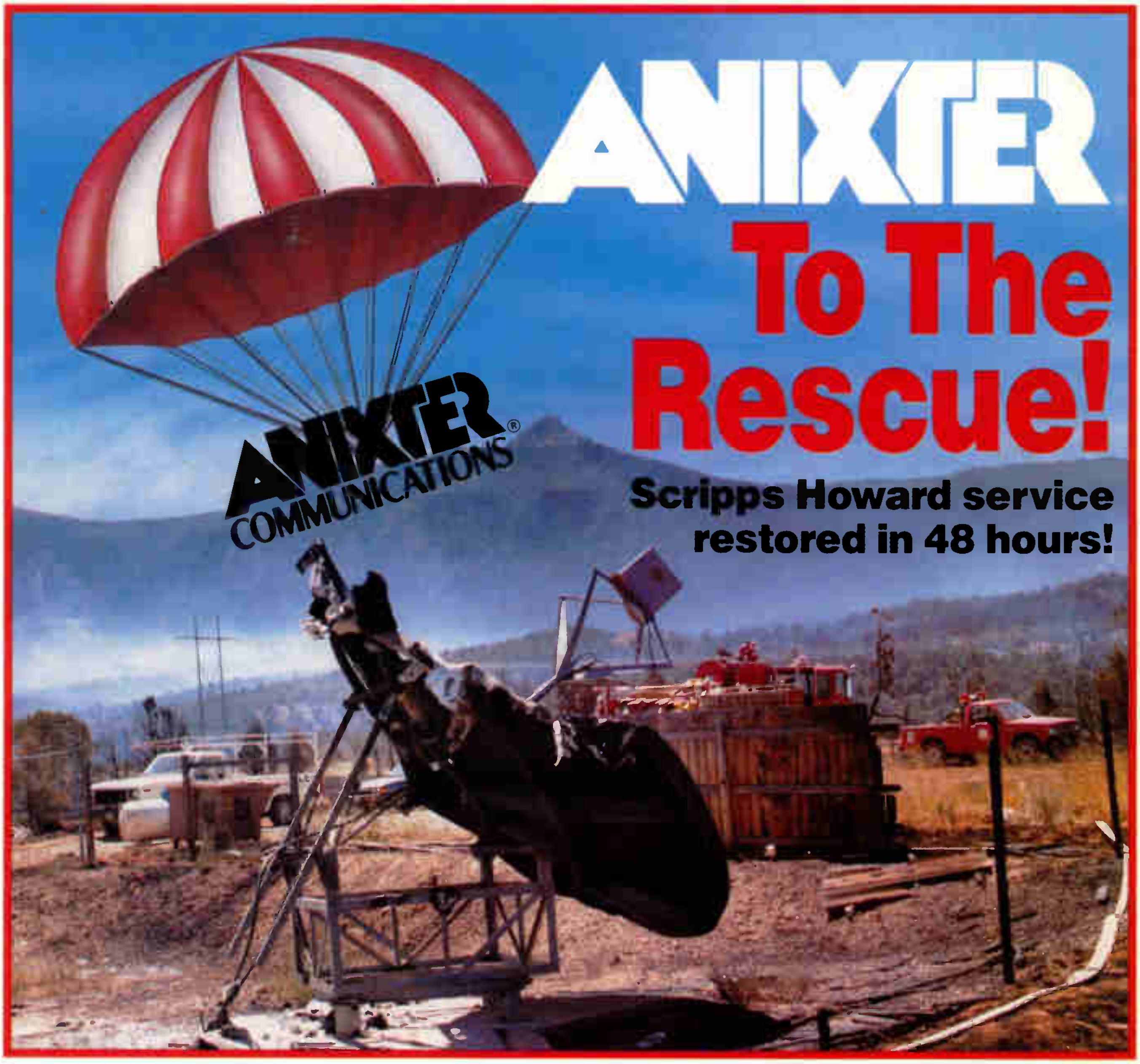

PARACHUTE, CO — Fire destroyed a Scripps Howard cable system, but service to the 900 subscribers here was restored in about 48 hours, a Scripps Howard official said.

A forest fire completely destroyed the cable headend serving Parachute and Battlement Mesa, but Greg Griffin, general manager of Scripps Howard Cable Cos. in Colorado, said help from various vendors and distributors helped get a temporary system in operation. The fire destroyed the headend on Thursday night, July 9, he said. By Friday morning, Anixter Communications was sending out the necessary headend equipment needed to get 30 channels operating.

...Mr. Griffin said it will probably be a couple of months before a new permanent headend is constructed in Parachute, but praised the cooperation he received from Anixter and other vendors that provided equipment quickly and efficiently. "Anixter was great," he said. "Sometimes it takes two weeks to get bags of fittings from some distributors, Anixter had the stuff there the next day."

From MULTICHANNEL News — July 27, 1987

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