COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Cable-Tec Expo '93

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- Architectures for tomorrow's networks
- Cable was there — Supercomm '93
- Troubleshooting the distribution system

June 1993

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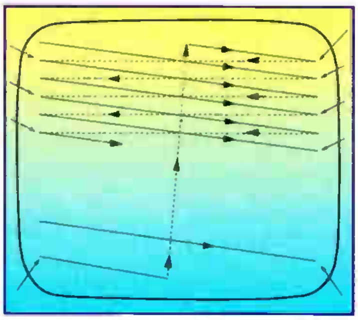

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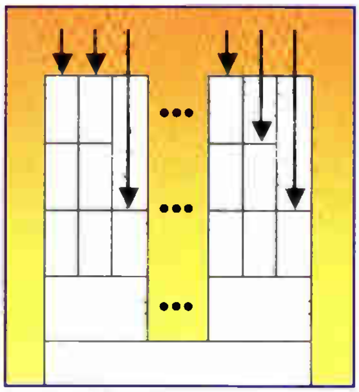

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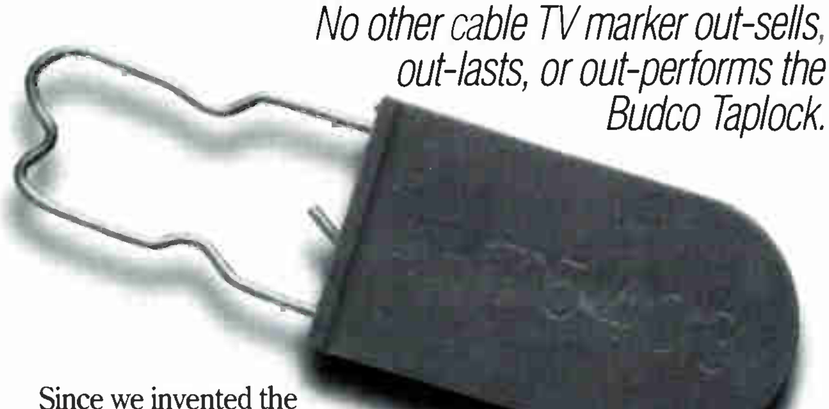

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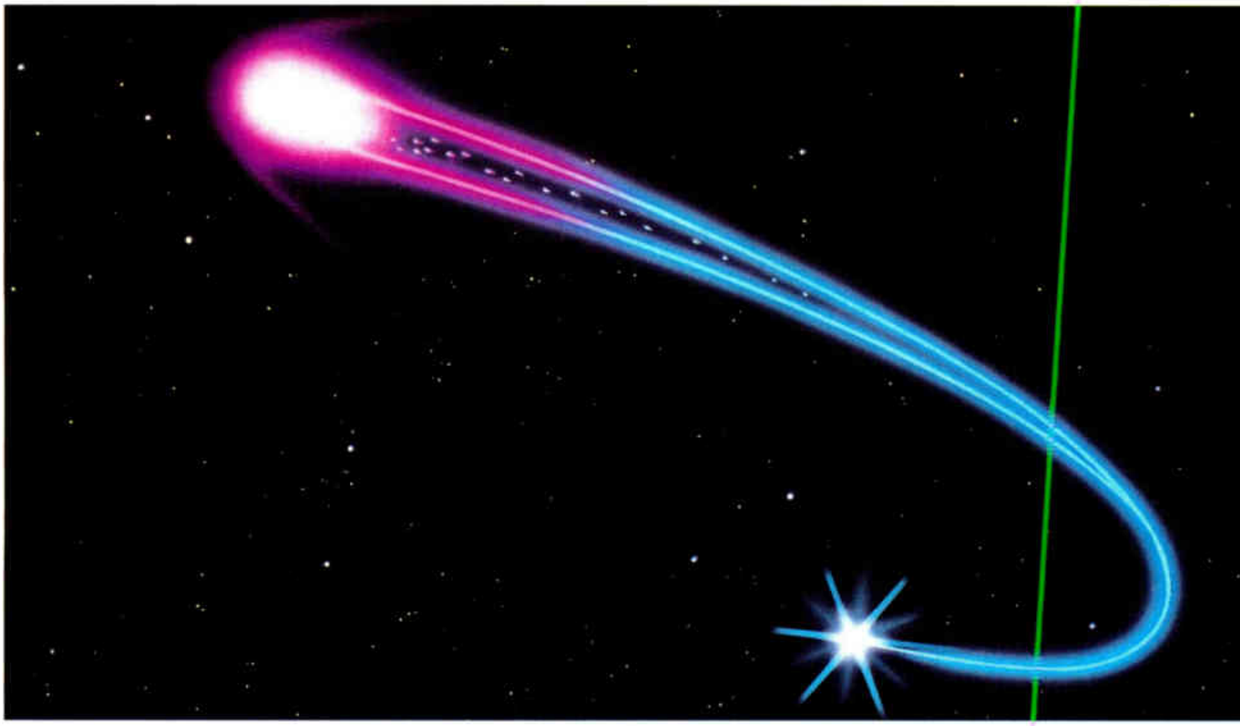

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Starfire 750

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GI General Instrument

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HDTV attributes recommended by Labs

BOULDER, CO — Cable Television Laboratories made two specific recommendations for attributes it would like to see in any newly proposed high definition TV (HDTV) transmission system that might be offered by an alliance between the four current HDTV system proponents.

According to Craig Tanner, vice president of advanced TV projects at CableLabs, "We have identified multilevel vestigial sideband transmission to be of strategic value because it can be extended to higher bit-rate performance over cable systems. We also would like to see an interlaced scanning format for high definition video, with plans for a later migration to progressive scanning."

In more news, CableLabs sponsored a conference on multimedia and potential interactive business opportunities in Washington, DC, in late April. The conference was a forum in which Labs members examined interactive services as the "economic and technical locomotive" that will drive the next step in the evolution of the cable networks.

S-A announces several contracts

ATLANTA — In one of the first moves to bring the benefits of the electronic superhighway directly into the home, Cablevision Systems Corp. ordered 50,000 digital-ready Scientific-Atlanta Model 8600^{X} home communications terminals for its Yonkers, NY, system to deliver a variety of new and future video services.

Time Warner selected S-A as the subscriber equipment supplier and integrator for the full service network, the interactive electronic superhighway it will install in the Orlando, FL, area late this year. S-A will provide digital home terminals and headend equipment to handle ATM-based two-way digital video and audio, telephony and other interactive multimedia services. Toshiba will work jointly with S-A to develop the high capacity terminal.

Paragon Cable of San Antonio ordered $1.4 million in distribution equipment to upgrade its 4,500-mile plant to 550 MHz with a base for further expansion to 750 MHz. Paragon says it anticipates its needs may reach a total of $10 million in S-A distribution products over the next five years. Time Warner Cable of Houston ordered $16 million in fiber and distribution equipment to be used in upgrading its 5,000-mile plant to 550 MHz with a foundation for further expansion to 1 GHz.

Vyvx, the nationwide TV services affiliate of WilTel, and IDB Communications, a transmission services provider, ordered an MPEG-based digital video compression system from S-A. Terms of the agreement were not disclosed.

ANTEC makes stocking agreements

In an exclusive agreement, ANTEC Communications Services committed to stock 10,000 DigiCipher commercial IRDs with ongoing delivery commitments by General Instrument to satisfy 24-hour deliveries to customers. The agreement also covers the developing product family for commercial compression equipment that is evolving through input from the cable industry and the CableLabs process.

ANTEC also will carry the entire line of optical and metallic cable test equipment manufactured by Tektronix.

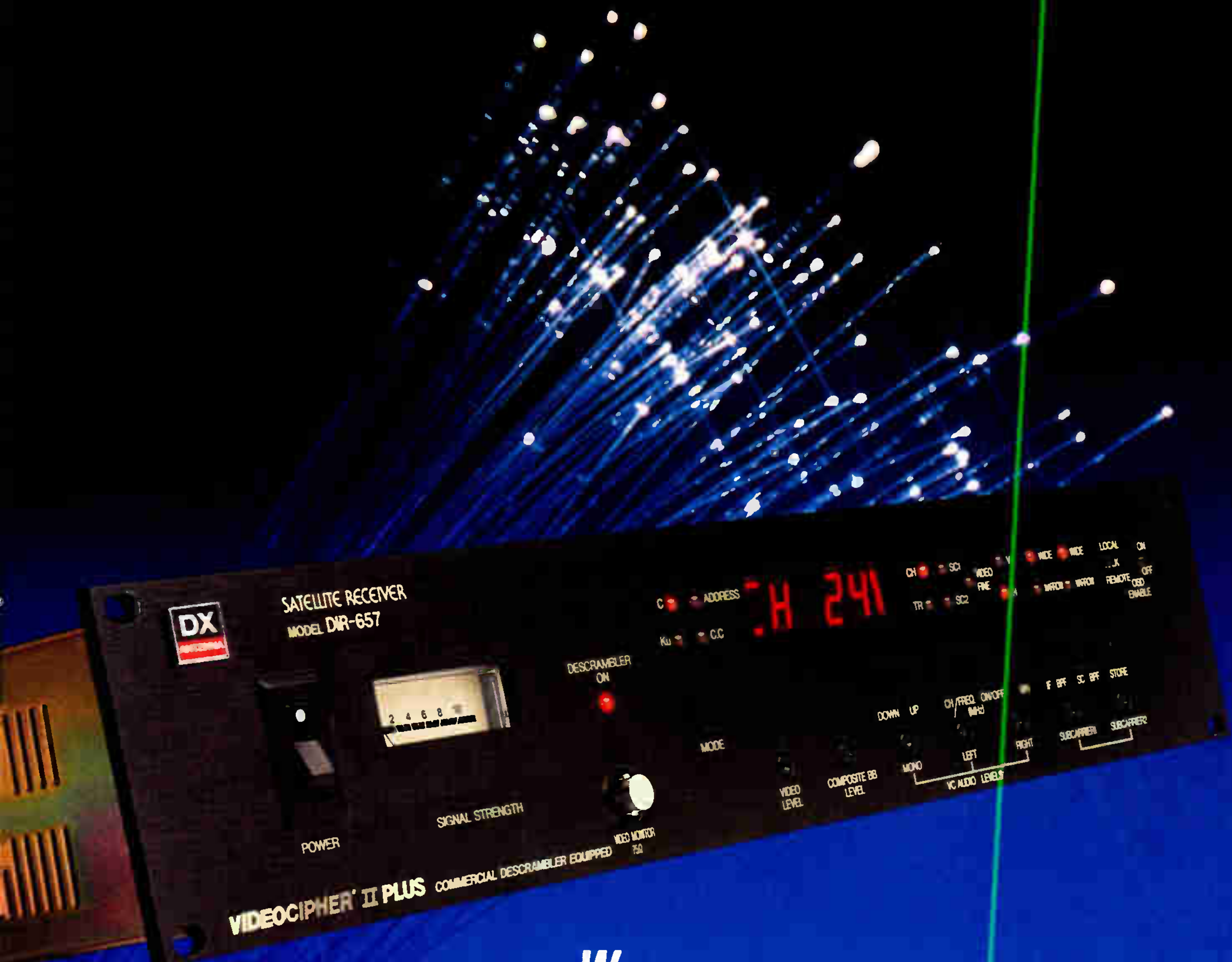
As well, ANTEC Network Systems made exclusive agreements with Harmonic Lightwaves to market the new YAGLink Plus (YL+3200) and the new YAGLink Network Manager Expander in North America.

The Network Systems division also announced Rhinelander, WI-based Midwest Video's purchase commitment for Laser Link II and 16 miles of 6, 12, and 18 count LXE fiber-optic cable to support regional interconnect projects and expansion of the existing optical plant. Three nodes also will be added to Midwest Video's cable TV system.

☛ AT&T is the first manufacturer to specify a maximum level of polarization mode dispersion (PMD) in its conventional single-mode fiber in an effort to reduce the distortion this transmission attribute has on AM video signals used by CATV.

☛ The National Cable Television Institute

Light up your fiber with the best broadcast quality video possible.



With more broadcasters and CATV operators realizing the benefits and switching to fiber optic networks, the demand for "signal purity" and higher signal quality transmission has increased.

DX sheds a new light on high performance for today's cable operators with the new DIR-657 integrated receiver/ descambler. With a long list of features, including RS-250B broadcast quality performance and optional RS-232C interface for remote operation, the new DIR-657 outshines all other satellite receivers in delivering the sharpest video and soundest audio signals possible.

For more information write to DX Communications Inc., 10 Skyline Drive, Hawthorne, NY, 10532 or call (914) 347-4040.

DX ANTENNA

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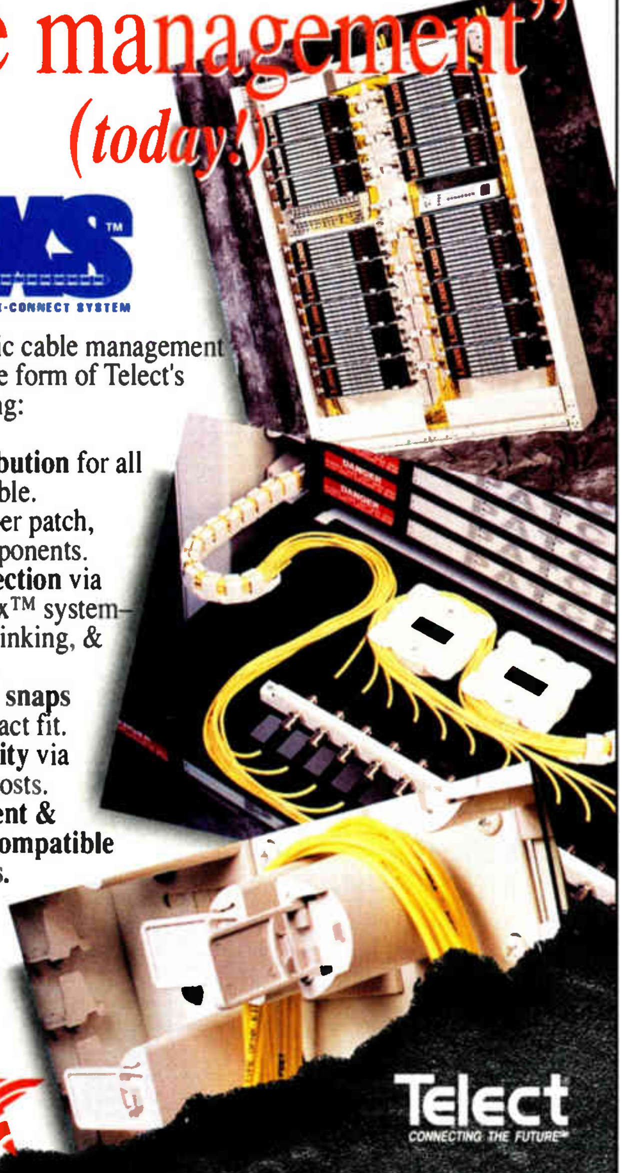

announced a new course titled "CATV Tests & Measurements." This course not only takes technicians through testing procedures step-by-step, but explains why a measurement must be made.

☛ CompuServe has renamed the CATV subsection of its broadcast professional forum to include SCTE in the title. CompuServe, the nation's largest computer information access service, can be used with a PC and a modem. If you're not a CompuServe member, call (800) 848-8199, ext. 175 for a free introductory package with $15 on-line credit.

☛ Electronic System Products Inc. (ESP), the Atlanta-based company that specializes in the design of cable TV hardware and custom integrated circuits, and Probita Inc., the software development and products company in Boulder, CO, announced an agreement to jointly pursue business opportunities with MSOs that can benefit from the companies' combined expertise in addressable technologies, digital compression, interactive TV and system services.

☛ Superior Electronics Group relocated the company's general offices and manufacturing facilities of Cheetah Systems. The new address is 6432 Parkland Dr., Sarasota, FL 34243. The new phone is (813) 756-6000 and the fax is (813) 758-3800.

☛ Tektronix announced its own TV equipment rental program. The new factory-direct program covers all TV instruments the company sells and includes a unique option to buy.

☛ Harmonic Lightwaves' YAGLink Network Management system is now compatible with standard cable TV networking products such as AT&T transmitters and Alpha power supplies.

☛ American Lightwave Systems received an order for several DV6000 16-channel uncompressed digital fiber-optic video transmission systems from Continental Cablevision of New England. Equipment orders are expected to total $5 million-$6 million.

☛ Gail Snyder started her own business, Rock Distributors Inc., based in Castle Rock, CO; (303) 660-1553. Initially it will offer a variety of compatible remote controls. The company also entered into a contractual agreement with Authorized Parts Inc. to offer its complete line of converter parts and specialized repair tools.

☛ Long Systems signed a reseller agreement with ALR computers. The full software line of Long Systems will be bundled with the ALR computer at special package prices.

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Pioneer's new BA-9000 addressable converter is designed to immediately increase your profit potential. Our field-proven **Near-Video-On-Demand** capability provides you with increased pay-per-view revenue opportunities. Plus, Pioneer's **Icon-Driven On-Screen Menuing** makes the system extraordinarily user-friendly. And our **Advanced Digital Scrambling** ensures you a secure revenue stream.

EXPAND REVENUE TOMORROW

The BA-9000 also opens up new avenues of profit potential. The **Expansion Port** means that it's future-ready, making it capable of accommodating evolving multimedia applications. With **Backwards Compatibility**, the BA-9000 delivers the flexibility to replace converters gradually, avoiding large capital outlays. For more information, call Pioneer. It's the best investment you can make today–for tomorrow.

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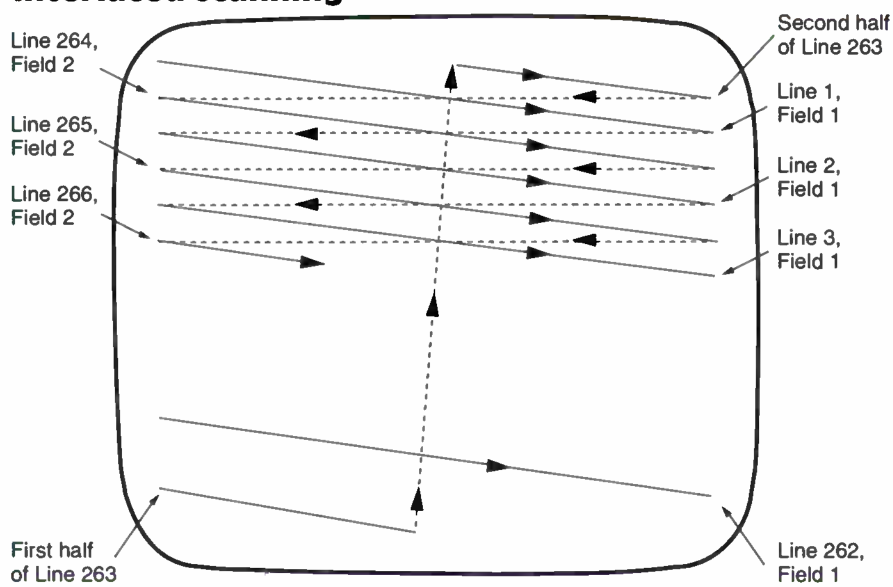
Frame rates and flicker

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

There has been much discussion and some controversy over what

Interlaced scanning



the frame rate of high definition TV should be. Currently all four of the digital HDTV systems under consideration are proposing a 59.94 frame/field rate. There are a number of challengers to this rate — especially those in the computer camp (who incidentally carry substantial political weight) — who decry carrying over a standard imposed when color TV was developed and now unnecessary in the digital world. But first a review of some fundamentals in the illusion of motion in films and television.

Human perception

The illusion of motion in films and television depends on some quirkiness of human vision that determines necessary frame repetition rates. Basic to television and motion pictures is the presentation of a rapid succession of slightly different still pictures ("frames"). Between frames the light is cut off briefly. The visual system retains the image during the dark interval so that under specific conditions the image appears to be present continuously. Then, any difference in the position of an object from one frame to the next is interpreted as motion of that object.

For this process to represent visual reality *two conditions* must be met. *First*, the rate of repetition of the images must be high enough so that the motion is depicted smoothly with no sudden jumps from frame to frame. *Second*, the rate must be high enough so that the persistence of vision extends over the interval between flashes — no flicker. The magnitude of the flicker effect depends on two parameters, the field repetition rate and illumination of the eye's retina by the image. Flicker can be reduced and ultimately made unnoticeable by increasing the field repetition rate or reducing the retinal illumination. The retinal illumination is determined by the image brightness and the size of the pupil's aperture. The latter, in turn, depends on the brightness around the image, the *surround brightness* (ambient light), as well as that of the image itself.

In a darkened motion picture theater, the surround brightness is low, the pupil aperture is relatively large as the eye automatically adjusts to the low light level, and the retinal illumination is high in relation to the screen brightness. In a typical home environment, the surround brightness is higher, the pupil aperture smaller, and the retinal illumination is lower in relation to the image brightness. As a result, the image brightness can be greater without causing visible flicker in a home TV set than with motion pictures in a theater. The difference is increased still further by using the lower field rate of 48 per second in motion picture systems.

Table 1: TV and theater display parameters

	Field rate fields/s	Screen luminance (ft.L)*	Contrast ratio	Ambient fc	Resolution
Receiver	60	60-120	30:1	5-15	275 TVL
Theater	48	16-25	100:1	0.1	4,800 TVL

* ft.L x 3.426 = cd/m² = nit

Motion picture frame rates

Early in the development of motion pictures it was found that motion could be depicted smoothly at any frame rate faster than about 15 per second. This led to the establishment of 16 frames per second (fps) as a standard, a rate still used in home movie equipment. Experience in production for theaters showed that very rapid motion, so prevalent in the Wild West, could not be faithfully shown at 16 frames per

Table 2: Typical light values

Source	Luminance (ft.L)	Source	Luminance ft.L
Sun at meridian	4.8×10^8	Overcast sky	650
Sun near horizon	1,750,000	Candle flame	2,900
Moon	750	Inside frosted 60-W bulb	27,000
Clear sky	2,300		

second. So despite an increase in film costs of 50%, the frame rate was changed to 24 fps. This remains the worldwide standard.

As theater projectors became more powerful and the images correspondingly *brighter*, flicker at 24 fps became a serious problem. As previously noted the brighter the picture the more rapid the frame repetition required. To increase the frame rate without otherwise subjecting the system to change, a two-bladed rotating shutter was added to the projector, between the film and the screen. When this shutter was synchronized with the film advance, it shut off the light briefly while the film was stationary — each frame receiving *two* blasts of light. The flash rate was thus increased to 48 per second, allowing a substantial increase in screen brightness. No adverse effect was produced on the appearance of moving objects since the frame rate remained at 24 fps. In due course, wider and brighter pictures became available and a three-bladed shutter is now available, increasing the flash rate to 72 Hz.

TV frame rates

No such simple interruption of images suffices for television. To obtain two flashes for each frame, it was arranged from the beginning of public TV service in 1936 to employ the technique of interlaced scanning. Interlaced scanning permits the frame repetition rate, and hence the *bandwidth*, to be reduced by one-half with very little increase in flicker. Thus, interlacing achieves *two* goals — reducing flicker and saving bandwidth. Each frame is divided into two fields, with the even and odd lines scanned on alternate fields. (See the accompanying figure on page 14.)

The perception of large-area flicker is based on the field rate (60 fields/s) but the bandwidth requirements are based on the frame rate (30 fps), which is one-half the field rate. The specific frame/field rate was chosen initially not only because the values were sufficient to eliminate flicker but also because at that time video circuits were made with vacuum tubes and to reduce visible 60 Hz power interference — or "hum bar" — in the picture it was easier to lock the sweeps to the 60 Hz and thus "freeze" the hum bar. A stationary hum bar was far less objectionable than one non-locked and "floating" through the picture. A comparison of TV and motion picture system parameters is shown in Table 1 on page 15. The light values shown in Table 2 present typical brightness conditions seen daily.

Computer display frame rates

Problems associated with inter-

Table 3: Some computer display s

Basic mode	Resolution	Horizontal sync
Text	720 x 400	Negative
EGA	320 x 350	Positive
VGA	640 x 480	Positive

laced scanning arose when computer-generated imagery was first displayed on interlaced TV monitors. While the total area of the image flashes at the rate of the field scan, twice the frame scan, the individual lines repeat at the slower frame rate giving rise to *interline flicker*. When computer-generated text is displayed on interlaced TV monitors the letters blink at a very disturbing and unacceptable rate. This led the computer world to use progressive scanning in its displays. Of course progressive scanning at 60 fps doubles the bandwidth, but for text it doesn't matter since a computer-generated page of text is not sent as a display but at the extremely slower data rate of a sequence of ASCII characters.

In olden days when IBM set standards it developed several for computer displays: CGA (color graphics adapter), EGA (enhanced graphics adapter) and VGA (video graphics array). Table 3 shows some of their parameters.[1]

Enter more computer display standards. VESA (Video Electronics Standards Association — comprised of VGA manufacturers) produced some new standards prompted by higher resolution requirements. Table 4 shows several of the VESA standards.[2]

One further complication of TV display standards came with the introduction of color in 1953. There is an irrevocable relation between the scan rate and the value of the color subcarrier. Either one will determine the other. If the value of the subcarrier was determined by the then-used scan rate of 15,750 scan lines/second (60 fields/second), then that subcarrier produced a beat with the sound carrier. Either the sound carrier or the color subcarrier had to be shifted enough to avoid the beat. It was decided to shift the color subcarrier and the new scan rate became 15,734.264 Hz (59.94 fields/second). Table 5 on page 18 shows some typical monitor parameters for various display systems.[3]

Conclusions

As previously noted there has been considerable discussion over the specifics of an HDTV scan standard that, of course, includes the frame rate. In fact, a task force within the FCC HDTV Advisory Committee on "North American HDTV Production" has been formed to work on recommendations. Because in the digital signal there is no longer any need to shift the scan rates there are

ndards

Vertical sync	Horizontal frequency	Vertical frequency
Positive	31.5 kHz	70 Hz
Negative	31.5 kHz	70 Hz
Positive	31.5 kHz	60 Hz

Table 4: Several VESA standards

Standard	Date	Pixels	Refresh (Hz)	Typical application
VS901101	11/90	640 x 480	72	14" monitor
VS900603	6/90	800 x 600	72	14" monitor
VS910801	8/91	1,024 x 768	70	Approved for up to 17" monitor

Table 5: Typical monitor parameters for various display systems

Characteristic	2,000-line computer monitor	1,000-line computer monitor	HDTV monitor	VGA computer monitor	Conventional high-end TV monitor
Pixels/horizontal	2,048	1,280	1,920	640	440
Lines/vertical	2,048	1,024	1,035	480	485
Viewing distance	18-30″	18-30″	5-15′	18-30″	5-15′
CRT size (in.) (typical)	20 x 20 square	19 diagonal	34 diagonal	13 diagonal	27 diagonal
Luminance (fL.)	23	25	160	35	160

those who favor returning to the 60 Hz vertical rate because it is simpler to handle and the computer people feel that for the upcoming multimedia world and for any further, as yet undetermined applications, conversions would be far more straightforward. The program production group also favors the 60 Hz.

However, the broadcasting camp is adamant in its opposition to 60 Hz. Broadcasters insist that, because for years to come, they will have to frequently downconvert HDTV to NTSC to integrate HDTV program material into their NTSC broadcasts, they must stick with the 59.94 rate (even though they admit that a conversion from 60 to 59.94 could be made at the broadcast site). In separate interviews with the leading engineers in each of the four proposed digital HDTV schemes each emphasized that as far as their systems were concerned the systems would work equally well with either 59.94 or 60. In the task force a suggestion was made by the broadcasters to start HDTV at 59.94 and when NTSC is phased out to change to 60. Since by the time NTSC is phased out there will be a huge number of HDTV receivers in place already operating at 59.94, these receivers would have to be capable of operating at 60. Receiver manufacturers in the task force meeting said that capability could be incorporated in the original receiver manufacture for a very low cost (perhaps a dollar or two) as long as it was a requirement from the beginning.

What change will finally be adopted is as yet unpredictable but perhaps a quote of inventor Charles Kettering should be kept in mind by all involved — "The world hates change, yet it is the only thing that has brought progress." **CT**

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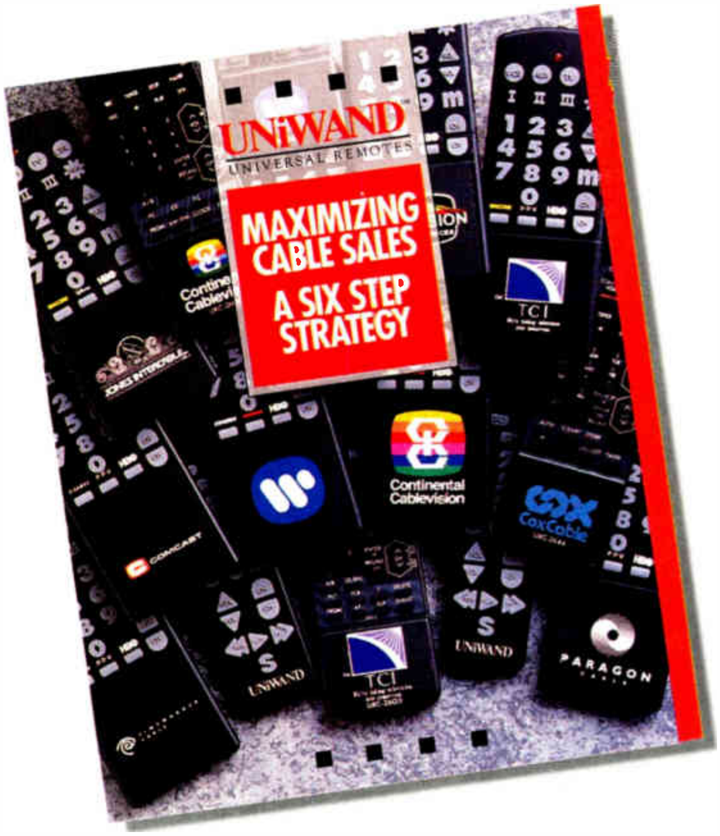
Read It And Reap



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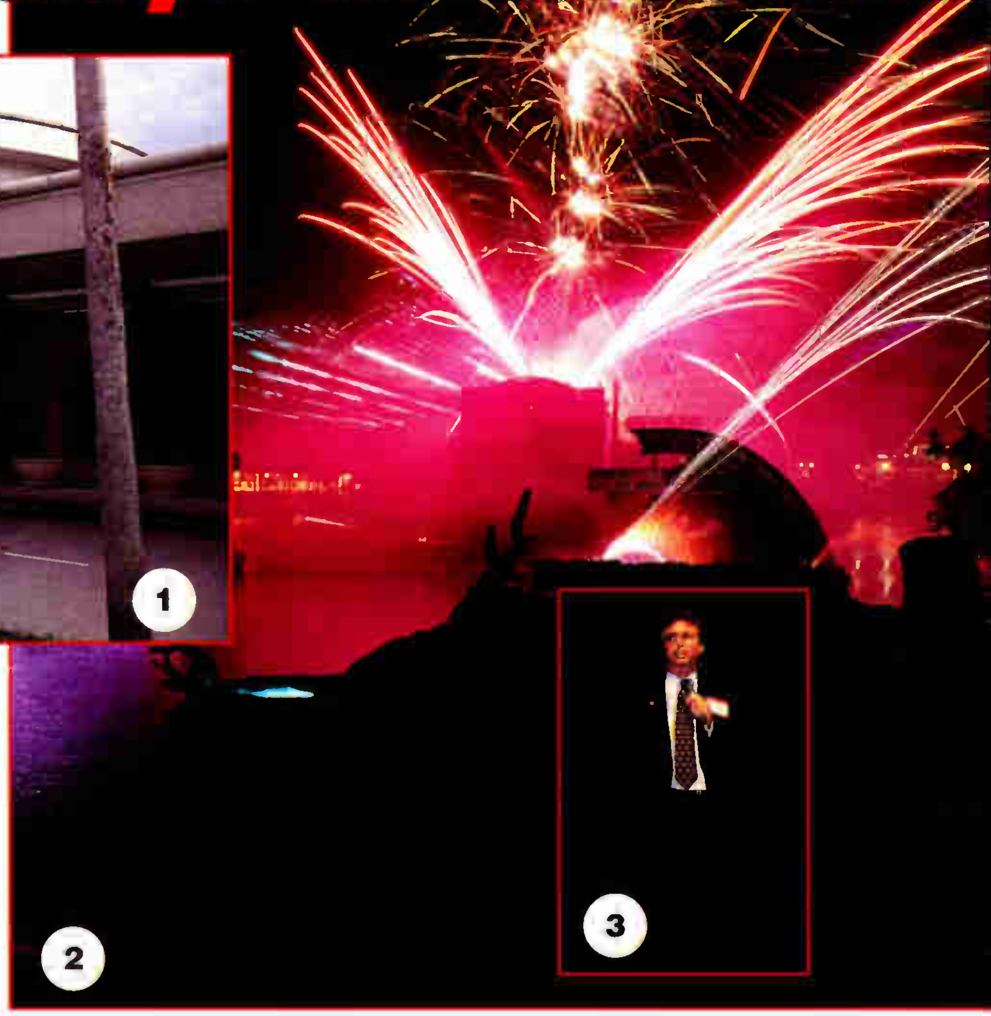
SCTE's days in the sun:



By Laura K. Hamilton
Photos by Bob Sullivan

SCTE, you've improved your successful Cable-Tec Expo every year with burgeoning attendance, packed technical forums, more exhibitors, and all those receptions and parties. What are you going to do next? We're going to DisneyWorld (and Universal Studios, MGM, Sea World, etc.).

That's right, the Society of Cable Television Engineers Cable-Tec Expo '93 took place in the hometown of Mickey, Minnie, Donald, Shamu, King Kong and E.T. ... and you can put your favorite character from your favorite attraction here. It's been called "the most popular tourist city in the world" — Orlando, FL. So, make sure the safety bar is firmly locked and hold on, here's the wrap-up of the best investment you can make in CATV technical training and education.

It's become redundant to call Cable-Tec Expo "successful," but take a look at the following highlights and try to call it anything else:

- Once again attendance was up. There were 2,300 registered attendees, which marks a 15% increase over last year's 2,000.

Cable-Tec Expo '93

1) The hub of Cable-Tec Expo '93 action was at the Orange County Convention Center. 2) Expo Evening boasted a fireworks spectacular at Sea World. 3) SCTE President Bill Riker kicked off the Expo prior to the Engineering Conference. 4) As always, Cable-Tec Expo T-shirts were hot items at the SCTE membership booth. 5) Pam Nobles of Jones Intercable refereed the Cable-Tec Games. 6) Continental Cablevision's David Spallinger was Expo '93 co-chair. 7) With a 15% increase over last year, Cable-Tec Expo registration was up again. 8) Bill Grant accepted his Member of the Year Award at the Annual Awards Luncheon.

• Exhibitor personnel was up 6% from last year with 1,700 people answering questions and demonstrating their company's products on the show floor. You can read more about the exhibitions on page 44.

• Coverage of the Annual Engineering Conference begins on page 22. If you weren't one of the conferees packing the forum, you missed a great chance to catch up on digital, cable/telephony, new technologies' effect on subscribers, and pay-per-view technology.

• Lunch time at the Engineering Conference always means the SCTE Annual Awards Luncheon. Turn to page 30 to see the members and friends the Society chose to honor.

• What really makes Expo Expo is its heavy emphasis on technical training. On page 34 you can read about workshops that covered everything from fiber-optic architectures to safety to the new Federal Communications Commission regulations and much more.

• All work and no play is never a good way to approach Expo. Turn to page 46 and relive the Arrival Night and Welcome receptions, as well as the International Good Neighbor and ham operator get-togethers. And don't forget the memorable Expo Evening at Sea World and the many other chances there were to relax.

This wrap-up was written with assistance from Eric Butterfield, Ron Hranac, Wayne Lasley, Shelley Ollig and TeleResources' Lawrence Lockwood.

Annual Engineering Conference: How will we integrate the technology boom?

Keeping cable TV engineers up to date with tomorrow's technology today is a big part of what the Society of Cable Television Engineers is all about. And this year's Annual Engineering Conference (the day before the official Cable-Tec Expo began) took on digital technology, cable/telephony integration, effects of technology on the subscriber, and video-on-demand.

As is tradition prior to the Engineering Conference, SCTE President William Riker welcomed the registrants and outlined the schedule of the upcoming Expo. He whet everyone's appetite for the technology feast laid out before them over the next few days as well as recommending attractions and sites in Orlando for after-hours and after-Expo fun.

So with visions of workshops and Space Mountain dancing in their heads, conferees settled back for a full day's indulgence into cutting edge CATV technology.

1) Attendees swarmed into the Engineering Conference. Speaking at the "Applications of Digital Technology" session were: 2) CableLabs' Scott Bachman, 3) Time Warner Cable's Jim Ludington and 4) TCI's Tom Elliot.

The wonderful world of digital

The first session of the Engineering Conference, "Applications of Digital Technology," was moderated by Roger Brown, editor of *CED*. This session was scheduled with three presenters, Tom Elliot, vice president of TCI, Scott Bachman, vice president of CableLabs and Jim Chiddix, senior vice president of Time Warner Cable. Chiddix was unable to attend and his material was presented by Jim Ludington.

Tom Elliot reviewed various technology drivers in the modern world of technology, e.g., showing the progress of capabilities in the computer world from mainframes to minis to PCs and the latest RISC (reduced instruction set computing). He also discussed in some detail comparisons of capabilities of competitors to CATV — RBOCs, DBS, MMDS and broadcast, which clearly showed many of CATV's performance advantages over them.

Jim Ludington discussed in generalities the Time Warner "full service network" proposal, which is initially planned for implementation in Orlando, FL, in 1994. He presented a video tutorial on the background of communications from telegraphy through telephony and television to the present day use of fiber-optic cable and video compression in CATV to eventually provide interactive sources.

He also had a slide presentation of a concept of the magic buzz word "multimedia." Within that concept he addressed ideas for the use of ATM (asynchronous transfer mode) of data (including video) at gigabit rates in CATV network architectures that permit transmissions from *many* sources to *many* destinations.

Scott Bachman of CableLabs made a presentation that essentially was an overview of the business history and analysis of cable vs. many competitors, e.g., print, broadcast, etc. →





1) "Cable and Telephony Integration" Moderator Dean DeBiase, ANTEC, chats with outgoing SCTE Chairman Ron Hranac prior to the session, which included speakers 2) Dawson Communications' Fred Dawson, 3) AT&T's Carl McGrath, 4) Brooks Telecommunications' Larry Lehman and 5) Jones' Chris Bowick.

Keeping up with evolution

"In 2002, we won't be in the cable business (and) the RBOCs won't be in the phone business ...," said ANTEC's Senior Vice President of Marketing Dean DeBiase. He was the moderator for "Cable and Telephony Integration: Balancing Revenue Opportunities and Network Evolution," which featured presentations by Jones Intercable's Group Vice President/Technology Chris Bowick, *The Cable Telco Report*'s Fred Dawson, Brooks Telecommunications' Senior Vice President Larry Lehman and AT&T's Technical Manager/CATV Systems Carl McGrath.

Bowick began with a look at future telecommunications opportunities including competitive access, personal communications networks, two-way interactivity and data communications services. Competitive access is an especially important issue because long distance phone service providers have had to pay the RBOCs and other independent carriers large fees for access to local exchanges, customer service would improve, and it would provide route diversity and special routing options. To determine an operator's role as a competitive access provider, Bowick said basic market parameters must be evaluated, network architecture must be designed and business plan criteria assessed. Because there are deficiencies in both cable and telco capabilities, "we're going to see a lot more synergies being exploited between the CATV and telco industries," he said.

Indeed, if cable wants to be a player in the growing telecommunications field, its next step is "to build the expertise to make that full-service network operate," said Dawson. He examined the telcos' efforts in this direction, focusing on ADSL as a tool for transporting video down twisted pair. He also said there will be many opportunities in bandwidth allocation, and those that are there first, offering the best services, will be the winners, regardless of which technology is used. "Cable's window is short — maybe two years — to get its act together to compete in the telecommunications industry," he said.

Lehman examined the graceful evolution of cable's broadband networks from coax to fiber/coax, analog to digital/analog, tree-and-branch to star/bus and video entertainment to information. Filling the growing demand for information services (such as distance learning, video telemedicine, residential interactive services and point-to-point data services) requires connection with many locations. Lehman said that there will be competing telecommunications networks in major cities and urban areas because there is enough business to justify multiple infrastructures. However, there need to be cooperative infrastructures in rural areas to justify modern telecommunications infrastructure. This way, all communities, large or small would have access to all telecommunica-

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Reader Service Number 44

1) "New Technologies and their Effects on the Subscriber" was moderated by Michael Smith of Adelphia Cable. Among those speaking at the session were 2) Jim Farmer of ESP, 3) Vito Brugliera of Zenith and 4) Judd Hoffman of Panasonic.

tions, information and entertainment services.

McGrath discussed digital transport for video and communications systems and how networks are evolving toward this capability. He also examined the extremes between analog and digital technology. He then provided a view of the cable network of the future based on the large number of tools currently available, which will grow larger. Finally, McGrath looked at ATM (asynchronous transfer mode) as an important part of the new networks, since it focuses on multiple services.

Pleasing the sub with technology

The "New Technologies and Their Effects on the Subscriber" session was moderated by Michael Smith, director of engineering, Adelphia Cable Communications. The presentation had four speakers, Claude Baggett, director, consumer electronics systems of CableLabs; Vito Brugliera, vice president, Zenith Electronics; James Farmer, vice president, ESP Inc.; and Judson (Judd) Hoffman, vice president, Panasonic Technologies.

Claude Baggett delivered a paper on "The Impact of Outside Influences on Cable Delivery Systems" in which he discussed the relations of the CATV industry to the consumer manufacturers, i.e., TV set makers. He outlined some of possible demands that may come from the computer industry because of future multimedia requirements. He made note of special requirements of the expanding "work at home" or telecommuting activities including the need for wide enough bandwidth capabilities to accommodate the growing business involving imagery manipulation and transfer.

Vito Brugliera gave a paper on "On-Screen Display — A New Technology for the Consumer Interface," in which he discussed in some depth work done at Zenith to provide what is commonly called an on-screen program guide. With newer CATV systems offering an ever-growing number of channels, an organized method for the viewer to select his programming becomes very important. The system he described interfaces to the consumer via software-selected displays on the TV screen and controlled by a hand-held remote.

Jim Farmer discussed some of the current and possible future complexities facing the CATV subscriber in his paper "The Subscriber Quandary." He briefly reviewed the history of the "cable box" — the home converters and current problems in their relation to new TV set capabilities. He particularly noted cable-ready sets with their own remote controls that are often negated with a converter. Farmer said that with the advent of delivery to the home of compressed digital TV, these problems appear to be ongoing because of the requirement for a home "decompressor" box.

Judd Hoffman, in his paper "Cable and CEBus in the Home Environment," reviewed some of the history of the Electronic Industries Association Consumer Electronic Bus (CEBus) Committee, which was formed in 1984 with the intention of finding and standardizing a method of networking consumer entertainment and telephone products in the home. The CEBus committee has developed an in-home type of wiring of coaxial cable and telephone twisted pair with software that allows multiroom control of these functions. Hoffman described these networks and their components in some detail, particularly emphasizing the flexibility of the CEBus to grow with new businesses that may be introduced into the home.

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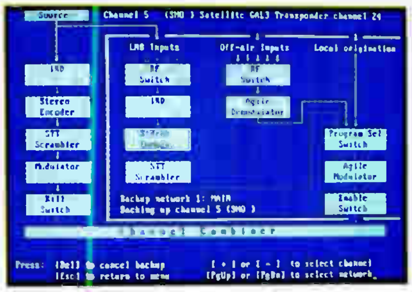

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1) Moderator Paul Levine of CT Publications at "Pay-Per-View Technology Update" with General Instrument's Geoffrey Roman, TCI's Terry Wolf and Scientific-Atlanta's Paul Harr. Taking their turns expounding on the video-on-demand challenge were: 2) Roman, 3) Wolf and 4) Harr.

1

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(VOD) are staggering, to say the least. The billions of dollars being racked up by the video stores are ripe for cable to take a bite, but how do we get there from here? The final session of the Engineering Conference, "Pay-Per-View Technology Update" gave some definite clues.

Paul Levine, president/group publisher of CT Publications Corp., moderated the session and kicked it off by reminding everyone that the people in the cable TV technical community are the ones who'll develop this "superhighway" we've heard so much about in cable's not-so-far-off future and VOD is a big part of that.

General Instrument's Vice President of New Technology and New Business Development Geoffrey Roman started the discussion with ideas on how cable systems' networks, headends and in-home equipment must change to reach the *full* VOD goal.

Obviously, digital compression and fiber optics are two enabling technologies for VOD, Roman added. As well, a "new world of in-home equipment" must be developed, which might include several different pieces of hardware that would be tailored to specific customers' needs.

"We're in an excellent position to capitalize on VOD," Roman concluded.

"We're by far the only high-volume video provider today and if we intend to stay so, we must move toward video-on-demand," said Paul Harr, marketing manager for Scientific-Atlanta.

He warned further that if we don't do it first, our competitors will.

The system must be both analog and digital, Harr added, because an operator must have the ability to retain current subscribers while providing the services that digital allows to the ones who want it. He also thinks the VOD system "must look and feel like a VCR." That is, the subscriber must have the ability, for example, to stop the VOD movie if the phone rings just as if he were getting it off his VCR. The system must be price-competitive and user-friendly. That means on-screen menus, prompts and simple selection of movies.

We have analog near-video-on-demand (NVOD) being tested around the country now. Harr says digital NVOD should appear by next year and an information superhighway with full digital storage of movies by 1995.

TCI's Terry Wolf finished off the Engineering Conference. (He's the director of addressable technology for the company.) He likened addressability and pay-per-view to a wagon. The trick is to not let the wagon fall apart because one or more of the many communication links necessary to make the wheels of the wagon turn breaks down.

Wolf reiterated Harr's remarks that VOD must work as a VCR would, but he added that you should remember that many of your subscribers can't even set the time on their VCRs. Therefore, educating customers will be an integral part of VOD. — *LH, LL, SO*

SCTE excellence prevails over Awards Lunch

Every year the Society of Cable Television Engineers membership gets the chance to break bread together and recognize excellence at the Annual Awards Luncheon. And the winners were ...

• William Grant was the 1993 recipient of the Society's Member of the Year Award in recognition of his service to the Society. Among his SCTE activities are speaking in a series of SCTE videotapes based on his book, *Cable Television*.

• Expo Program Subcommittee members William Riker and Dave Spallinger (co-chairmen), Roger Brown, Dean DeBiase, Jim Farmer, Paul Levine and Mike Smith received awards for their efforts in Cable-Tec Expo '93.

• The Program Subcommittee of the Emerging Technologies 1993 conference was recognized for its efforts in the planning of the successful January 1993 conference. Receiving awards were: Tom Jokerst (chairman), Walt Ciciora, Tom Elliot, Dan Pike, Bill Riker and Kevin Smith.

1) SCTE President Bill Riker presided over the awards. 2) Outgoing board members Rich Henkemeyer (left) and Ron Hranac (right) with Riker. 3) Tom Elliot of TCI (left) accepts on behalf of John Malone CT's Service in Technology Award. CT's Paul Levine (center) gave a check to Riker for the SCTE's Scholarship Fund in Malone's name. 4) Hewlett-Packard received the Chairman's Award from Hranac. 5) TCI's Elliot (new SCTE chairman) accepted the gavel from Hranac. 6) Riker and Bill Grant, SCTE Member of the Year.

• The following were recognized for their contributions as technical program coordinators at regional cable shows: Dan Pike (1993 Texas Cable Show); Diana Riley (1992 Atlantic Cable Show); Tom Elliott and Bill Riker (1992 Western Cable Show), and Ralph Haimowitz and Rich Henkemeyer (1993 North Central Cable Show).

• SCTE Personal Achievement Awards, which were established (based on the SCTE Outstanding Achievement Award) to recognize technical personnel in our industry for outstanding job performance, were presented to Robert Baker and Charles Nydegger. →

• The former Adirondack, Northern New England, Ozark Mountain and Shasta/Rogue Meeting Groups all were elevated to full chapter status in the Society.

• Outgoing members of the SCTE board of directors: Tom Elliott (Region 1), Ron Hranac (Region 2), Mark Wilson (Region 5), Rich Henkemeyer (Region 6), Jim Farmer (Region 9) and Richard Covell (at-large).

• Richard Abraham, Jerry Kittelson, Jonathan Kramer, Joe Van Loan and Dane Walker were elevated to senior member status in the Society.

• Hewlett-Packard was the recipient of the 1993 Chairman's Award.

• Mel Welch of Genesis received first place in SCTE's third annual Field Operations Award competition. Dick Hall of TCI and Enrique Lomas of Times Mirror were the second and third place winners.

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

CT's Service in Technology Award

A highlight of the luncheon was the presentation of *Communications Technology's* Service in Technology Award. This year's honoree, TCI's John Malone was unable to attend, but sent a videotape accepting the award. He praised the Society's educational presence in the industry and stressed its work toward training and certifying the CATV technical community. CT Publications Corp.'s President/Group Publisher Paul Levine presented a check to SCTE President Bill Riker in Malone's name for the Society's Scholarship Fund.

New board members, officers

Also recognized were the newly elected board members that officially took their seats at the Society's board of directors meeting held the day before the awards were presented. The new board members, beginning their two-year terms, include Wendell Bailey, National Cable Television Association, At-Large; Wendell Woody, ANTEC, At-Large; Steve Allen, Jones Intercable, Region 1; Pam Nobles, Jones Intercable, Region 2; Robert Schaeffer, Star Cablevision Group, Region 6; Hugh McCarley, Cox Cable Communications, Region 9; and Diana Riley, Jerry Conn Associates, Region 11.

They join the eight SCTE board members currently serving their terms: Tom Elliot, TCI, At-Large; Norrie Bush, Columbia Cable, Region 3; Wayne Hall, Warner Cable, Region 4; Jennifer Hays (who recently replaced Multimedia's Mark Wilson, who stepped down because of a transfer that took him out of the region), Digital Cable Radio, Region 5; Terry Bush, Trilithic Inc., Region 7; Jack Trower, WEHCO Video, Region 8; Mike Smith, Adelphia Cable, Region 10; and Walt Ciciora, Time Warner Cable, Region 12.

The board elected officers at its meeting and these people were recognized. New officers are: Elliot, chairman; Ciciora, eastern vice chairman; Nobles, western vice chairman; Bush, secretary; Arnold, treasurer; and Bailey, additional executive committee member. — *LH*

1) Riker (left) and Diana Riley (right) with Hall of Fame inductees Steve Bell, Jim Grabenstein's wife, Kathleen and son Mark (accepting for Jim who was posthumously inducted). 2) Hranac (right) with new SCTE Senior Members. 3) Riker (left) with Hranac, who presented the Chairman's Award to H-P's Duane Hartley and Rex Bullinger. 4) Jack Trower (center) elevates meeting groups: Adirondack, Northern New England, Ozark Mountain, Shasta/Rogue. 5) Riker with Field Operations Award winner Mel Welch.

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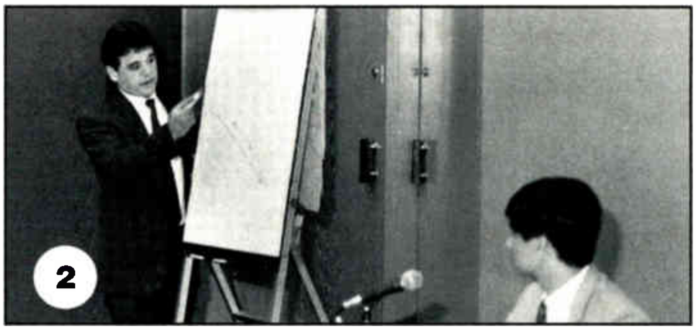


1) "Introduction to Digital Technology" with ONI's Randy Reynard and AT&T's Kenneth Metz. 2) "Tech Re-Act" with the FCC's Michael Lance and John Wong. 3) "Using Basic Test Equipment" with Coaxial International's Ron Hranac and Time Warner Cable's Steve Johnson. 4) Hranac explains CATV measurements. 5) Cablevision of Central Florida staffers videotaped Cable-Tec Expo '93 workshops.

Cable-Tec Expo '93's technical plate was full. The Society of Cable Television Engineers never forgets the main sustenance of Expo is technical training and this year attendees loaded up on workshops, engineering meetings, technical demonstrations and more.

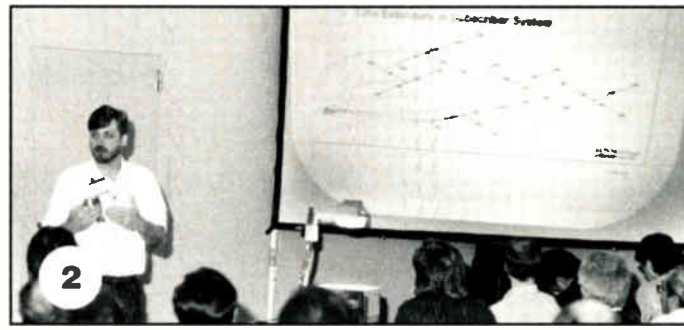
Ten workshops were offered to satisfy all kinds of techy appetites. Conferees brought in their proceedings manual (a book of technical papers from the workshops and Engineering Conference) and hot cups of coffee courtesy of the National Cable Television Institute. However, even the heartiest of you could only attend six of them over the two days they were offered, so here's a rundown of all of them.

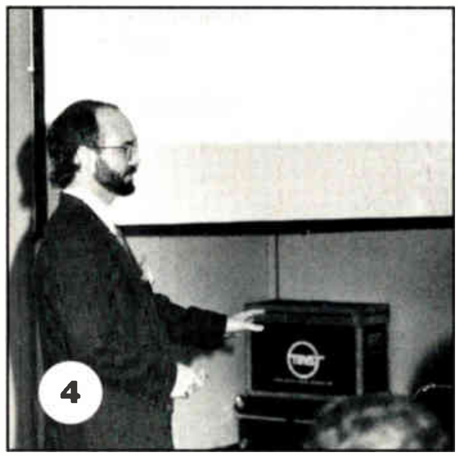
Getting serious about safety

Do you think you know all you need to about safety? If your answer is yes, think again. Although we're starting to do what we need to, there's still a lot to learn, and some things we're still not doing right, said SCTE Director of Training Ralph Haimowitz during "Safety: NEC, NESC and OSHA Regulations." This is evidenced by the 22 recorded on-the-job deaths last year, most of which were absolutely preventable.

One major problem is that managers are putting technical personnel in the position of "safety coordinator," when it's actually an administrative-type job involving the filling out of forms and procurement of appropriate literature. Technical personnel should be in charge of the actual training portion of a safety program. Haimowitz also described what would occur during an Occupational Safety and Health Administration visit and suggested that if your system is fined, you should appeal, since almost every case of appeal results in a reduced or eliminated fine. To prevent problems from occurring in the first place, the SCTE is offering the new *Health and Safety Manual.*

Some new concerns have arisen among cable personnel, one of which is the question of what to do about the risk of contact with blood-borne pathogens, especially Hepatitis B and HIV. OSHA's recommendation is that employees be informed of risks and preventive measures, but mainly that helping an injured co-worker is to be considered a "good





1) "Improving Your Interpersonal Communications Skills" with TKR Cable's Jim Harley. 2) "Fiber-Optic Architectures and Construction Practices" with Adelphia Cable's Joe Selvage. 3) Scott Bachman of CableLabs at "Outage Reduction Techniques." "Safety: NEC, NESC and OSHA Regulations" featured 4) Chris Story of Comm/Scope and 5) SCTE's Ralph Haimowitz.

Samaritan" act, with the inherent risks.

Chris Story, director of research and development for Comm/Scope, focused on NESC rule changes for sag and tension, how they are applied to cable installations, and tools available to simplify compliance. NESC Rule 250 involves general loading requirements and maps; Rule 251 more specifically deals with conductor loading; and Rule 232A covers vertical clearances of wires, conductors, cables and equipment above ground. Story listed the three types of cable loading (cable weight, ice loading and wind loading) and gave examples for the latter two. He then highlighted Spanmaster, which is a software created to provide CATV operators a tool to examine sag and tension issues. This is available to system operators from Comm/Scope.

Tele Services President Jim Stilwell finished with a look at the NEC and the NESC. The NESC is published by the NESC Committee and the IEEE, its members are mostly lobbyists and trade groups, and the publisher must often be contacted directly for a copy. The NEC is published by NFBA; its members include insurance companies, power companies, consultants, etc., and is available in most bookstores.

The NEC is not a regulation or law by itself, and must be adopted by a state, county, city, town, etc. It serves electricians and electrical inspectors and is revised every three years. Stilwell said one of the most severe problems recently is grounding. As water utilities begin the switch to plastic meters, the cable companies must turn to other grounding methods. He then invited participants to share their grounding problems and solutions with the group.

Responding to rereg

"Test Procedures Under Technical Reregulation." featuring Calan's Syd Fluck, Jerry Green and Bill Morgan, presented procedures to provide operators with maximum flexibility to obtain information on system performance, comply with new standards and create a minimum of inconvenience to subscribers.

Fluck began by discussing the tests and measurements required under 76.605 technical standards, which include carrier frequency, signal level, signal level variations over time, in-channel response, carrier-to-noise, distortions, hum, baseband video and leakage. He then focused on in-channel response measurement, providing examples. He suggests taking measurements on 10-20 of each type of converter used in the system, with minimum interruption resulting.

Green concentrated on carrier-to-noise (C/N) ratio measurements, stressing the differences between C/N and signal-to-noise (S/N). The NCTA recommended method is: 1) measure carrier level, 2) turn carrier off, 3) measure noise level at minimum RBW of 300 kHz and UBW of <300 Hz, and 4) subtract the correction factor from the delta level. Correction factors to be taken into consideration are the 4 MHz noise bandwidth, peak detector vs.

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Reader Service Number 56

1) S-A's Frank Little and 2) Tektronix' Rick Jaworski at "Distortion Analysis and Troubleshooting." 3) "Fiber-Optic Documentation, Restoration and Testing" featured William Morris of Corning, Billy Pyatt of Siecor and F.E. (Gene) Bray of ANTEC. 4) Calan's Bill Morgan and Jerry Green discuss "Test Procedures Under Technical Reregulation" with Terry Bush of Trilithic and Syd Fluck of Calan.

RMS detection and the noise floor of the measurement device. Green also provided an example of how to do this, and highlighted the narrowband tunable filter procedure.

In light of the new regulations, operators should try to ensure that the customer receives a quality picture, and not worry so much about following the regs letter-by-letter, said Morgan. When measuring distortions, the operator should determine the converter contribution, make the plant measurement before the converter, then combine the measurements. "These measurements aren't trivial," Green said, "and there are a thousand ways to screw them up." However, if the manufacturer's specifications are used "you should be pretty safe," he said. Finally he covered the three methods of plant measurement: traditional, extrapolation and CTB with CW carrier, which allow use of simple test equipment.

Distortion and noise tackled

Scientific-Atlanta's Engineering Department Manager Frank Little's portion of the "Distortion Analysis and Troubleshooting" workshop was an in-depth demonstration of many of the impairments occurring in current CATV networks. Using a TV set to show recorded images of noise and distortion, Little covered C/N picture quality degradation, composite triple beat and composite second order picture quality degradation.

Among the distortion analysis topics that Rick Jaworski (product marketing manager RF and cable TV products at Tektronix) offered information on were spectrum analyzer distortion free dynamic range, effects of adding a preselector, measuring noise or signal close to the instrument noise floor, checking and improving instrument noise floor, C/N, calculating the C/N correction factor and more.

Fiber architecture, construction

If you wanted to get into the "Fiber-Optic Architectures and Construction Practices" workshop, you had to show up early. It was a popular one and standing room only.

Adelphia Communications' Joseph Selvage (manager of systems engineering) took a look back at how we've arrived at the fiber architectures we have now and gave some in-depth details on possible future architectures. The attributes and the drawbacks of the following architectures were covered: trunk and feeder, backbone fiber, cable area network, fiber-to-the-feeder (FTF), fiber to the service area, neutral networks and passive networks.

Selvage called the passive network "FTF to the extreme. It's taking it to its logical conclusion." He then went into detail on the neutral network that is being set up by Adelphia. It's a web-style architecture with no predefined "root" locations and movable node locations. It has a separate transportation and subscriber transportation system and dual tier transportation system. The network has a lot of integrity and is designed, but the only thing still standing in the way is cost.

Keeping fiber up and running

The three presenters — F.E. (Gene) Bray, a consultant for ANTEC, William Morris of Corning and Billy Pyatt from Siecor — delved into what it takes to keep your fiber-optic plant up and running in the "Fiber-Optic Documentation, Restoration and Testing" workshop.

Morris discussed the history and some of the optics fundamentals of

1) The NCTA Engineering Committee met prior to the expo. 2) The SCTE Interface Practices Subcommittee was headed up by Jack Radzik, George Bollinger, Brian Bauer and Jim Haag (chairman). Discussing details after the SCTE Design and Construction Subcommittee meeting were 3) Sally Kinsman (co-chair of upgrade/rebuild working group) and 4) Keith Burkley (chairman of the subcommittee).

fiber developments. He also reviewed some current problems with fiber handling operations.

Pyatt, in his presentation on "Optical Cable System Documentation and Restoration," outlined many requirements for CATV in a number of significant areas, i.e., personnel, equipment, training and what he called "Lights (Out), Camera, Action" having to do with maintaining a fiber-optic installation.

Our digital future

As was the case with several of the workshops, "Introduction to Digital Technology" was extremely crowded — less than even standing room only. It had two presenters: Randy Reynard, manager of training programs at Optical Networks International and Kenneth Metz, a distinguished member of the technical staff for AT&T.

Both speakers presented material in fundamental formats regarding the new technological world we are now entering. Reynard reviewed some of the history of information transmission capabilities, i.e., copper wire , coaxial cable, microwave, satellite and the newest technology of fiber optics. He went into some depth regarding various aspects of the present and proposed standards for digital data transmission including a brief review of SONET (synchronous optical network).

Metz also reviewed much of the basics of digital signal processing and transmission, especially directed toward the requirements for a video signal. He reviewed in some detail methodologies involved with digitization of video standards such as the internationally accepted CCIR-602.

Tech Re-Act

Gone are the days of just worrying about CLI when it comes to our thoughts of the Federal Communications Commission, as was the case in the workshop on "Tech Re-Act" presented by the FCC's John Wong and Michael Lance. Not that CLI wasn't a topic of this session. It was. (By the way, the commission still favors flyovers as giving the best representation of leakage effects with regard to air navigation interference.) But as expected much attention was given to the new regulations resulting from the Cable Act.

Lance began by covering each of the measurements required in the new technical standards, including testing location, effective dates, when and how many times each test should be performed, and the number of channels to be tested.

Emphasizing what he referred to as the "one big change," Wong said that the FCC may no longer pre-empt local franchising authorities from adopting more stringent standards; however, they must get FCC approval to do so. This alone should give our industry an indication of the importance that Congress sees in the local connection. Noting that the Cable Act is now law and that any challenges must prove its unconstitutionality, Wong continued by providing the commission's time-line to achieve the conditions of the act and covered in detail what the cable industry has in store to be in compliance.

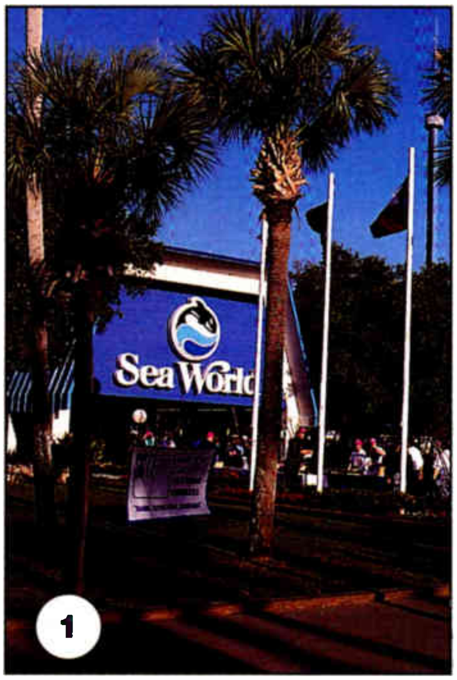
Throughout the presentation it became apparent that compliance will not always be a piece of cake. In reference to rate regulations, Wong said, "I looked at the formula and it makes the CLI formula look easy."

Outage reduction

Scott Bachman of CableLabs hosted an outage reduction techniques workshop, warning of the future when there is "going to be less tolerance for an outage or disruption in service."

Mike Miller of Viacom demonstrated that likelihood with survey results of customers whose service evaluations directly reflect the number of outages suffered. Consequently, those customers will switch companies. Miller suggested an objective tracking system that doesn't rely on human judgment, a system that is reliable and not labor-intensive. The system should be

Fun in the Orlando sun



1) Sea World, site of this year's Expo evening. 2-3) Guests enjoying the hospitality of the International Lounge. 4) Shamu in action, star of Expo evening. 5) The purple hat brigade invades Sea World, waiting for Shamu's next big splash. 6) The next generation of cable techs and engineers enjoying the thrill of Sea World.

In Orlando, FL, you have the happy dilemma of having more attractions to choose from than you could possibly visit, and Cable-Tec Expo '93 parties and receptions made the dilemma that much harder. As an award for a hard day's work, expogoers got the opportunity to socialize with fellow technical types from all over the country, and for that matter, the world.

Wavetek RF Products mugs are now a familiar and popular souvenir from Expo. Attendees hunkered down on beer, soda and chili dogs at the company's Arrival Night Reception.

The next night everyone headed over to the Grand Ballroom in the Clarion Plaza Hotel for the Welcome Reception sponsored by AT&T Network Systems, Power Guard, Times Fiber Communications, Zenith Electronics and the Society of Cable Television Engineers.

Third Annual National Cable-Tec Games

The highlight of the Welcome Reception was the Cable-Tec Games, coordinated by the SCTE Cable-Tec Games Subcommittee, emceed by Ron Wolfe of Times Warner and sponsored by ANTEC and *Communications Technology*. Stephen Jaworski of NCTI emceed the games' most popular event, Cable Jeopardy, while Pam Nobles of Jones Intercable refereed and Coaxial International's Ron Hranac supplied additional commentary. Keeping track of the scores were Robert Hagan of Don Rey Cablevision and Radiene Watson of Pyramid Industries.

Scheduled events and their sponsors were as follows: Cable Splicing, Comm/Scope and Gilbert Engineering; TDRs and Signal Level Meters, ComSonics and Riser-Bond; Go Fetch, Time Warner Cable; and Cable Jeopardy, NCTI.

Doug Lanham of Century Cable won the overall competition and was awarded the gold medal, Steve Allen of Jones Intercable won the silver and Tom Lockwood of TCI took the bronze.

Individual event winners were as follows:

- Cable Jeopardy: David Dulin, Century Cable (gold); Doug Lanham (silver); Steve Allen (bronze).
- Go Fetch: Doug Lanham (gold); Tom Lockwood (silver); Steve Allen (bronze).
- Cable Splicing: Steve Allen (gold); John Minginas, WEHCO (silver); Tom

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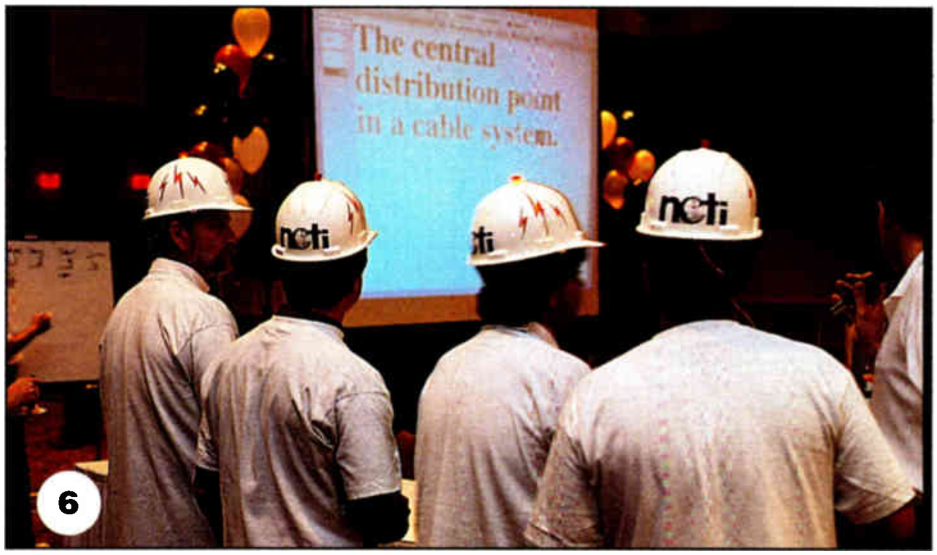

1-2) Big turnout for the Welcome Reception, complete with musical entertainment. 3 and 5) Cable-Tec Games, held at the Welcome Reception, challenged the skills of today's techs and 4) provided entertainment for onlookers in the bleachers. 6) The flashing hard hats of Cable Jeopardy, the most popular of the Cable-Tec Games. 7) Emcee Ron Wolfe awards Doug Lanham of Century Cable with the overall individual gold medal.

Lockwood (bronze).

- TDRs and Signal Level Meters: Doug Lanham (gold); Paul Eisbrener, Columbine Cable (silver); Tom Lockwood (bronze).

Expo Evening

With more Expo attendees bringing along their families than ever before, Expo Evening at family-oriented Sea World was particularly apropos. ANTEC, Comm/Scope, Jerrold Communications, Scientific-Atlanta and SCTE sponsored.

Desserts, coffee and soda were served at the Shamu Pavilion and then conferees filled the stadium to ooh and aah over the Shamu "Night Magic" Show. Kids of all ages donned their waterproof Cable-Tec Expo hats provided by *Communication Technology* to watch the incredibly trained killer whales. The evening was topped off by a laser and fireworks show.

Internationals

The interest in cable internationally was highly apparent at the International Good Neighbors Reception as well as at the International Lounge.

The International Good Neighbor Reception allowed technical types from all over the world to meet face to face and socialize. The reception was sponsored by Electroline, Hughes Aircraft, *International Cable* magazine, Lindsay, Sachs Communications,

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1-2) At the Arrival Night Reception an attentive wait staff saw to the needs of thirsty expogoers, who proved themselves hungry as well. 3-4) The International Good Neighbor Reception gave international guests a place to meet, eat and relax. 5) Ham operators from around the globe gathered to chat and exchange call letters at the Ham Operator's Reception. 6) The awarding of door prizes always adds to the fun, as hams NØIVN, NØUXA, N1ACQ, KØFRP and NØAYE can attest to.

Triple Crown and SCTE.

Jerrold Communications, RMS Electronics and *International Cable* magazine hosted the Cable-Tec Expo '93 International Lounge. The lounge served as an informal business center for foreign guests and offered telephone and fax resources as well as light refreshments. Translation services also were available.

House of Delegates, membership meetings

The SCTE national board of directors and officially designated representatives from the Society's 74 chapters and meeting groups gathered at the closed House of Delegates meeting to discuss chapter support.

SCTE members also had the chance to meet with the national board and staff during the Annual Membership meeting, which provided a forum for members to ask questions and express concerns.

Hams reception

Always a highlight for Cable-Tec attendees who also are ham radio enthusiasts, the Amateur Ham Radio Operators' Reception offers participants the chance to put call letters to faces. Scientific-Atlanta provided the refreshments and dozens of companies donated 49 door prizes that were distributed among attendees from 19 states and three countries.

Lucky Jeff Cohen (N1ACQ) of Harron in Bourne, MA, took home the grand prize of the TS-690S HF tranceiver donated by Scientific-Atlanta and Tele-Communications Inc. Other noteworthy winners were: TH-47A HT ARRL Ant. BK courtesy of Texscan and Wegner — Betty (W5TQK) and Herb Timberlake (W5TQI) of Sammons in Fort Worth, TX; MFJ 1274 TNC courtesy of Time Warner Communications Training Center — Jerry Bybee (KG7GQ) of TCI in Portland, OR; TH-28 HT donated by ANTEC — Roger Blakeway (G1PXM) of SCTE in the United Kingdom; MFJ 1278 TNC donated by Time Warner — Steve Manzi (K3GIY) of Times Mirror in Hatboro, PA; TH 78A HT contributed by RTK — Ian Macfarquhar (VE30S) of CUC Broadcasting in Scarborough, Ontario; MFJ 1270B TNC donated by ComSonics — Jim Dryden (W6KIS) of Buckeye Cable in Toledo, OH; FT-530 HT courtesy of the National Cable Television Institute — Tony Piccolo (W1OSG) of Texscan in El Paso, TX; and 2K Heath amp donated by Zenith — Dick Kirsche (N1CBW) of Greater Media of Chicopee, MA.

Golf tourney

Expogoers/golfers took advantage of the warm Florida sunshine at the second annual SCTE Golf Tournament the day after Expo. With shotgun starts at 7:30 a.m. and 1 p.m., players drove and putted their way to a relaxing end to Cable-Tec Expo '93.

Meet you in St. Louis next year (June 15-18) for the Cable-Tec Expo '94. — *EB, LH, SO*

New directions in digital networking

By Carl McGrath
Technical Manager, AT&T Bell Laboratories

The age of digital broadband services for the mass market is upon us. The continuous advancement of digital signal processing (DSP) technology now makes it possible to transmit high fidelity video, audio and communications traffic in a fraction of the spectrum once required in an analog domain. For the present, we focus on ways to incrementally change the services platform. "How many channels will be required to implement near-video-on-demand (NVOD)?" "Will straightforward, staggered-start pay-per-view (aka EPPV) take most of the viewers interest?"

These and other similar questions pervade the industry at all levels, both business and technical. Few will argue that today's best answers will give way to better ones as the marketplace evolves and consumer demand defines new applications. Continued evolution is a certainty. What delivery platform will most economically and transparently support that evolution is the subject of the following material. The underlying assumption for this discussion is that 10 years from now today's signal processing systems will be as technologically advanced as today's 1,200 baud modem.

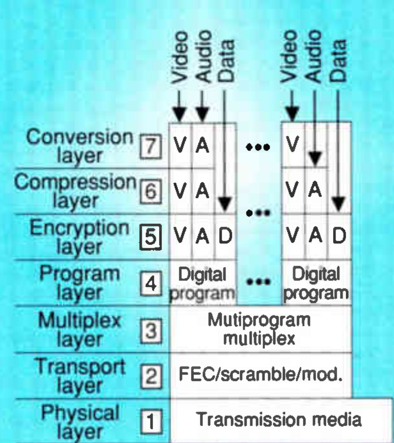
In the following, I will review some of the basic characteristics of digital services as we know them today and compare them with similar drivers during the first digital network revolution. Next, I'll propose and discuss a networking model for use in evaluating various deployment alternatives. Finally, a brief look at how asynchronous transport mode (ATM) networking concepts, a popular near-term candidate, provide an open structure for the evolution of these services.

For simplicity, the first digital network revolution referred to here is the conversion of the world-wide telephony network over the past 25 years. Many of the drivers and deployment considerations faced in that network conversion are applicable to this discussion. This in no way should infer that earlier, broadly deployed digital signaling systems such as telegraphy and smoke signals are any less significant in demonstrating efficient use of bandwidth and signal-to-noise ratio (S/N).

Source characteristics

High-volume, high-capacity network design for services with dominant signal sources logically evolves based on the characteristics of those signals. Analog telephony evolved from the 4 kHz basic POTS (plain old telephone service) channel into an integrated narrowband/broadband switched network that utilized all practical types of communications facility: open wire, paired wire, coaxial cable, AM and FM radio and satellite channels. Niche applications for "broadband " services were accommodated by concatenating adjacent channel bandwidth on the broadband facilities. In a similar fashion, broadband analog CATV systems have evolved based on the NTSC standard allocation of 6 MHz per service. Interfaces have been developed to match the required performance to particular media, such as FM for relatively noisy satellite channels.

Figure 1: Interface structure model



"A major responsibility of network architects and planners is to ensure that a flexible path exists for future services evolution and network expansion."

Digital telephony — Order, simplicity, ubiquity

In the digital domain, a 4 kHz POTS channel requires 64 kbps and is known as a DS0 channel. The 64 kbps rate is based on achievable analog-to-digital (A/D) conversion performance when systems were first deployed. Specifically, sampling at an 8 kHz rate was consistent with available bandpass filters and 8 bit pulse code modulation (PCM) was required to provide adequate S/N, comparable to equivalent high-grade analog channels. Since the 64 kbps digital voice channel was equivalent in performance to the ubiquitous analog 4 kHz channel, it could be deployed interchangeably in the existing analog network fabric in an evolutionary manner.

First deployed in the relatively costly toll portion of those networks, digital PCM evolved along a cost and performance curve that allowed it to overtake toll switching fabrics, then local switching fabrics and virtually all transport systems. Today, the remaining analog systems in these networks interface through A/D interfaces and are rapidly being phased out. Digital connectivity in the residential market extends to most Class 5 (local) switching offices and in many cases close to the home, through the use of subscriber line carrier systems that place the A/D point in the local loop. Many large businesses have digital PBX systems that connect directly, digitally, to the network. In some cases that digital connectivity continues all the way to the telephone instrument, the first applications of the integrated services digital network (ISDN).

(Continued on page 74)

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Transporting analog and digital video channels via a WDM CATV lightwave system

The following is adapted from a paper presented at the 1993 Society of Cable Television Engineers Emerging Technologies Conference and printed in the conference's proceedings manual. The article deals with a lightwave system that transports 80 analog carriers and 16 uncompressed digital video channels, and provides performance data from the combination of AM and digital video over the same optical fiber using wavelength division multiplexing (WDM).

By Robert W. Harris
Senior Applications Engineer, Fiber Optics
And Charles Mao, Ph.D.
Engineering Product Development
C-COR Electronics Inc.

The use of fiber optics for transmission of video, audio and data has become commonplace in CATV, broadcast, educational and private networks. Analog AM fiber systems are replacing coaxial cable for local distribution within the CATV network while digital systems are being used for headend or hubsite elimination and for transmission of various data services.

Typically, the analog and digital transmission systems are operated separately from each other on their own optical fiber. However, as CATV systems grow and services are expanded, there is a need to obtain maximum usage of the fiber. This may include using wavelength division multiplexing (WDM) to allow both analog and digital to coexist on the same optical fiber.

Experimental set-up

The 50 to 550 MHz AM system used for this experiment is the same type that is currently being used in CATV applications. The AM transmitter uses a highly linear 1,310 nm DFB laser with a built-in optical isolator. A Dix Hills Matrix generator provides 80 CW carriers to the input of the AM transmitter, each with an optical modulation index of 3.9% per channel. The AM receiver uses a low noise, highly linear InGaAs PIN photodiode and a balanced transimpedance amplifier. The InGaAs photodetector has a broad 1,200 to 1,700 nm optical bandwidth.

The digital system used for this experiment also is the same type that is currently being used in CATV applications. The digital system operates at 1.6 Gb/s (gigabits per second) and uses synchronous time division multiplexing (TDM) to transport 16 uncompressed, pulse code modulated (PCM) digital video channels. The 1.6 Gb/s serial data stream is scrambled with a non-return to zero (NRZ) format. The digital transmitter uses a 1,550 nm DFB laser without an optical isolator. The digital receiver uses an InGaAs avalanche photodiode (APD) with a broad 1,200 to 1,700 nm optical bandwidth.

A Tektronix TSG-170A provides the input video test pattern to the A/D converters. The video is digitized at 8-bit resolution. A Tektronix VM-700 analyzes the recovered digital video from the digital-to-analog (D/A) converters. While the payload on this digital system is 8-bit video, the data ports on the optical transmitter can accept a variety of coding and framing patterns that allow different types of signals to be transported (i.e., 9-bit video, 16-bit audio, etc.).

Figure 1: Lightwave WDM system for unidirectional transmission of digital video and analog AM signals

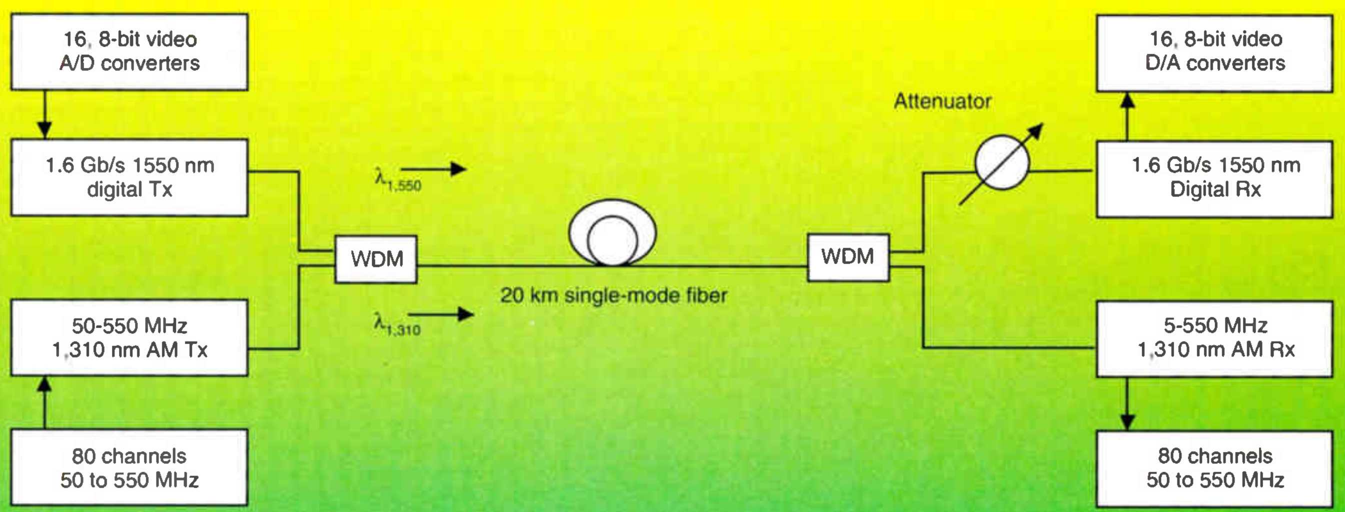


Table 1: CSO, CTB and C/N performance at 1,310 nm on a unidirectional WDM system with and without 1.6 Gb/s digital video at 1,550 nm

	CSO		CTB		C/N		
Channel	Without digital	With digital	Without digital	With digital	Without digital	With digital	C/N Δ
83.25 MHz	-67.3 dB	-67.0 dB	<-68.0 dB	<-68.0 dB	53.4 dB	51.0 dB	2.4 dB
325.25 MHz	-63.6 dB	-63.7 dB	<-68.0 dB	<-68.0 dB	52.9 dB	51.0 dB	1.9 dB
547.25 MHz	-61.8 dB	-61.2 dB	<-68.0 dB	<-68.0 dB	53.0 dB	51.2 dB	1.8 dB

The optical path consists of two 10 km spools of standard single-mode fiber, two wavelength division multiplexers, a >30 dB variable optical attenuator and various optical jumpers. The optical fiber attenuation is less than 0.4 dB/km at 1,310 nm with less than 3.5 ps/nm/km dispersion at 1,310 nm. Two types of WDMs are used: unidirectional and bidirectional.

Unidirectional WDMs are used when operating both systems in the same direction. Insertion loss at both wavelengths, including connectors, is less than 0.6 dB. The optical isolation for the WDM devices are greater than 40 dB. Bidirectional WDMs are used when operating each system in opposite directions. Insertion loss at both wavelengths, including connector loss, is less than 0.6 dB and directivity is greater than 65 dB.

The analog system, optical fiber and WDMs are connectorized with FC/APC connectors. The digital transmitter, receiver and optical attenuator are equipped with super FC/PC optical connectors. An HP 8153 lightwave multimeter is used to measure the optical power levels of both systems. An HP 71401C signal analyzer is used to measure the RF performance of the AM system.

Unidirectional transmission

The system is configured as shown in Figure 1. The signal from the 1,310 nm AM transmitter and the 1,550 nm digital transmitter is wavelength division multiplexed onto a single fiber using a high isolation (40 dB) unidirectional WDM. At the receive end, following transmission through 20 km of standard single-mode fiber, the WDM signal is demultiplexed using another high isolation unidirectional WDM coupler and sent to the appropriate receivers.

The digital system is first activated while the AM system remains off. The output power of the digital transmitter measures -0.3 dBm. The variable optical attenuator is then adjusted until the digital receiver reaches optical threshold. Operation below threshold will cause a loss of clock synchronization within the receiver and subsequent loss of digital signaling. By setting the digital receiver at threshold, we are able to determine if activating the AM system will add a significant amount of noise to cause the receiver to move beyond threshold. Optical threshold is measured at -30.1 dBm. A video output from one of the D/A converters is routed to the VM-700. The video performance is measured and found to exceed RS250C medium haul specification. Specifically, a 61.3 dB video signal-to-noise ratio (S/N) is measured.

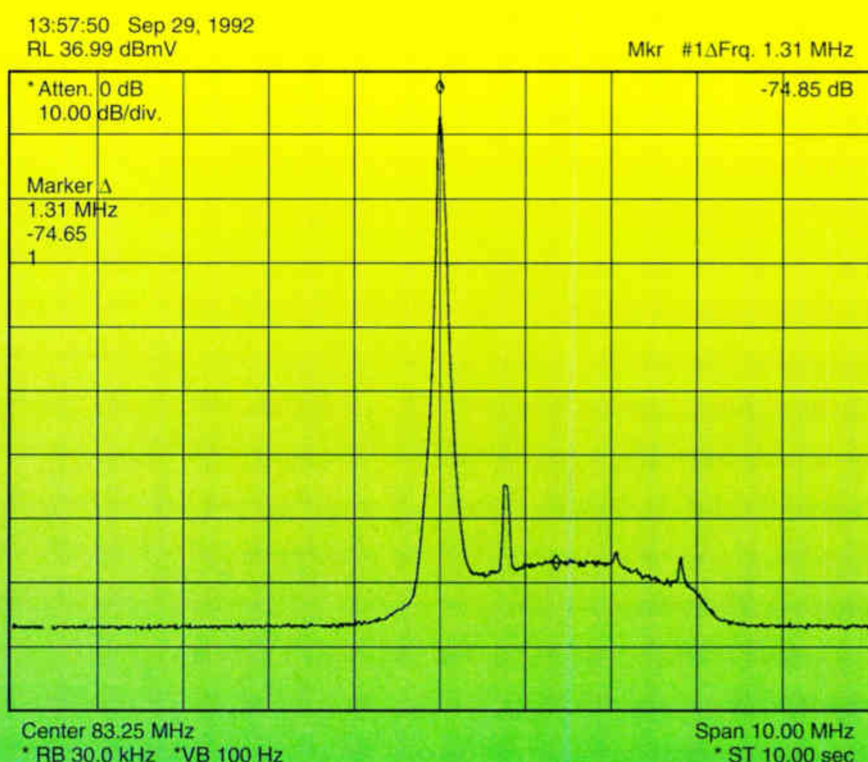
An optical power level of -38.4 dBm at 1,550 nm is measured at the 1,310 nm port of the receive side WDM. Therefore, -38.4 dBm of 1,550 nm optical power is present at the input to the AM receiver. Once both systems are activated, AM performance measurements will determine if that amount of 1,550 nm optical power is low enough in magnitude to avoid causing a problem within the 1,310 AM receiver.

The digital transmitter is then turned off and the AM system activated. The output power of the AM transmitter is measured at 5.7 mW (7.6 dBm). The optical input power measured at the AM receiver is -2.39 dBm. The composite second order (CSO), composite triple beat (CTB) and carrier-to-noise ratio (C/N) are measured at three frequencies using standard NCTA recommended practices. The values are shown in Table 1 under the heading "Without digital."

The 1,550 nm digital is then reactivated. The system now has both 1,310 nm analog and 1,550 nm digital signals operating over the same fiber. The optical input to the digital receiver is remeasured and remained at -30.1 dBm. The 1,310 nm AM signal, therefore, has no noticeable effect on the digital receiver threshold. (Note: A more accurate measure of

(Continued on page 82)

Figure 2



External modulation for AM fiber CATV transport

The following is adapted from a paper presented at the Society of Cable Television Engineers' "Fiber Optics Plus '92" conference. It appears in the "Fiber Optics Plus '92 Proceedings Manual."

By Israel M. Levi
Director of Product Marketing
Moshe Nazarathy
Vice President, Research and Development
And Josef Berger
Vice President, Engineering
Harmonic Lightwaves Inc.

In the last couple of years a great deal of progress has been made in improving the performance of direct modulation AM fiber CATV systems based on 1,300 nm DFB laser technology. (See Table 1.) Although some additional advances can be expected in the performance of DFB lasers, practical limitations on output power, channel loading, RIN (relative intensity noise), and sensitivity to optical reflections from the fiber, splices and connectors are difficult to overcome. AM fiber CATV systems based on external modulation can now be designed to minimize and in most cases eliminate these limitations, making the use of fiber more practical and economical. Figure 1 depicts the principal differences between direct and external modulation lightwave transmitters. With external modulation, the functions of light generation and modulation are separated, providing the flexibility for optimization of the laser and modulator for specific applications. This flexibility is particularly important in AM fiber CATV applications that impose tough requirements on the transmitter.

The key components of the external modulation transmitter are the solid-state Nd:YAG laser, which operates in a CW mode, and the electro-optical modulator made in lithium niobate ($LiNbO_3$). The Nd:YAG laser can be designed and optimized for the required output power, light beam quality, spectral characteristic, RIN, long-term stability and reliability. Independently, modulator design can be optimized for optical loss, RF drive, bandwidth, frequency response, long-term stability and reliability. The modulator is an inherently nonlinear device with a precise sine shaped RF-to-light transfer characteristic (Figure 2). Under closed loop control, the modulator can be biased to null out the even order beats, resulting in negligible composite second order (CSO) distortions. However, the odd order beats generated by an uncompensated modulator would result in unacceptable composite triple beat (CTB) distortions.[1]

In the last several years a great deal of research has been conducted on improving the linearity and increasing the depth of modulation of external modulators.[2, 3, 4] Only recently have practical solutions to the linearization problem materialized, making this technology viable for CATV applications. There are two main methods of linearization employed in commercially available external modulation transmitters — one is based on optical feedforward compensation while the other on RF predistortion compensation (Figure 3 on page 58). The optical feedforward technique requires an additional laser in the transmitter and the cancellation of distortions actually takes place in the receiver. Predistortion compensation, however, consists of strictly electrical conditioning of the RF signal to the modulator. The predistortion method offers important advantages such as simplicity, ease of installation and system flexibility. A comparison between direct and external modulation transmitter parameters is given in Table 2. →

Table 1: AM fiber CATV systems progress

	1989	1990	1991
Number of channels	40	40	60
Link (dB)	5	7	10
Carrier-to-noise ratio (dB)	50	50	50
Composite second order (dB)	-60	-60	-65
Composite triple beat (dB)	-65	-65	-65
Price ($ in 000)	30	20	15

Table 2: Direct and external modulation transmitter parameters

	Direct modulation	External modulation
Number of channels	60	80
Power (mW)	4-6	10-20
m (%) @ 60 Ch.	4	3.6
RIN (dB/Hz)	-155	-165
CSO (dBc)	-65	-70
CTB (dBc)	-65	-65
Connector penalty	Yes	No
Fiber penalty	Yes	No

Figure 1: Principal differences between direct and external modulation lightwave transmitters

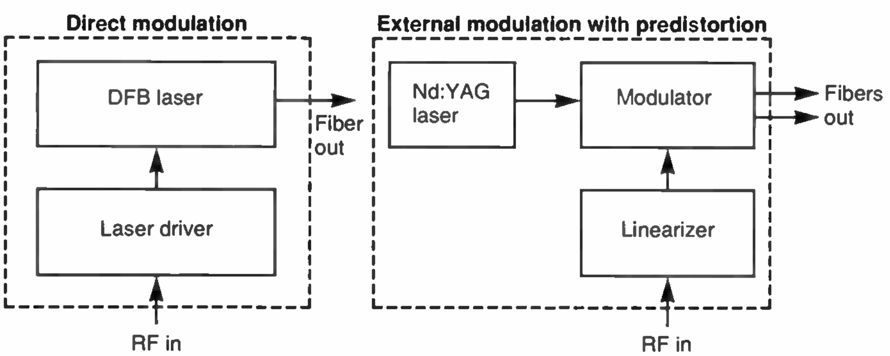


Figure 2: Modulator transfer characteristic

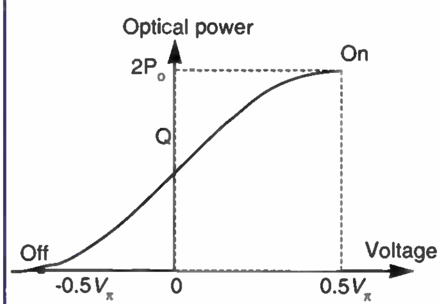


Figure 3: Linearization using RF predistortion compensation

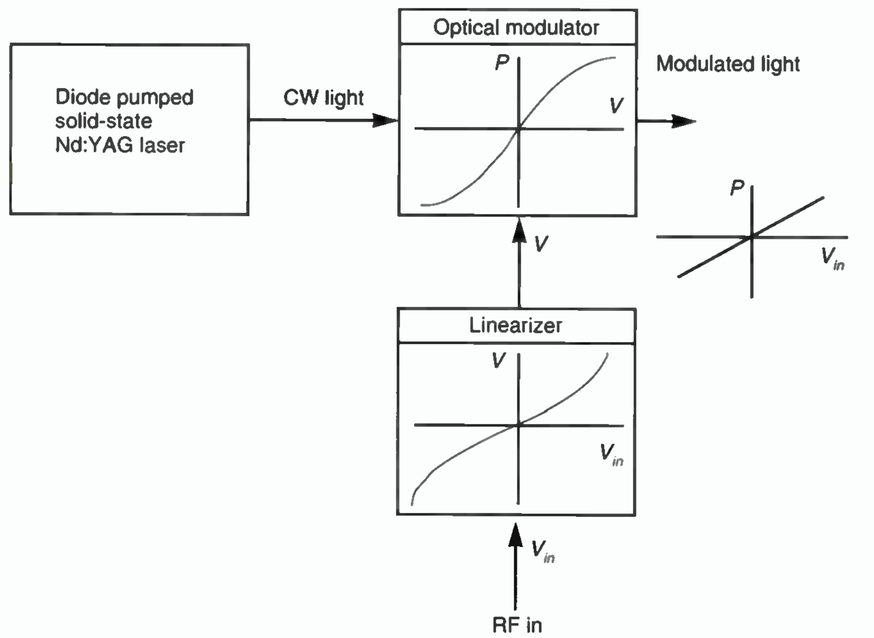
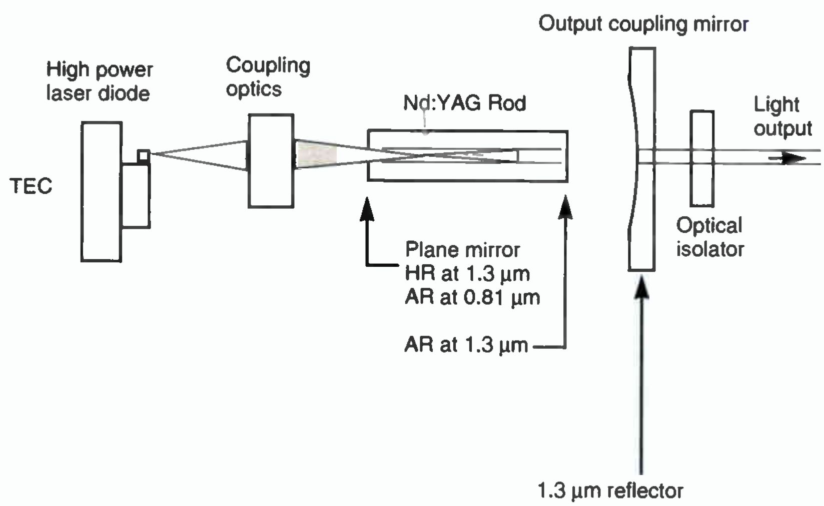


Figure 4: Diode-pumped laser construction



Solid-state diode-pumped Nd:YAG laser

Diode-pumped solid-state lasers, which were developed in the early '70s and became popular at the end of the '80s, are well suited as CW sources for external modulation systems.

• *Construction and operation.* The construction of a diode-pumped laser is depicted in Figure 4. It consists of a high-power semiconductor laser diode pump source, coupling optics, Nd:YAG crystal and resonator mirrors. The pump is an 808 nm AlGaAs quantum well laser with output power between 0.5 to 1 watt emitted from a broad active area of about 200 µm x 1 µm. This laser diode is mounted on a TEC (thermoelectric cooler) such that its light spectrum can be fine-tuned by adjusting its temperature to match the absorption band of the Nd:YAG material.

The high-power laser diode light beam is collimated, shaped and focused on the Nd:YAG crystal using micro-optic lenses. The pump light at 808 nm is absorbed in the first few millimeters of the Nd:YAG material, exciting the Nd atoms up to the pump bands (Figure 5 on page 90). In response to the pump light, the Nd:YAG emits light in 1,319 nm. Using selective coatings on the Nd:YAG crystal and the output mirror, the 1,319 nm light is confined to a resonant cavity overlapping the pump volume. A portion (1-2%) of the intracavity light is coupled through the output mirror of the resonator.

• *Design parameters.* The output beam of the laser is near perfect Gaussian shaped, allowing efficient coupling to single-mode waveguides. Typical output power from solid-state Nd:YAG lasers ranges from 50 to 200 mW. The high frequency noise from the semiconductor laser diode pump is filtered by the Nd:YAG crystal, which has a cutoff frequency of approximately 200 kHz. The RIN of these lasers in the CATV band is typically <-165 dB/Hz. The Nd:YAG laser provides a spectrally narrow (<0.5 nm wide), stable emission spectrum at 1,319 nm. The optical feedback threshold for noise and distortion degradation is inherently better for Nd:YAG lasers than for DFB lasers.

The immunity to back reflection from the fiber and connectors is further enhanced by using an optical isolator to isolate the gain medium of the Nd:YAG laser from the external modulator and subsequent fiber. The external modulator by itself acts as an attenuator for the return light, further enhancing the isolation of the laser. Light at 1,319 nm back-reflected into the laser diode pump (which operates at 808 nm) does not interfere with the pump's normal operation because of the different wavelengths.

• *Reliability.* The reliability of the Nd:YAG laser depends primarily on the power rating and the actual operating power of the semiconductor laser diode pump. All other components are passive, exhibiting no inherent degradation mechanisms. By derating the operating power of the pump, the lifetime of the laser can be extended to match the 10- to 20-year operation of DFB lasers. Facet power density and the type of laser material determine the power ratings and the lifetime of semiconductor lasers.

For example, the facet peak power of amplitude modulated DFB lasers can be as high as 20 mW on an emitting area of only 2 µm square. An Nd:YAG laser, pumped by a 1 W broad area laser diode has an emitting area of 200 µm square. Thus, the facet power density of the pump laser is half that of the DFB laser, although the total power is much higher. Accounting for the material differences between InGaAsP and AlGaAs, the expected lifetimes will be almost comparable. Optically efficient design allows operation at lower pump power, thus extending the life of the laser.

(Continued on page 90)

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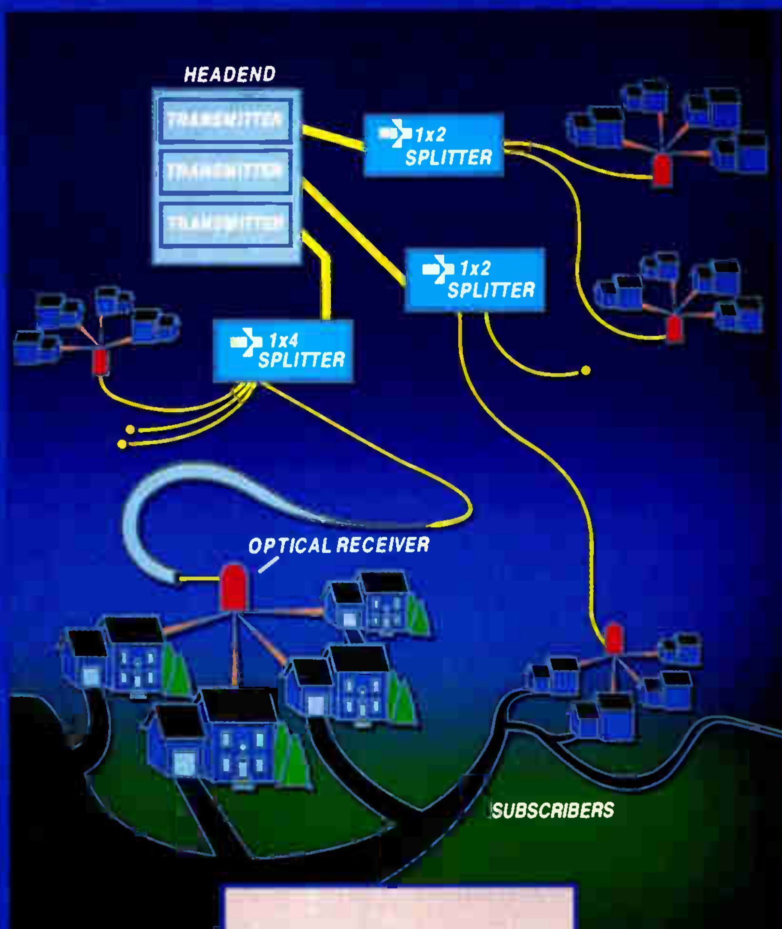
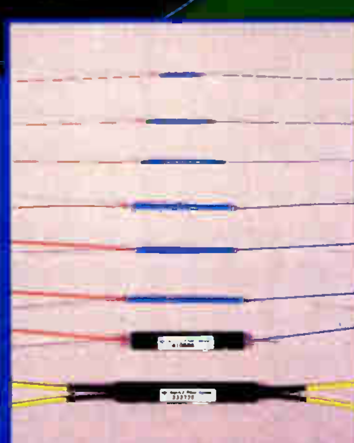


For CATV systems Gould has wavelength independent splitters with low insertion loss and high directivity (≤-65.0dB) -- guaranteed for environmental stability and performance at the headend or in the field. Components are in stock in a variety of standard and customized package styles.



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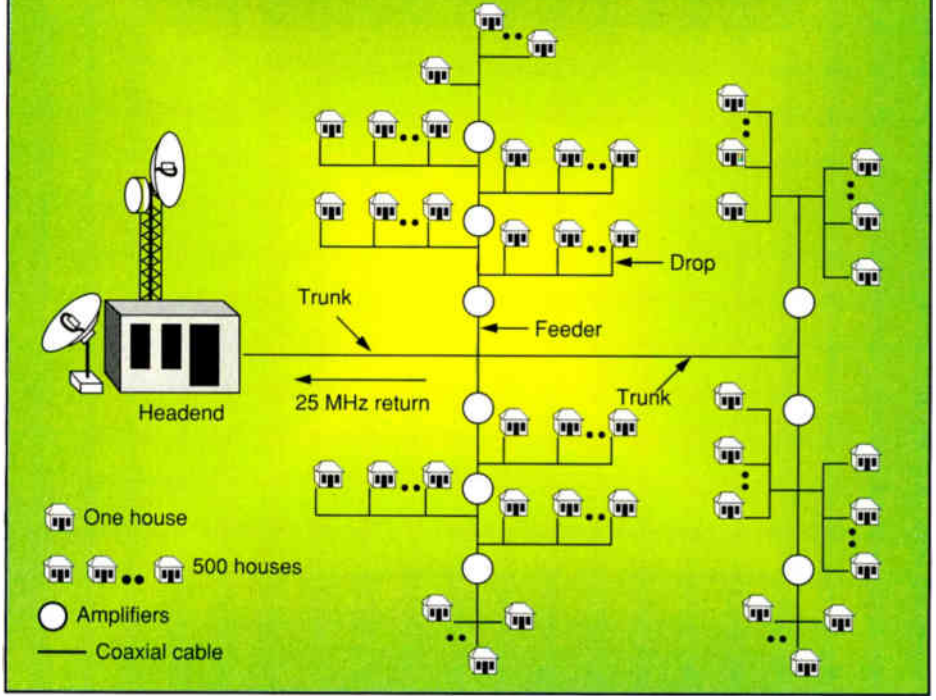
How wide bandwidth and FTF networks affect drop plant

By Mitchell Olfman
President/CEO, Electroline Equipment Inc.

Cable TV operators can assume almost nothing about the future except that it involves higher bandwidth systems, more optical fiber, intense competition for the loyalties of customers and provision of new types of services, including digital-based video and telecommunications. The early months of 1993, for example, found several cable operators moving rapidly toward a 750 MHz/1 GHz bandwidth target.

Tele-Communications Inc., for example, announced late in 1992 that it was launching an accelerated rebuild program that would outfit virtually all of its networks with fiber-to-serving-area (FSA) designs, activating to 550 MHz initially but rolling up to 750 MHz as hybrids are made available. Newhouse Broadcasting and Adelphia Communications are among the major operators expanding bandwidth up to 750 MHz as well. Time Warner Cable Group has settled on a 1 GHz platform while Viacom Cable also is testing a 1 GHz platform at its Castro Valley, CA, system. At the same time, TCI, Time Warner, Rogers, Viacom Cable and Newhouse Broadcasting, among others, are installing optical fiber ring networks connecting many headends in a city or region. All of those decisions affect the way the industry designs its headend facilities, trunk and feeder plant.

Figure 1: Traditional network has 25 MHz return bandwidth for an entire system



Headend, trunk impact

Consider headend location, for example. Traditionally, headend location has principally been dictated by real estate considerations (where suitable lots are located), terrestrial interference issues and coaxial cable loss (trunk lines can only be run so far from any headend or hub site). But especially when digital transmission and optical fiber rings are available, the headend location no longer is dictated by these earlier considerations. In essence, the headend can be located anyplace on the ring.

The advent of optical fiber technology similarly has altered industry thinking about how trunk plant is designed. Before, designers would start at a headend or hub location and work out into the plant, stretching the trunk up to the point that design signal parameters cannot be met. Noise and distortion were the primary limitations. The substitution of optical trunk for coaxial cable, however, changes all that. Today, network design begins with assumptions about types of services to be provided (how many channels of analog video, how much bandwidth for digital video, how much for new telecommunications). Those assumptions in turn drive decisions about use of the available return bandwidth using standard sub-split electronics.

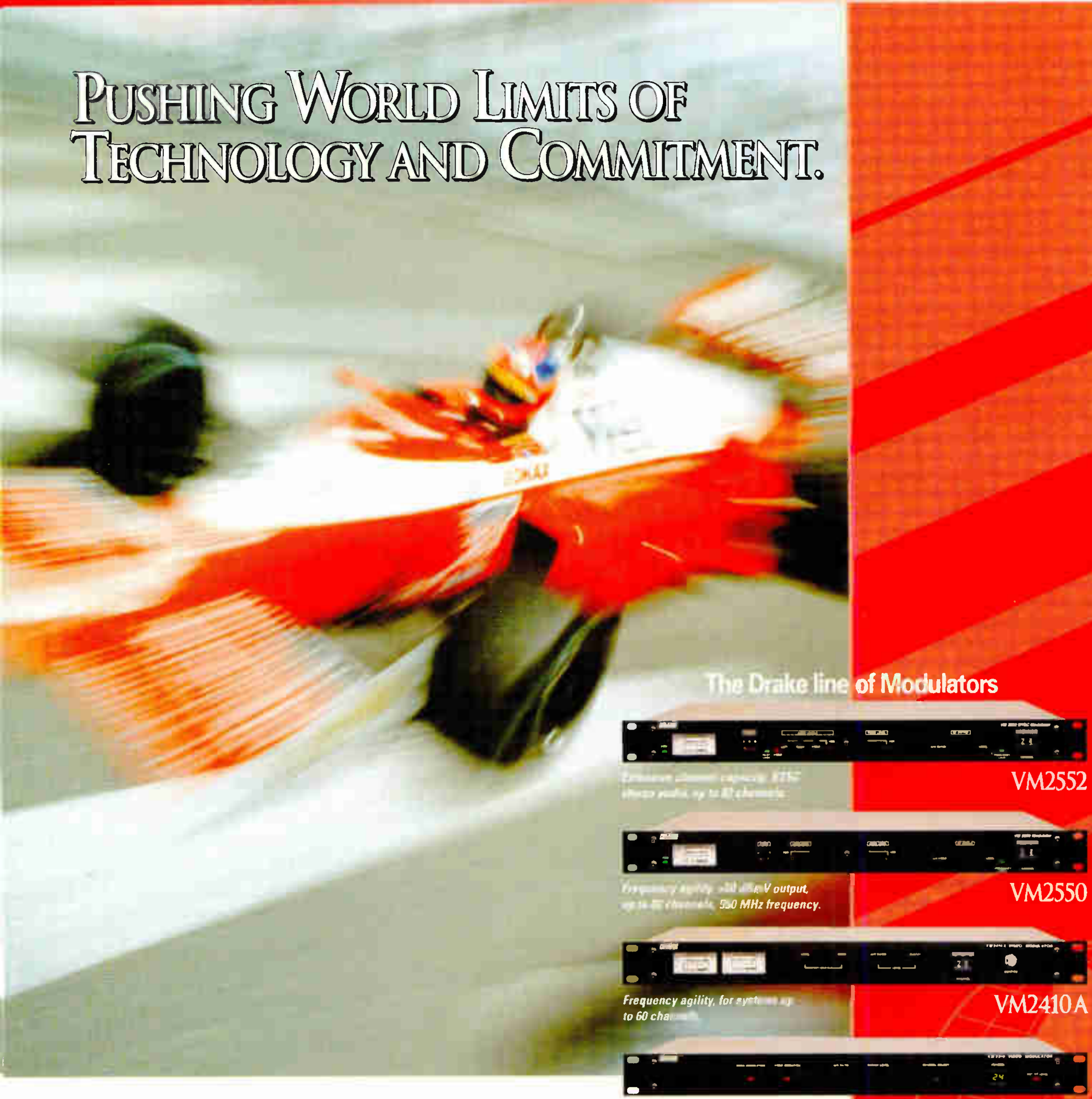
Just as cellular telephone systems break a city up into discrete areas so a given set of frequencies can be reused in the same market, cable operators can segment their networks using optical fiber so that the 5 to 30 MHz bandwidth can be reused. One way of doing this is to segment the entire cable system into discrete "serving areas" of perhaps 500 to 2,000 homes, each fed from one optical receiver. When that is done, the total network return bandwidth effectively is multiplied by the number of serving areas.

For example, old tree-and-branch networks (Figure 1) had the 5 to 30 MHz bandwidth available (at least theoretically) to all customers on a single trunkline, representing something on the order of 25 MHz return bandwidth for 10,000 passings. But assume that same cable system is upgraded with fiber, creating five optical serving areas of 2,000 homes each (Figure 2, page 96). Then each 2,000-home area has access to its own 25 MHz return bandwidth. So effective network return bandwidth now grows to 125 MHz, even though standard subsplit electronics are used.

Taking this example one more step,

(Continued on page 96)

Pushing World Limits of Technology and Commitment.



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The forgotten architecture — powering

By Margaret Gaillard
Manager, Design and Drafting
Jones Intercable Inc.

An architecture often overlooked is powering. Conventional powering is designed so the trunk and feeder actives are fed off of the same power supply. This type of powering architecture works well for cable TV but doesn't meet the needs of new and future technologies.

To address the new technologies, trunk actives should be powered with standby power supplies and feeder actives powered with non-standby power supplies. I like to refer to this powering architecture as "optimized powering" (OP). *(Editor's note: A variation of this approach is known as "hardened trunk," where the feeder is powered separately from the trunk using localized non-standby supplies. The trunk is powered with standby supplies, often equipped with status monitoring. For more on hardened trunk, see the article on outage reduction in the February '93 issue of "CT.")* Not only does OP increase powering efficiency, the annual operating costs are cheaper than conventional powering. As well, existing power grids are easier to match using OP architecture.

Gina Lemkau of Jones Intercable has been comparing conventional powering to OP. The study involved different design architectures and densities.

The first test area was designed at 550 MHz utilizing a CAN (cable area network) architecture with an average density of 50 homes per mile powered conventionally. For a 720-mile system, 389 standby power supplies were needed with an average loading of 62%. Capital needed for these 15 amp standby power supplies is $394,035. This results in an operating cost of $228,058 per year. Total cost the first year (capital and operating) is $622,893. If 15 amp non-standby power supplies are used the total first year cost is $331,143.

The same design was used for the second test area utilizing OP architecture. A total of 404 power supplies were needed with the following breakdown:

- 6 amp non-standby: 159 with an average loading of 73%.
- 9 amp non-standby: 144 with an average loading of 71%.
- 15 amp standby: 101 with an average loading of 73%.

Up front capital for these power supplies is $171,335. Operating costs are $171,102 per year. The total first year cost is $342,437. Initial first year savings provided by OP architecture is $280,455 for a 720-mile system designed at 550 MHz and density of 50 homes per mile.

The next design area utilized fiber backbone architecture at 750 MHz and a density of 100 homes per mile applying conventional powering. A 1,400-mile system would require 900 standby power supplies with an average loading of 69%. The capital outlay for power supplies is $697,500 and annual operating costs of $588,015. Total expenses first year is $1,285,515.

Powering the same system mentioned in the previous paragraph using OP architecture resulted in 1,500 power supplies with the following breakdown:

- 3 amp non-standby: 200 with an average loading of 79%.
- 6 amp non-standby: 700 with an average loading of 70%.
- 9 amp non-standby: 200 with an average loading of 65%.
- 12 amp non-standby: 200 with an average loading of 80%.
- 15 amp standby: 200 with an average loading of 76%.

Capital cost of power supplies is $451,500 and annual operating cost is $550,934, totaling $1,002,434. Primary savings of the OP architecture for a 1,400-mile system designed at 750 MHz averaging 100 homes per mile is $283,081.

The last test area was designed at 550 MHz employing fiber backbone averaging 100 homes per mile.

Powering parameters

- 15 amp standby power supplies were used on trunk actives.
- 3, 6, 9 and 12 amp non-standby the feeder actives.
- 3 amp power supplies cost $205 each.
- 6 amp power supplies cost $220 each.
- 9 amp power supplies cost $235 each.
- 12 amp power supplies cost $250 each.
- 15 amp power supplies cost $775 plus 3 batteries at $80 each.
- Electricity cost $0.12/kilowatt-hour

Powering a 1,400-mile system conventionally requires 672 standby power supplies at a cost of $542,500. Average power supply loading is 62%. Annual operating expenses are $411,482, resulting in a total cost of $953,982.

OP architecture applied to the same design scenario as the previous paragraph would require 1,428 power supplies with the following breakdown:

- 3 amp non-standby: 644 with an average loading of 70%.
- 6 amp non-standby: 476 with an average loading of 68%.
- 9 amp non-standby: 112 with an average loading of 65%.
- 15 amp standby: 196 with an average loading of 76%.

Capital outlay for power supplies is $445,500. Annual operating cost is $407,832. Total first year expense is $853,332. Utilizing the OP architecture results in an initial savings of $100,650.

The average savings of OP architecture over conventional powering seems to be directly related to the design architecture and/or densities. Fiber backbone architecture at 550 MHz and 750 MHz with 100 homes per mile has a capital savings of 33% and an operational savings of 7-10%. CAN architecture at 550 MHz with 50 homes per mile has a 45% capital and 25% operational savings. **CT**

Ham radio operators in the cable TV industry

The following is a list (in alphabetical order) of amateur radio operators employed in the CATV industry. It was compiled by Steve Johnson, N0AYE, who is in the process of adding a new category to include packet addresses for each of the hams. Please send any additions or corrections to Steve Johnson, at Time Warner Cable, 160 Inverness Dr. W., P.O. Box 6659, Englewood, CO 80155-6659; fax (303) 799-5651.

Name	Call	Company	Location
Acevedo, Nelson	KP4FEN	CATV Noroeste	San Antonio, PR
Adams, John	AB6ID	Sonic	Sacramento, CA
Adams, Mark	KA4WCB	Scientific-Atlanta	Norcross, GA
Alexander, Gary	KE5BS	Post-Newsweek	Altus, OK
Alfred, Arvid	KA7GFQ	Glacier Cablevisionn	Deming, WA
Allen, Fred	KA0YAE	TCI	New Hope, MN
Allen, Steve	KC6VCC	Jones	Roseville, CA
Almeyda Jr., William	KN4BX	Prestige Cable	Cartersville, GA
Amos, Alan	KN1O	Jerrold	Stow, MA
Anderson, David	N7PQA	TCI	Seattle, WA
Andrews, David	N1ESK	Storer	New Haven, CT
Annibaldi, Rich	N8TBJ	Pioneer	Columbus, OH
Ash, Ivan	K4IML	Consultant	Columbia, MD
Atkins, Gary	W0CGR	CSU Tech Svc.	Ft. Collins, CO
Austin, Daryl	WD8KJZ	Paragon	San Antonio, TX
Bach, Thomas	KA9PDM	Clear Cablevision	Saline, MI
Bailey, Wendell	KC3BU	NCTA	Washington, DC
Baker, James	N6WRV	USATEC	Jolon, CA
Baker, Steven	KA1OEX	Continental	St. Paul, MN
Bannister, David	KK4FL	Fairfax County	Fairfax, VA
Barnes, Richard	W4IXN	Scientific-Atlanta	Atlanta, GA
Barnes, Ron	N0PDC	Triad Comm.	Littleton, CO
Bartlett, Dave	N0CQC	TCI	Englewood, CO
Baur, Wayne	WB9HIE	TCI	Cahokia, IL
Baxter, Frank	K2ZLA	Cable Mgmt. Svc.	Schenectady, NY
Beckham, Chuck	N4XZV	Voltex Battery	Doraville, GA
Beeman, Paul	KA2MUM	Viacom	Smithtown, NY
Belyea, Brinton	W4GSF	1st Commonwealth	Gloucester, VA
Bentley, Bill	N5POB	Dimension	Midland, TX
Beuret, Kit	KH6JDE	Time Warner Cable	Honolulu, HI
Biggar, Norm	VE3MTV	Maclean Hunter	Owen Sound, Ont
Blackstone, Larry	W8FZ	Dantron	Milton, FL
Blais, Brian	N1KQQ	Continental	Springfield, MA
Packet address: @N1MEA.#WMA.MA.USA.NA			
Blanchard, David	KA0HIB	Municipal Util.	Coon Rapids, IA
Blanchard, James E.	N1FEC	Adelphia	Sandwich, MA
Blumberg, David	N1HHI	ACS	Manchester, NH
Blumsack, Harvey	W1VIK	Superior Optic	Marietta, GA
Bohnhoff, Mark	WB9UOM	M. Bohnhoff	Wheeling, IL
Borchert, Marshall	KD0DU	Riser-Bond	Aurora, NE
Borsetti, Paul	N4PMT	Scientific-Atlanta	Atlanta, GA
Bourne, Dave	WB8TMP	Pioneer Comm.	Columbus, OH
Bowen, Todd	KB5OVM	Textel Cable	Autin, TX
Bowick, Chris	WD4C	Jones	Englewood, CO
Bowles, Tom	W7VA	King Video	Seattle, WA
Boye, Greg	WB8NGA	Time Warner Cable	Columbus, OH
Bray, James R.	W0FBC	Time Warner Cable	Kansas City, MO
Brillhart, Scott	N5JJZ	TCI	Tulsa, OK
Brinkley, Chris	WA4LSW	Marks Cable	Portage Lake, OH
Packet address: @WB8BII.#NEOH.OH.USA.NA			
Brown, Bob	N0EUH	Westec	McLouth, KS
Brown, John H.	W7CKZ	TCI	Olympia, WA
Brown, Philip	WA0ZFE	Sumner Cable TV	Wellington, KS
Brown, Charles	KD4BCX	Time Warner Cable	Greensboro, NC
Brownell, Eric	KB6YI	Sonic	Sacramento, CA
Bryan, Tim O.	WH6CAD	Jones	Hilo, HI
Burns, Bob	K1RB	Continental	Brockton, MA
Burrell, John	KF0QY	Tektronix	Denver, CO

Name	Call	Company	Location
Burton, Jack S.	WB2CJS	Cablevision	Woodbury, NY
Butts, John	N2JUG	MCTV	New York, NY
Bybee, Jerry	KG7GQ	TCI	Portland, OR
Caci, Joe	KA2OCF		
Cady, Terry	KC4HPU	King Video	Tujunga, CA
Cappe, Roger	WA4PEA	Cox	Gainesville, FL
Capron, John	WB2RUQ	Philips	Manlius, NY
Carey, Bill	KC4BPK	Time Warner Cable	Fayetteville, NC
Carr, George	WA5KBH/G0	Cablevision	Bedsh Luton, UK
Carr, Mike	N4PON	Paragon	St. Petersburg, FL
Carr, Peter	WB3BQO	Montague CableTV	Montague, NJ
Carvis, Timothy	WB9ULP	NYT Cable TV	Cherry Hill, NJ
Cerino, Charles	WB3HVH	Comcast	Philadelphia, PA
Chambers, Chris	N8PAS	Cable Link	Columbus, OH
Checketts, Rick	KA0KZB	Jensen Tools	Phoenix, AZ
Chesney, Tom	WH6CED	Time Warner Cable	Honolulu, HI
Christensen, Joseph	WB7WTS	White Pine Cable	Ely, NV
Ciciora, Walt	WB9FPW	Time Warner Cable	Stamford, CT
Clayton, Francis	AH6X	Kauai Cable	Kekaha, HI
Cohen, Jeff	N1ACQ	Harron	Londonerry, NH
Cohn, Bill	N9MHT	Zenith	Glenview, IL
Packet address: @W9ZMR.IL.USA.NOAM			
Colegrove, Tom	WA6QBQ	Lectro	Santa Clarita, CA
Packet address: @K6IYK			
Colter, Dave	WA2ZCN	Block Island Cable	Block Island, RI
Coombs, Gary	N4OJW	Scientific-Atlanta	Atlanta, GA
Cordero, Francisco	KP4CJ	CATV Noroeste	Aguadilla, PR
Crown, Ron	KH6JI	Kauai Cable	Kalaheo, HI
Danekind, John	WD8PXI	Coast CATV	Cincinnati, OH
Davidson, Alan	G4PSU	ABP Ltd.	Bramley, UK
Davis, Gary	WD8LTS	Antietam Cable	Hagerstown, MD
Davis, Keith	N9IBS	Comcast	Paducah, KY
Davis, Matt	N8OCO	Cable Link	Columbus, OH
Dawkins, Al	K0FRP	Time Warner Cable	Denver, CO
Dean, Brad	K1KEK	TCI	S. Yarmouth, MA
DeHart, Steve	N2PFB	Philips	Manlius, NY
Deierlein, Peter	KD2LN	Philips	Manlius, NY
DellaGuardia, Joe	WB2WLY	TCI	Baltimore, MD
Dewey, Steve	N8JRJ	TCI	Royal Oak, MI
Dickinson, Bob	W2CCE	Dovetail	Bethlehem, PA
Dickinson, Ed	WA2FAC	Dovetail	Bethlehem, PA
Dineen, Jim	WB7RIQ	TCI	Aberdeen, WA
Ditlow, Doran A.	WA8EOW	TCI	Grand Rapids, MI
Domina, Frank	N9MXI	Zenith	Glenview, IL
Driscoll, Sean	WA2CRB	Cross Country	Warren, NJ
Dryden, James	W6KIS	Buckeye Cable	Toledo, OH
Duda, Lada	OK2BLD	Cable Plus	Ostrava, Czech.
Dudziak, Ted	WA1GPC	EIP Microwave	San Jose, CA
Dusbabek, Lee	WB6KAJ	Cableware Elec.	Brea, CA
Packet address: @WB6YMH.#SOCAL.CA.USA			
Duval, Joe	AA4JV	Hillsborough County	Tampa, FL
Dzuban, Mark	KB2IT	Cross Country	Warren, NJ
Ehman, Roy	VE6EV	Retired	Lubbock, TX
Eichenlaub, Frank	N0TPR	TCI	Denver, CO
Eide, Joe	KB9R	Time Warner Cable	Eau Claire, WI
Emig, Tim	KK4YU	Storer	Louisville, KY
Engelman, Paul	N6KZW	Continental	Stockton, CA
Epling, Jack	KC6HMP	Ventura County	West Lake Village, CA
Evanko, Steve	N2HCR	Blonder-Tongue	Old Bridge, NJ
Evans, Bill	VE4UD	EB Systems Ltd.	Winnipeg, Man
Evans Jr., Bernie	W6JMK	TeSCO	Topanga, CA
Evanyk, Walt	W8KSW	Cable Health Care	Dallas, TX
Packet address: @W5YI			
Everett, Chris	KB5GGY	Cox	Oklahoma City, OK
Faber, Randall	WA1NSL	Amer. Cable Comm.	Beltsville, MD
Farmer, Jim	K4BSE	Scientific-Atlanta	Atlanta, GA
Farmer, Jim	N4IBW	Superior Tele.	Atlanta, GA
Felker, Lex	N4LF	Time Warner	Washington, DC
Packet address: @KA4USE			

→

New directions in digital

(Continued from page 52)

A well-know hierarchy of digital interfaces based on the DS0 rate has evolved. In the U.S., this is referred to as the North American Digital Hierarchy and consists of the familiar DS1 (1.544 Mbps, a multiplex of 24 DS0s) and DS3 (44.736 Mbps, a multiplex of 28 DS1s) transmission interfaces. CCITT countries have evolved a similar hierarchy, albeit at different, incompatible rates. International connections generally are made at the DS0 level, and only then after coding translations due to differences in the DS0 PCM coders. Services requiring more digital bandwidth than DS0 have evolved using multiple concatenated DS0s, and full DS1s or DS3s as necessary. In most cases, however, these interfaces have internal structures traceable back to, or divisible into, DS0 bit streams.

Overshadowed by the large volume of DS0 traffic, other wide area

"The age of digital broadband services for the mass market is upon us."

(networked) communications systems applications have been forced to conform to the N*64 kbps, or N*DS1 interfaces that are most economically available on a universal basis. This limitation is minimal for systems that ultimately interface with voice services, but has been increasingly inflexible in addressing broadband and variable rate services. This limitation, and the increasing demand for more flexible bandwidth allocation are the major drivers behind the need for a new networking strategy, the second digital revolution.

Data communications — Variable, complex, unique

Data communications channels, involving connections between computers and between computers and (usually slower speed) peripherals, have typically not been constrained by a simple rate determining mechanism like 8 kHz * 8 bits/sample. Rather, data channel demands are typically hardware and software/application-dependent. As hardware performance and application complexity increases, so too does the demand for channel bandwidth. The demand for rapid growth and customization by application has driven data networking into a split universe — local networking systems implemented specifically for data applications and wide area networks that interconnect the local networks.

Most data communications applications differ from telephony applications in that they are not real-time sensitive. This has facilitated the development and evolution of systems that are independent of connection rate and permit the user to obtain performance on a "willingness to pay" basis. Transmission delays covering the range of "0" (bus speed) through "hours" (dial up, store-and-forward) are implemented widely in today's systems. This flexibility has permitted data communications systems to adapt to a wide range of connection environments. However, the same lack of an optimally sized transmission channel time it has limited the growth of real-time or quasi real-time systems, or in some cases limited those applications to hard-wired networks with reduced flexibility.

Video, interactive broadband, multimedia — "A worst-case combination?"

From a network developers and operators perspective, digital video and related signals, often collected under the multimedia umbrella, represent a worst-case combination of the attributes discussed previously. Delivery is real-time, often requiring high responsiveness (low delay). Bit rates cover a broad range (e.g., 500 kbps to 15 Mbps) and are often variable, and connections are long term, measured in hours. Additionally, many video-related services will be highly asymmetric, requiring only a few kilobits per second upstream while requiring many megabits in the downstream (to the customer) direction. Note also that while upstream control messages may be of low average bandwidth, the high responsiveness requirement will in general require a high bit rate channel, either continuous or on a burst basis.

"Today's best answers will give way to better ones as the marketplace evolves and consumer demand defines new applications."

The challenges on network architecture and deployment represented by multimedia sources are not unique to broadband CATV networks. However, the fact that a high percentage of the digital traffic on future CATV networks will be digital video emphasizes the need for a solution. Payload characteristics for all networked services, voice data and multimedia, are evolving toward a common set of characteristics, data message/multimedia-oriented with wide variations in bit rate and delay tolerance. In general, a network structure offering bit rate, delay and routing flexibility with grades of service that can be appropriately tiered for costing considerations is required. CATV does have the opportunity to focus on a network optimized for multimedia, since it does not have a significant investment in first-generation digital networks. However, the broadening of CATV services into the telephony-like communications services necessitates the development and deployment of a compatible strategy, perhaps optimized for multimedia as a dominant payload.

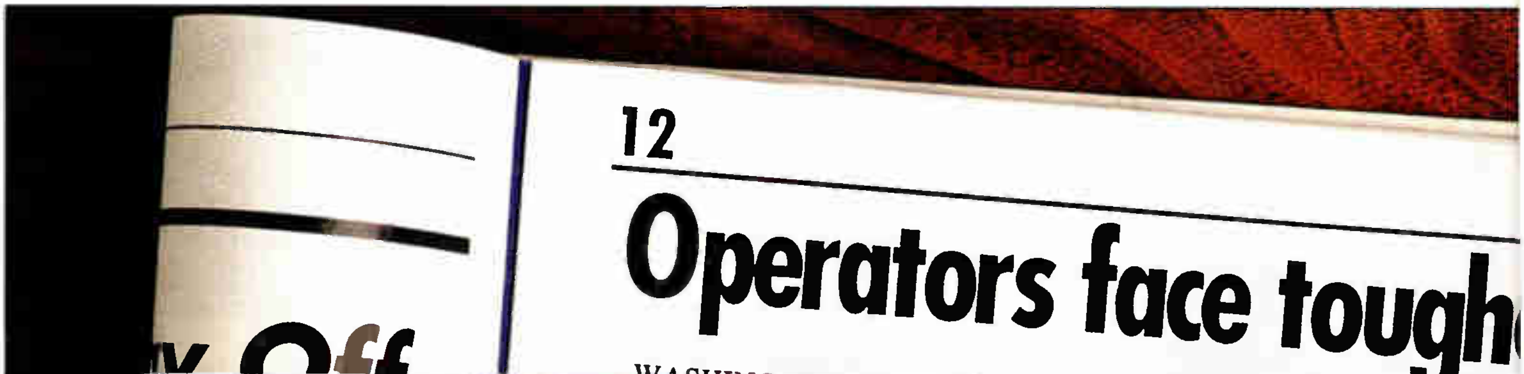
Network modeling — Evaluating alternatives

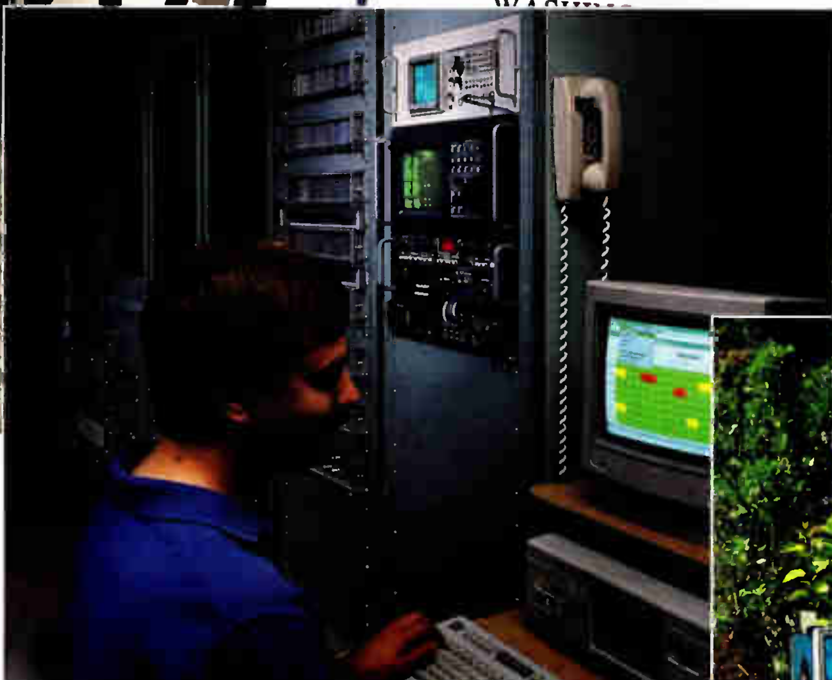
The development of open networking and protocol standards for communications systems has been facilitated by segmentation of the overall problem into well-identified functions or layers. The ISO 7 layer protocol stack for open systems interconnection (OSI) is a good example. This structured analysis technique leads to improved understanding of end-to-end interface issues, with or without interconnecting networks, and provides a well-understood basis for evaluation of alternatives.

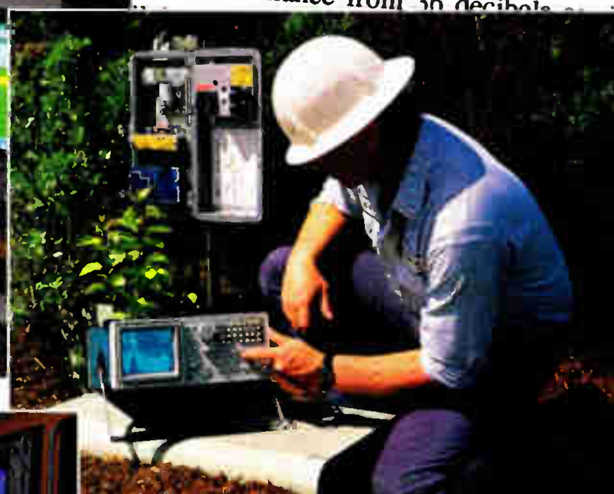
A layered network model

Having analyzed the networking challenges in CATV broadband net-

No problem!







(ABOVE) THE CMP500 CABLE TELEVISION MEASUREMENT PACKAGE — COMPLETE BASEBAND VIDEO AND RF MEASUREMENT CAPABILITY, INCLUDING ALL FCC PROOF-OF-PERFORMANCE REQUIREMENTS.

(RIGHT) A WAVEFORM MONITOR, VECTORSCOPE AND NTSC GENERATOR CONSTITUTE A LOW-COST SYSTEM FOR EFFECTIVE BASEBAND MONITORING.

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r technical standards

to comply with the new set of standards, operators will be required to conduct baseband video proof-of-performance tests. Specifically, these will include chrominance-luminance delay inequality, differential gain and differential phase measurements.

In order to create a uniform, nationwide scheme, the FCC said its standards will preempt local standards. However

rural cable systems serving fewer than 1,000 people will be allowed to negotiate with the franchising authorities for less restrictiv allowed redu

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works, a layered model for CATV networking as shown in Figure 1 on page 52 is proposed. Recognizing that there is no single best model for this application, this approach is proposed as a basis for comparison of various networking options and need not relate directly to physical interfaces between discrete equipment elements. In many cases, the provision of a virtual interface within an equipment element will facilitate future enhancements to the network.

- *Layer 1 — physical layer.* The lowest layer on the stack is the physical medium itself. In CATV systems, the obvious candidates are coaxial cable, fiber-optic cable and satellite links. Others might include wireless channels such as direct microwave distribution systems and perhaps even twisted-pair copper cable. These physical media support various bandwidths and in general are capable of supporting several modulation schemes, often simultaneously. In this model, the manner in which a particular physical layer is used will be defined by the second layer.
- *Layer 2 — transport layer.* The transport layer in this model defines the transmission or modulation format to be used on the physical medium and any channel processing (e.g., forward error correction) that is required in applying that format. Options such as quadrature phase shift keying (QPSK), quadrature amplitude modulation (QAM), vestigal sideband (VSB) and binary digital keying (return to zero, RZ, or non-return to zero, NRZ) are a few of the most likely digital modulation techniques for CATV digital applications. If using the model for a traditional AM system, AM-VSB and frequency modulation are typical formats for CATV.

"Simple math on the 5 byte header, 48 byte data cell concept will reveal that the basic (ATM) format is about 89% efficient."

If frequency division multiplexing (FDM) is used with the system, as is typical for all but the RZ/NRZ digital modulation options, then the modulation process is followed by appropriate frequency translations, bandpass filtering and broadband combining.

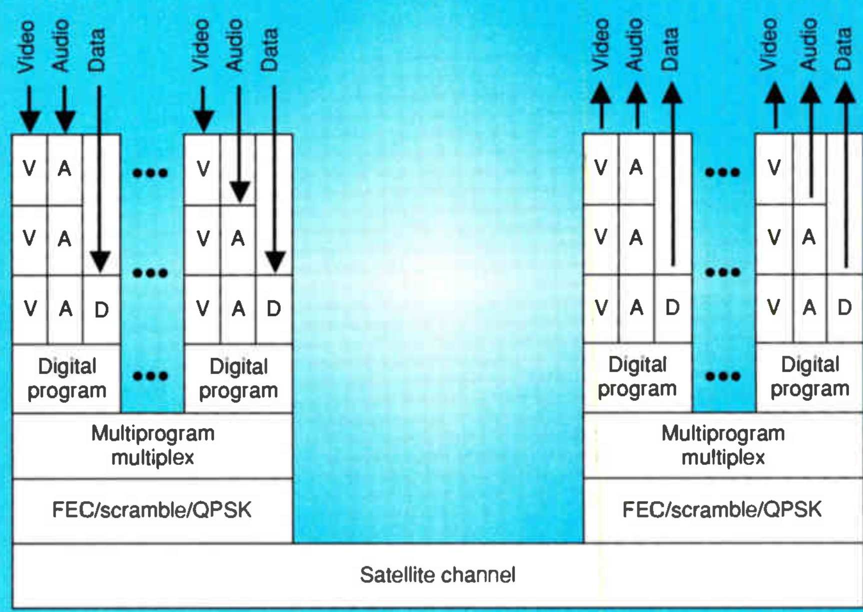
- *Layer 3 — multiplex layer.* Multiple information or program streams are combined in the multiplex layer. In digital systems, this step typically combines N "low-speed" signals into a single "high-speed" signal for interface to the transport layer. Combining rules and multiplex formats will be dependent on the interfaces chosen.
- *Layer 4 — program layer.* In the program layer, multiple related source streams are combined to create a single "package" called a program or perhaps more generally, a service. For example, a video stream and its related audio stream(s) and control (data) streams are processed so that in lower layers they appear as one stream, the program. This process may be defined as placing the streams in a well-defined frame format or simply adjusting bits in the headers of the component data packet streams. In the latter case, the program stream can contain several virtual channels, with real channels created on the fly by a program

layer that chooses specific data packet streams based on a program map that is downloaded or in some alternative manner delivered to the receiver.

In the case of a traditional AM CATV system, the program layer might be considered the step where video and audio channels are combined via subcarrier modulation to create the baseband NTSC video signal. Work in the MPEG 2 Systems Group is presently focused on developing program assembly standards for digital programs.

- *Layer 5 — encryption layer.* In digital systems, encryption of the bit stream can be applied at several levels in the process. In this model, we define the encryption layer to exist at the point where components (audio, video, data) of the program are identifiable and may wish to be individually encrypted.
- *Layer 6 — signal processing layer.* Each of the program components may pass through a processing step such as compression or transcoding, depending on the nature of the service.
- *Layer 7 — conversion layer.* The highest layer in this model provides an interface to the "outside world" that seeks to isolate the lower layers from the wide variety of signal sources. The conversion process is unnecessary if all signal sources are already in a format appropriate for the lower layers. Conversions might be a simple as translation from parallel digital-to-serial digital, or as complex as analog NTSC-to-serial digital component video (D1/CCIR 656).

Figure 2: Satellite uplink - headend downlink



Interlayer interfaces

One of the goals in applying a structured design approach to network design is to define interfaces that can be implemented by evolving technologies and therefore by various sources (equipment vendors). A good example for CATV networks is AM fiber technology as deployed today. The traditional interface to Layer 1 was a 75 ohm physical connection to the cable. AM fiber systems replace the coax with 75 ohm ports on laser transmitters and optical receivers. Higher layers in the network need not be modified and in fact are unable to distinguish the fiber-based Layer 1 from a coaxial one.

The definition of layer-to-layer interfaces becomes more complex in higher layers as the functionality of the layer processing increases. For this transport-oriented discussion, focus on interfaces at Layers 1, 2, 3 and 4 is appropriate. The end objective of a network based on this model is to provide services to end customers. Customers will be particularly satisfied if the manner in which they receive service is totally transparent to them (i.e., the same high-quality picture on their home TV sets whether delivered via a 200-channel AM-VSB system or a 200-channel compressed digital system). At an even lower level, those same customers need not care what transport medium was used to provide that service. This transparency assumes of course that it is physically possible to provide comparable services. Customer satisfaction with a video-on-demand (VOD) system based on a 500-channel compressed delivery system may be impossible to achieve, at least economically, with available AM technology, for example.

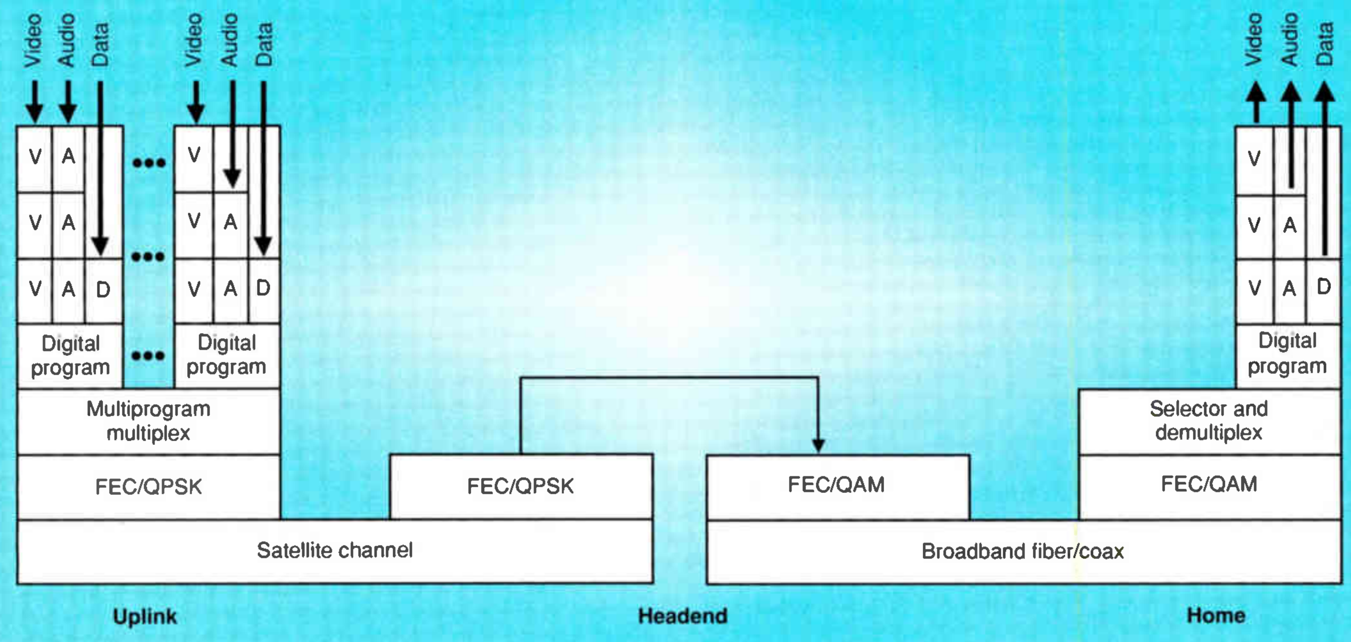
The transparency objective from the network providers perspective is to make several implementation options equivalent in terms of performance and functionality. These options might include purchasing equivalent or interoperable transport systems from several vendors or using different media and transport systems in various parts of the network, freely interconnecting them as necessary. Given the rapid pace of service evolution, it is particularly important that new networking architectures place as few constraints as possible on the nature of the program or service stream as defined previously. More specifically, avoiding constraints such as "only N * 64" deserves high priority as new services enter the marketplace.

ATM and Level 2-to-Level 3 interfaces

Asynchronous transfer mode is a broadband digital networking concept developed by CCITT committees to address the need for a flexible, universal transport capability for voice, data, video and other new services. It is in its initial deployment phases now, as ATM capability is seeded into existing Layer 1 and Layer 2 facilities. Although often considered to be a SONET-only transport standard, it is in its most general form simply a continuous stream of 53 byte packets, referred to as cells to indicate their fixed-length nature. Five bytes of every cell, the header, contain information about the nature of the 48 byte payload, where it is headed to (routing information) and other network defining elements. ATM descriptions abound in the literature, so here we will focus only on ATM's appropriateness for this application.

ATM provides two major benefits when used in the Level 3 to Level 2 interface. First, the multiplexing and demultiplexing processes that are implemented in Layer 3 need follow only simple rules, there is no complex frame format associated with the interface. Multiplexing is simply combining cell streams from multiple sources as cells become available. If a multiplex runs out of input cells to the combining process, it substitutes dummy or stuff cells. Bandwidth is available on an as-needed basis, permitting a wide range of rates for indi-

Figure 3: Satellite uplink - headend downlink - digital to home



vidual services or service components. Secondly, interfaces are asynchronous. The only limiting factor on the process is that some higher level control mechanism ensure that the total cell rate into the process be less than or equal to the output rate of the combiner.

A potential drawback to using ATM in video networks is throughput efficiency. Simple math on the 5 byte header, 48 byte data cell concept will reveal that the basic format is about 89% efficient. While competitive with traditional broadband digital transport framing formats, recovering some of this lost efficiency is currently a topic of discussion and a subject for consideration in establishing a network architecture. One proposal currently before the MPEG 2 Systems Subcommittee proposes a 192 byte cell structure, suitable for use as a transport format or easily converted into 4 ATM cells when required for transport on pure ATM networks.

Using the model — CATV digital networks

The analysis model of Figure 1 (page 52) can be used to analyze various network configurations for flexibility and extensibility. A simple example is shown in Figures 2 (page 79) and 3. In Figure 2 we model a simple satellite uplink to headend downlink, a simple one-hop network. Then, at some later date, the headend serves as a digital interconnect point between the digital satellite link and a digital CATV cable link, as in Figure 3. Using the model as a building block, evaluate your network evolution plans.

Summary

A major responsibility of network architects and planners is to ensure that a flexible path exists for future services evolution and network expansion. In many cases, expansion will mean interconnection and sharing of capacity with telephony-oriented networks, broadband digital links based on ATM and SONET. CATV networks, adding digital connectivity in the near future, are poised to take advantage of the most current trends and technologies. Careful analysis of present and future needs will ensure the maximum return for your network dollar. **CT**

Transporting analog and digital

(Continued from page 55)

the digital signaling is to analyze the digital eye pattern and measure the bit error rate before and after injection of the 1,310 nm AM signal. However, in setting the optical input power at the digital receiver threshold, any significant amount of additional noise from the 1,310 nm signal will cause the receiver to move below threshold.) The recovered digital video is remeasured and found that no change in video performance has occurred. All RS250C medium haul specifications are met and video S/N remained constant at 61.3 dB.

Next, the same analog channels are remeasured to determine if the 1,550 nm digital signal has any impact on the 1,310 nm AM signal. The CSO and CTB showed no measurable degradation. However, a full 2 dB rise in the noise floor was observed throughout the entire 50 to 550 MHz RF spectrum. The values for CSO, CTB and C/N are shown in Table 1 (page 55) under the heading "With digital." Figures 2 (page 55) and 3 respectively show the C/N measure-

Figure 3

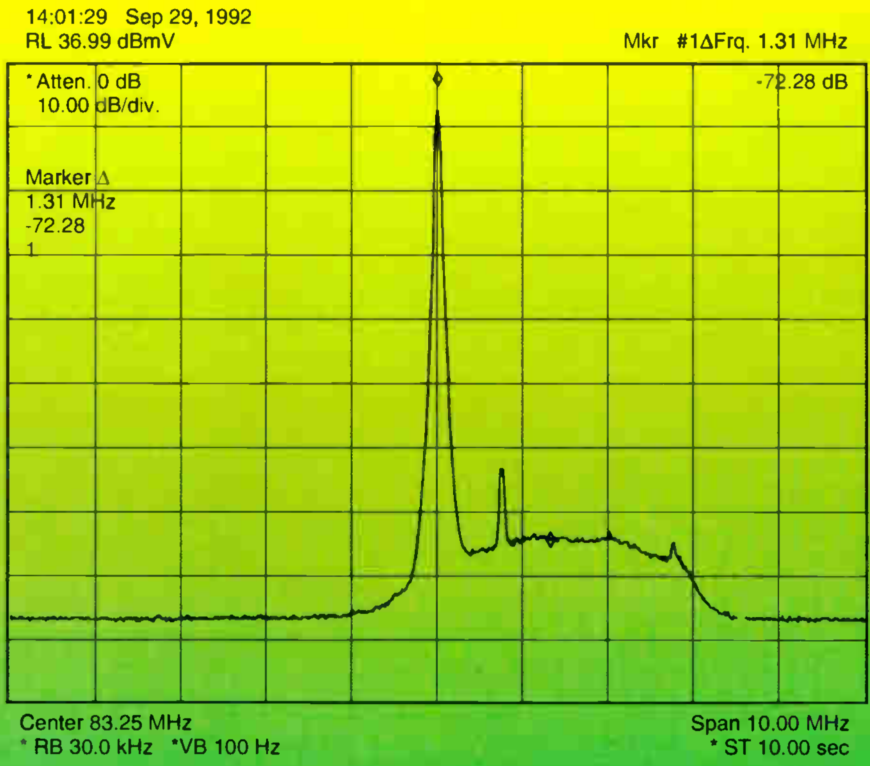
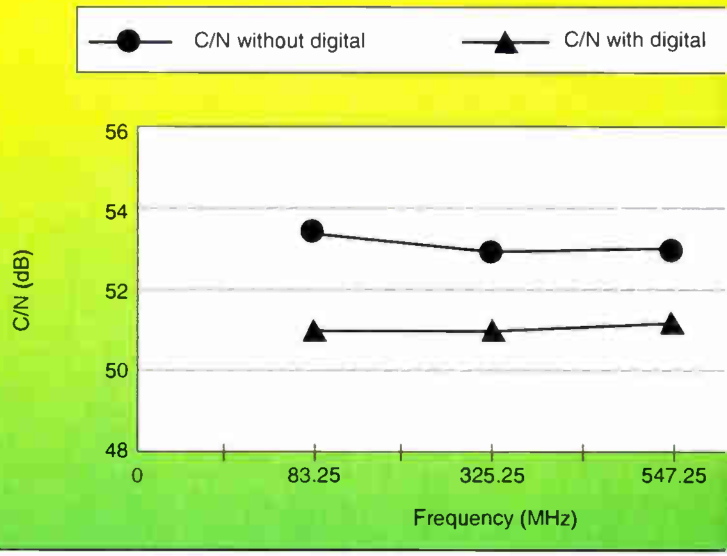


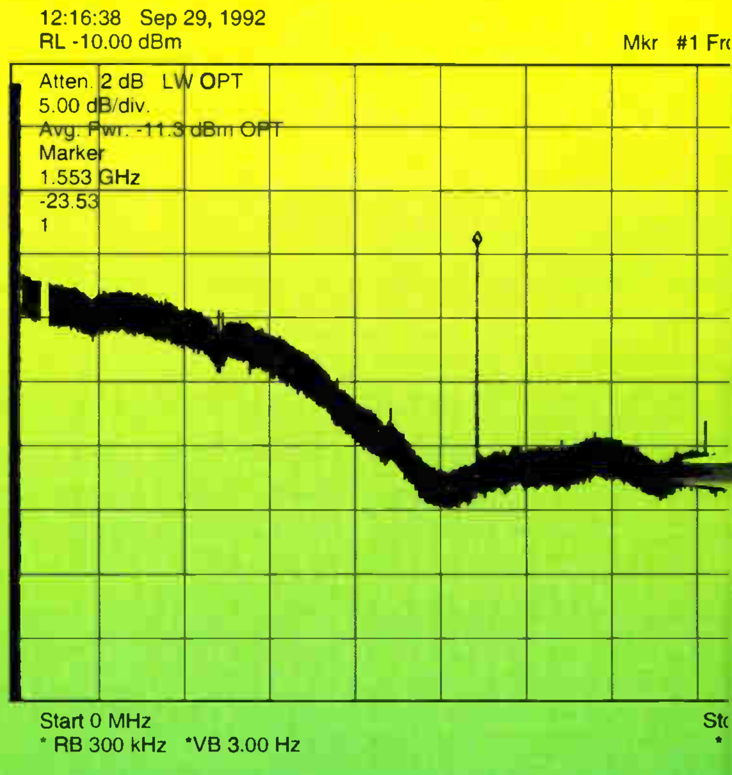
Figure 4: C/N for analog system with and without the presense of unidirectional digital data at 1,550 nm

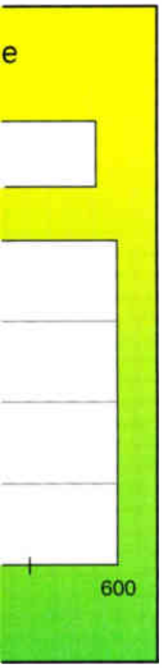


ment at 83.25 MHz without and with the digital signal activated. Figure 4 shows the C/N data points of the 1,310 nm signal both with and without digital.

The probable cause for this degradation is insufficient isolation within the WDM devices. A spectrum analysis of the 1.6 Gb/s NRZ digital signaling is shown in Figure 5. The figure shows the typical sin(x)/x function of an NRZ signal. To an analog system, however, this appears as random noise. Despite being nearly 40 dB down in level from the 1,310 nm AM signal, the detected optical power from the 1,550 nm signal has sufficient level to cause an impair-

Figure 5





ment in the 1,310 nm AM system. The result being an increase in the noise floor, thus, degradation in the C/N. To improve isolation, two or more WDM devices can be cascaded at the expense, however, of additional insertion loss.

An equation is given showing the relationship of the noise contribution from different sources to the total C/N. The total C/N in the WDM system is expressed as:

$$C/N_{TOT} = 10\log(C_A \div N_A) - 10\log[1 + (N_D \div N_A)]$$

$$= C/N_{AM} - 10\log[1 + (N_D \div N_A)]$$

Where:
C/N_{TOT} = total carrier-to-noise ratio
C/N_{AM} = carrier-to-noise ratio of the AM system
C_A = amplitude of AM carrier
N_A = noise contribution from AM system
N_D = noise contribution from digital system

As the noise contribution from the digital system approaches zero, the total C/N equals C/N_{AM}. Therefore, as WDM isolation increases, there is less noise contribution from the 1,550 nm digital signal.

Another consideration is the relative optical power levels of the two signals. A lower optical launch power of the 1,550 nm signal results in a lower 1,550 nm level at the analog receiver. The 1,550 nm signal will, therefore, have less impact on the 1,310 nm AM signal. If the ratio of AM optical power at 1,310 nm to digital optical power at 1,550 nm increases, then an improvement should be seen in the C/N of the 1,310 nm AM signal.

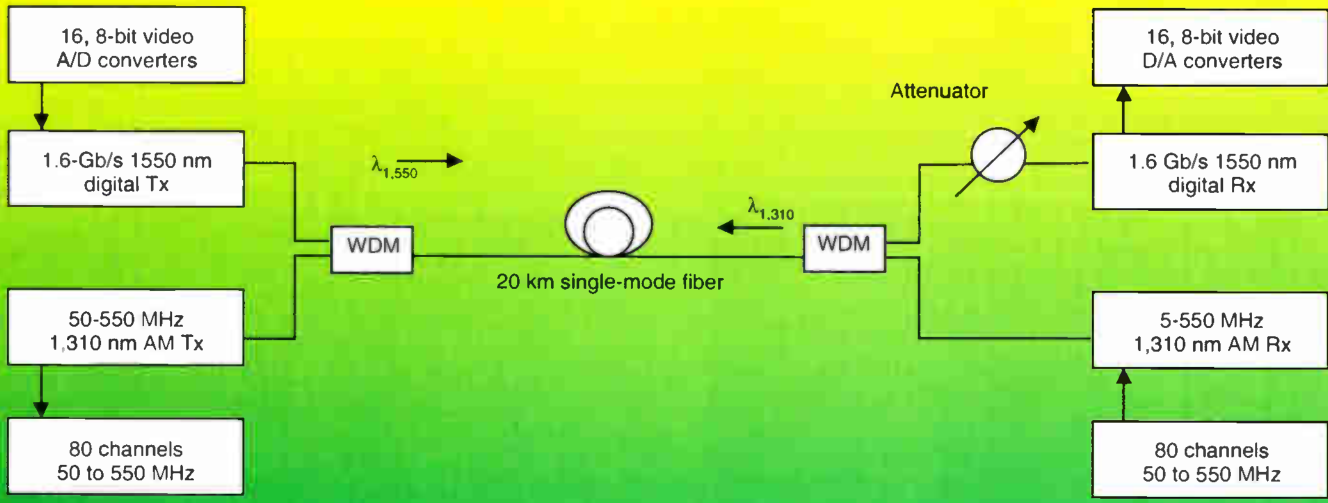
A relationship exists between relative optical power and isolation. The greater the isolation of the WDM, the larger the difference in relative optical power between 1,310 and 1,550 nm.

Given the relationship in WDM isolation, relative optical power levels and C/N, it is believed that any signal at 1,550 nm, regardless of modulation (analog or digital), could cause an impairment in a 1,310 nm AM system. This implies that two unidirectional AM systems, one operating at 1,310 nm and the other at 1,550 nm, can potentially interfere with one another. Further testing on unidirectional WDM AM systems is needed to verify this assumption.

Bidirectional transmission

The system is reconfigured as shown in Figure 6 on page 86. The same procedures are used for testing each system as outlined previously. Each system is first tested while the other is turned off to form a baseline for comparison. After both systems are activated and coupled into the fiber, the testing is repeated to determine if either system has an effect on the other. During bidirectional transmission we observed no measurable impairment of the 1,310 nm AM signal due to the presence of the 1,550 nm digital signal and vice versa. The values for CSO, CTB and C/N from the 1,310 AM both with and without the presence of digital at 1,550 nm are shown in Table 2 on page 88. →

Figure 6: Lightwave WDM system for bidirectional transmission of digital video and analog AM signals



Conclusion

Wavelength division multiplexing is commonly used in communication networks to expand the capacity of optical fiber. This experiment shows that both analog and digital signals can coexist on the same fiber; provided one pays attention to the isolation of the WDM devices and the relative optical power ratio between the 1,310 nm and 1,550 nm signals.

We have demonstrated a 1,310/1,550 nm WDM lightwave system that transports 80 channels (55.25-547.25 MHz) and 16 uncompressed digital video channels. The analog system uses a directly modulated DFB laser operating at 1,310 nm. The digital signal is a 1.6 Gb/s synchronous TDM digital system operating at an optical wavelength of 1,550 nm. Both systems are typical "off-the-shelf" components that are currently, and in-

Table 2: CSO, CTB and C/N performance at 1,310 nm on a bidirectional WDM system with and without 1.6 Gb/s digital video at 1,550 nm

	CSO		CTB		C/N		
Channel	Without digital	With digital	Without digital	With digital	Without digital	With digital	C/N Δ
83.25 MHz	-66.8 dB	-66.4 dB	<-68.0 dB	<-68.0 dB	53.1 dB	52.9 dB	0.2 dB
325.25 MHz	-62.6 dB	-62.8 dB	<-68.0 dB	<-68.0 dB	51.8 dB	51.9 dB	0.1 dB
547.25 MHz	-61.5 dB	-61.0 dB	<-68.0 dB	<-68.0 dB	52.8 dB	52.9 dB	0.1 dB

dependently, being used in a variety of CATV applications. No modifications or special alignment was performed on either system prior to, during or after testing.

Both unidirectional (same direction) and bidirectional (opposite direction) signal transmission were tested. The digital system showed no degradation in either unidirectional or bidirectional transmission. The AM system exhibited no measurable impairment in CSO, CTB or C/N when operation was bidirectional. However, in unidirectional operation, the C/N of the AM system was degraded by 2 dB.

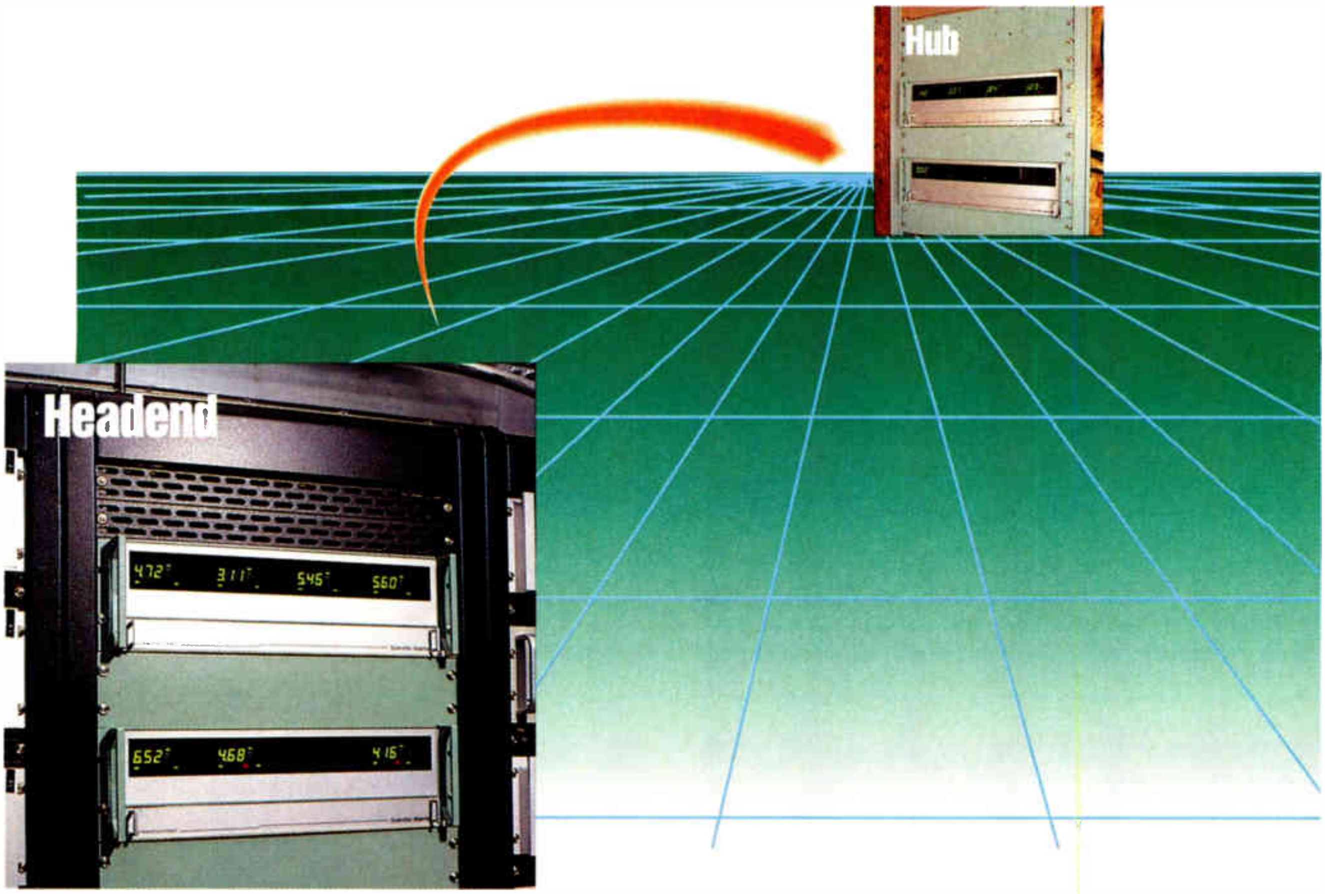
There are two causes for the lowering of the C/N in the AM system. The first has been attributed to insufficient isolation of the WDM. The second is due to the relative optical power at 1,550 nm. While the 1,550 nm energy present at the 1,310 nm port of the WDM is measurably small, it represents enough power to cause a rise in the noise floor in the recovered AM channels.

To gain additional isolation, two or more WDM devices can be cascaded. The added insertion loss from cascading multiple WDM devices is predictable and can be accounted for during the network system engineering. To gain a higher AM-to-digital power ratio, the digital system can be operated at a lower optical launch power. Additional testing is required to determine the precise relationship between WDM isolation, relative optical power and AM C/N.

This test also has demonstrated the robust nature of a synchronous digital transmission system. While the payload was 16 uncompressed digital video channels, a variety of digital formats also can be transported with same results — no degradation in digital system performance. This implies a wide range of applications including high-quality broadcast studio links, distant learning programming and transmission of SONET (*syn*chronous *o*ptical *net*work) compatible data all on the same optical fiber with AM signals.

As a final note, while the 1,550 nm signal in this experiment was digital, it is believed that a 1,550 nm AM signal will have a similar impact on a 1,310 nm AM signal when both systems are operated unidirectionally through wavelength division multiplexing. **CT**

Digital Fiber Performance at a Fraction of the Cost.



Only Scientific-Atlanta has the Dual Wavelength AM Supertrunk, a low cost, high performance alternative to digital and FM fiber systems.

Simplicity

The Dual Wavelength AM Supertrunk is simple and straightforward. Because it requires no signal conversion, the AM Supertrunk is ideal for digital compression, scrambling and digital audio applications.

And, in terms of size, a 7-tier AM Supertrunk takes up a fraction of the rack space of a comparable digital or FM system. That means less real estate and lower capital costs.

Economy

No signal conversion also means less equipment to buy, install and maintain. So, you can have an AM Supertrunk for about half the cost of competing technologies.

While digital systems deliver only 8 scrambled channels on a single fiber, the AM Supertrunk can carry 20 to 40 channels per fiber. The system is completely transparent to digital compression and scrambling schemes. This gives you significantly reduced fiber costs.

Performance

The AM Supertrunk delivers near headend quality signals to remote hub sites. That makes it well-suited for headend interconnections and remote hubbing in Fiber-to-the-Serving Area (FSA) applications. The modular design of the AM Supertrunk allows you to increase bandwidth without affecting performance simply by adding a single transmitter and receiver.

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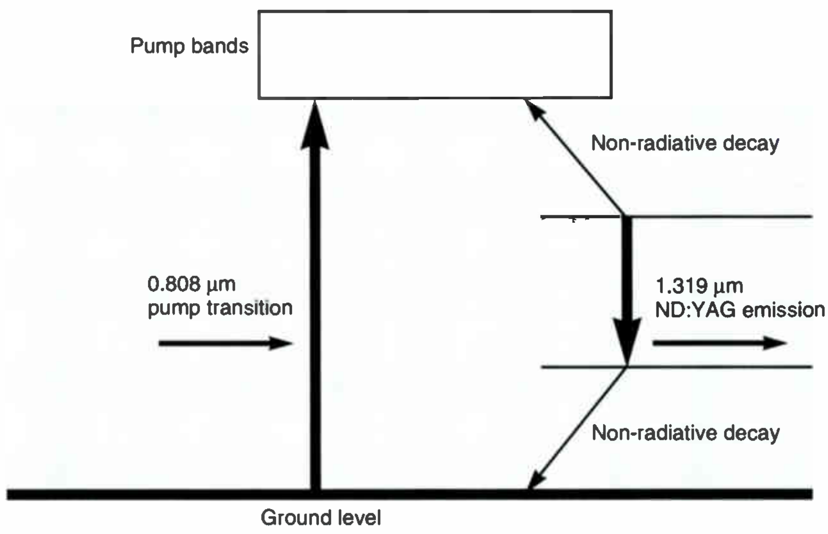
Figure 5: Simplified energy level diagram of Nd:YAG



External modulation system

(Continued from page 58)

• *Environmental requirements.* Until recently, Nd:YAG lasers and $LiNbO_3$ modulators had been used at room temperature and in environmentally controlled laboratory conditions. For the CATV environment, the laser and modulator are designed to operate inside a transmitter, which can be subject to ambient operating temperatures of 0°C to 50°C and storage temperatures of -40°C to +70°C, as well as shock and vibration during shipping.

$LiNbO_3$ modulator

The structure of an $LiNbO_3$ dual-output integrated optics modulator is depicted in Figure 6. This balanced bridge interferometer implements a modified design of the well-known Mach-Zehnder interferometer modulator. Integrated optic modulators generally are constructed by patterning optical waveguides into an $LiNbO_3$ substrate by means of microlithographic techniques and depositing electrodes on top of the waveguides. The interaction between the electrical and optical fields results in amplitude modulation of the light beam. The light from the Nd:YAG laser enters the input wave-guide and is split equally at a Y junction feeding two arms of a balanced bridge interferometer. An electro-optic coupler mixes the two light beams and routes them to the two outputs. The electrical signal applied to the electrodes generates intensity modulated lightwave signals at the two outputs. The light vs. voltage transfer characteristic of the device is given by:

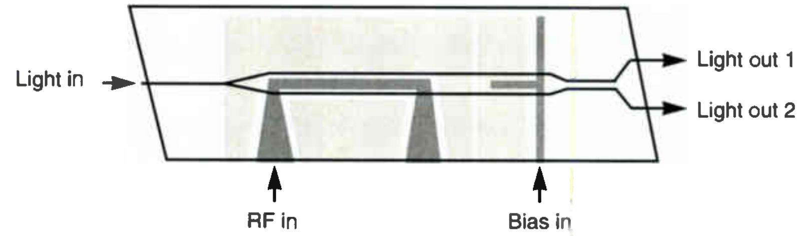
$$P_{\pm} = P_o[1 \pm \sin(\pi V \div V_\pi)]$$

Where:
$P_{\pm}$ = optical power outputs (the ± signs apply to the upper and

lower optical outputs respectively)
V = applied RF voltage
P_o = the average optical power output at each port
V_π = a constant called the half-wave voltage, namely the voltage required to switch any optical output from full extinction to maximum

The raised sine transfer characteristic of one of the outputs is depicted in Figure 2 on page 56. Compared to a traditional Mach-Zehnder integrated optic modulator, the balanced bridge interferometer is twice as efficient in terms of its optical power utilization.

Figure 6: Balanced bridge interferometer electro-optic modulator



The ideal bias point for CATV signals is the so-called quadrature point Q (half power point in Figure 2), around which the AC transfer characteristic is an odd function:

$p = \sin(q)$ with $q = \pi V \div V_\pi$

Where:
p = normalized output power

At the Q point the even orders of intermodulation are nulled out (i.e., the CSO distortion becomes negligible).

The bias point of the device is determined by its geometry (e.g., an imbalance in the lengths of the two interferometer arms). Temperature variations and stress may cause the bias point to drift a small fraction of $V\pi$ away from the Q point. Such drifts are slow, with time constants of minutes or even hours. However, a tracking DC voltage applied to the bias electrode can ensure operation at the Q point. This property is utilized in the realization of a robust parametric feedback control system to be described. This system nulls out the CSO of the transmitter over the instrument's lifetime, resulting in CSO performance superior to alternative direct modulation laser technology.

CTB linearization

Expanding the nonlinear compressive characteristic in a power series

$$\sin(\theta) = \theta - \frac{1}{6}\theta^3 + \frac{1}{120}\theta^5 + \ldots \text{ with } \theta = \sum_{i=1}^{N} m\cos(w_i t + \phi_i)$$

it is apparent that once the modulator is tightly maintained at its Q point by the parametric control system, the CSO distortions are eliminated. Thus, the system becomes limited by odd orders of distortion and intermodulation products (i.e., CTB distortion).

For example, assuming N = 60 and m = 0.036, injecting 60

NTSC channels into an unlinearized modulator at a modulation index of 3.6% per channel would result in an unacceptable CTB of -39 dBc.

Two approaches to the linearization problem have resulted in realizable systems: the feedforward and predistortion techniques. The feedforward method requires additional lasers to supply feedforward corrective signals. Distortion correction effectively occurs in the optical domain in the receiver photodiode. This method is therefore complex and requires electrical compensation for the fiber chromatic dispersion associated with lasers at different wavelengths, thus is potentially sensitive to the topology of the optical distribution system.

The alternative approach uses broadband predistortion linearization (Figure 3 on page 58). This technique takes advantage of the fact that external modulators have a consistent and stable transfer characteristic, generally unaffected by optical power, temperature and aging.

Because of this unique property, it is possible to conceive a broadband two-port network — called linearizer — to precondition the RF signal. The linearizer is inserted between the transmitter RF input and the electro-optic modulator. The result is a substantially linear overall transfer characteristic. To this end, the linearizer should have an expansive characteristic, since the modulator transfer characteristic is compressive.

Formally, let the linearizer transfer characteristic be $V = f(V_{in})$. The overall light power vs. voltage transfer characteristic of the linearized source is given by:

$$p = \sin[(\pi \div V_\pi) f(V_{in})]$$

If the shape of the nonlinear transfer characteristic of the linearizer is chosen to satisfy:

$$f(V_{in}) = [(g^{V_\pi} \div \pi)\sin^{-1}(KV_{in})]$$

Where:
K = some arbitrary gain factor
g = a scaling factor that is ideally unity (g = 1)

the resulting linearized transfer characteristic is linear: $p = KV_{in}$

This description of the linearization process is oversimplified since it neglects frequency-dependent effects. A more complete description of the linearization process in the frequency domain is that the linearizer should generate distortion products that are equal in amplitude but opposite in phase with the distortion products generated by the modulator. In practice, a vectorial cancellation of intermodulation products from 50 to 550 MHz must be achieved. A measure of the degree of linearization is the CTB suppression, which is defined as the difference between the CTB generated by the unlinearized and linearized modulator. A CTB suppression of about 17 dB for 50 modulated carriers at a modulation index of 3.2% yielding a CTB of -60 dBc was previously reported.[2]

A new proprietary linearization circuit provides suppression in excess of 26 dB for 60 unmodulated carriers at modulation index of 3.6% resulting in CTB of <-65 dB. Furthermore, the same level of suppression is achieved with 80 unmodulated carriers at a modulation index of 2.8%.

CSO and CTB closed loop control

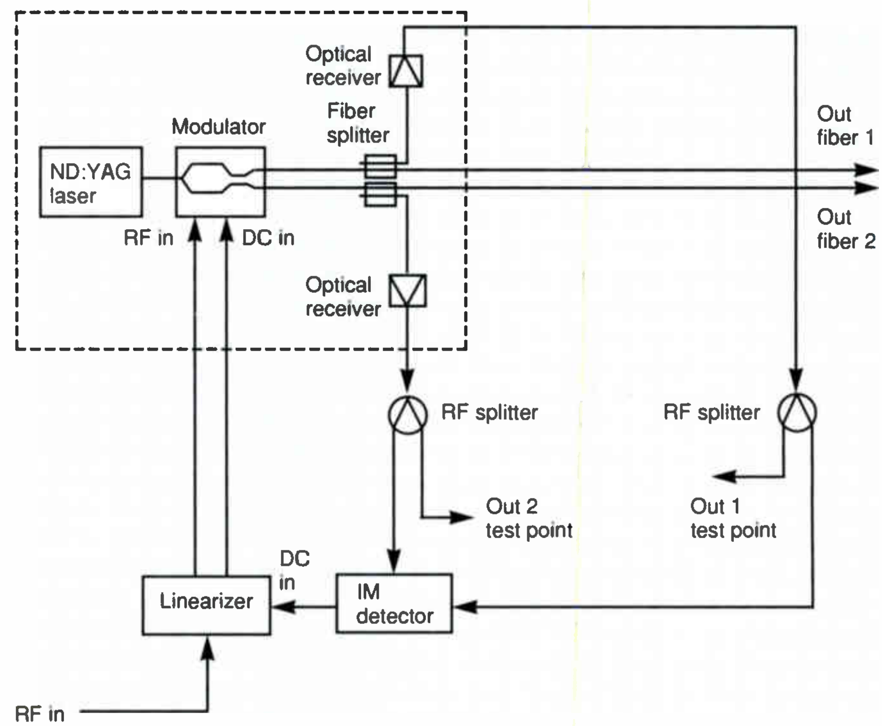
The long-term CSO and CTB performance of the transmitter is maintained by a closed loop parametric control system (Figure 7). Such loops are called parametric since the quantity that is fed back is a slowly varying quasi-DC signal obtained by processing of intermodulation beats. The CSO loop senses deviations of the modulator Q point away from the optimal bias point, and supplies a correction voltage to the modulator driver's bias control voltage so as to null out the CSO of the transmitter. The operation of this parametric control loop results in the modulator always being biased around Q point such that the CSO is <-65 dBc.

A separate closed loop is used to control and maintain CTB performance of <-65 dBc. This is done by controlling the relationship between the gain and the nonlinearity of the linearizer. The combination of these robust loops assures minimum CSO and CTB distortions and stable long-term operation.

System considerations

AM fiber CATV systems are known to require ever increasing optical power, either for better carrier-to-noise ratio (C/N) performance, longer reach or to feed multiple receivers by optical splitting. The C/N of an AM fiber link is given by: →

Figure 7: External modulation transmitter with predistortion linearization and parametric CSO & CTB control



$$C/N = 10\log_{10}\frac{(mRP)^2 10^{-2L/10}}{2B(2qRP\,10^{-L/10} + I_a^2 + R^2P^2 10^{-2L/10} 10^{RIN/10})}$$

Where:
m = modulation index
R = detector responsivity
P = transmitter power
L = link loss in dB
q = electron charge (1.6×10^{-19} C)
B = bandwidth
I_a = amplifier noise current density

For comparison between direct and external modulation, assume a 60-channel system (maximum channel loading for a typical DFB laser transmitter) and a receiver with $R = 0.85$, amplifier noise current of 8 pA/√Hz, negligible CSO and CTB. In practice there will be some CSO contribution from the detector at input power approaching 0 dBm.

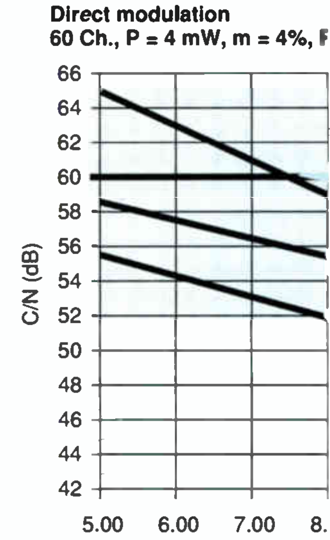
Figure 8 plots the link C/N and the individual C/N contributions due to RIN, shot noise and thermal noise vs. link loss, for direct and external modulation systems. The modulation index chosen as follows is consistent with CSO and CTB of <-65 dBc for high-performance DFB lasers and predistortion linearized external modulation systems. The DFB laser transmitter parameters chosen are: P = 4 mW, m = 4% and RIN = -157 dB/Hz. The chosen external modulation transmitter parameters are typical for a medium power unit with two optical outputs: È = 10 mW each, m = 3.6% and RIN = -163 dB/Hz.

There is clearly a significant C/N or reach advantage with external modulation due to the extra power, the lower RIN and the comparable modulation index. To take full advantage of the higher C/N, without being limited by CSO and CTB, it is necessary to design a wide dynamic range receiver with a high optical power handling capability.

Usually the external modulation transmitter is CTB-limited, whereas the detector in the receiver is CSO-limited. Therefore, there is no cascading effect for either CTB or CSO in the link. In contrast, both the DFB laser transmitter and the detector are CSO-limited, therefore, cascading results in higher CSO distortions.

Among the benefits of external modulation are: 80-channel loading, which eliminates the need for dual detector receivers; immunity to optical reflections, which allows the use of regular PC connectors; and no fiber-dependent noise and distortions. The benefits of predistortion linearization include: lower complexity, ease of installation, and receiver distance independence allowing total application flexibility. **CT**

Figure 8: Link C/N ar



References

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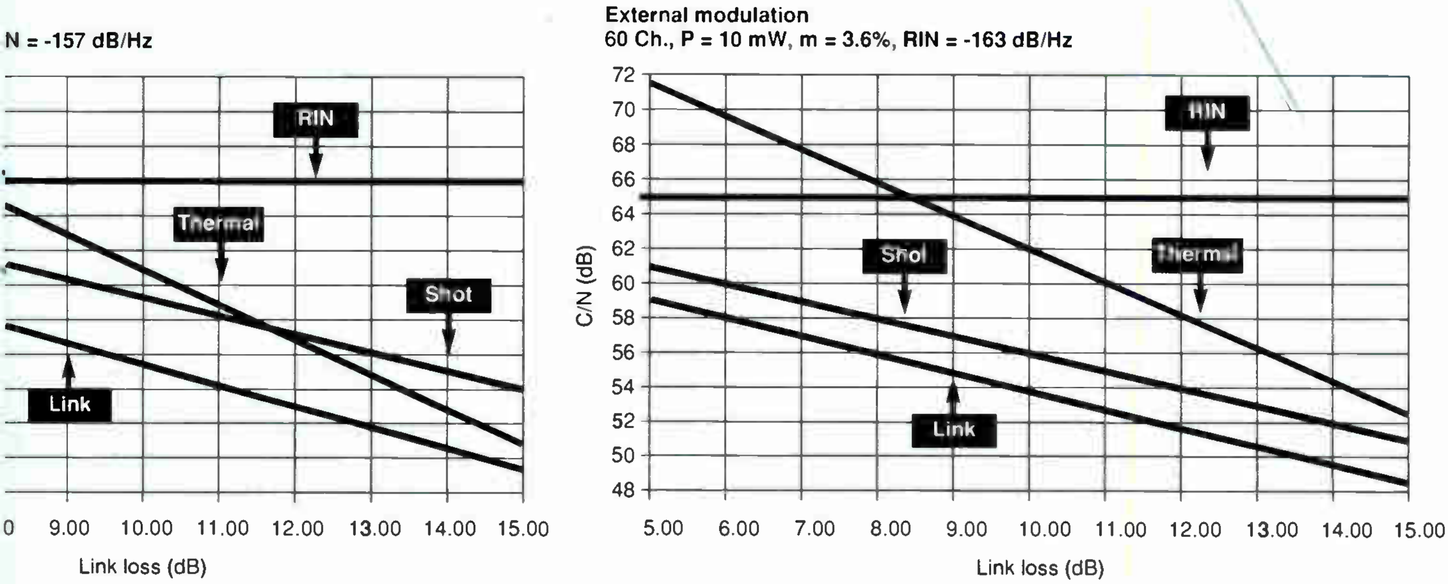
d individual C/N contribution for direct and external modulaton systems



Lett., Volume 1, pages 401-403, 1989.
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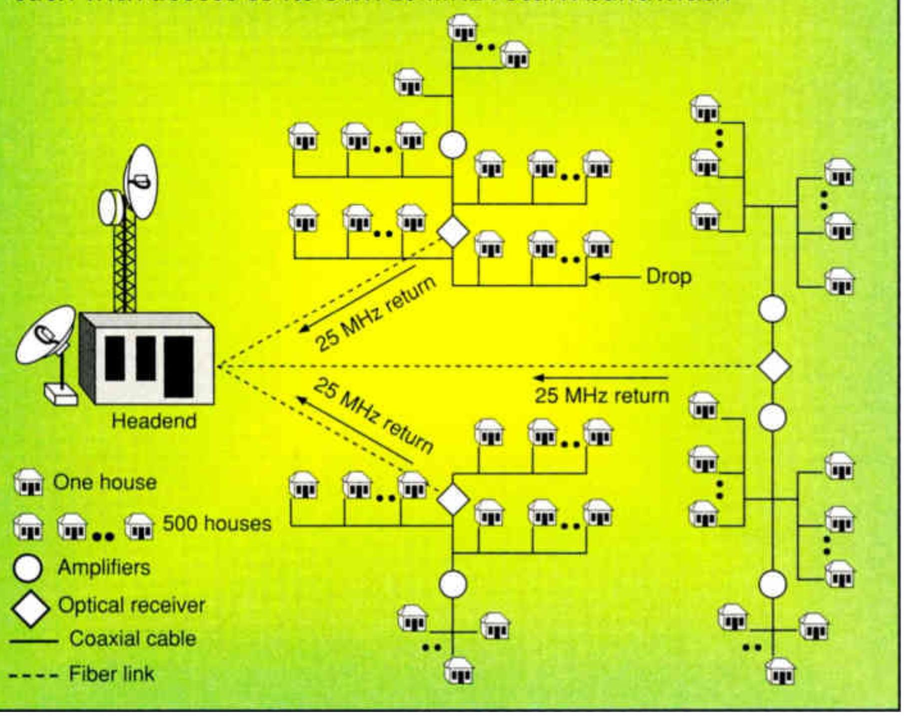
Drop plant

(Continued from page 60)

if fiber is pulled directly to a neighborhood of 500 homes (Figure 3, page 98), instead of 2,000, then 20 serving areas are created, each with its own 25 MHz return. That boosts the combined return bandwidth for the system up to 500 MHz (25 MHz x 20 serving areas). If 200-home serving areas are created, then effective return bandwidth jumps to 1,250 MHz for the same community of 10,000 passings (25 MHz x 50 serving areas).

This technique isn't limited to use of optical fiber media. Express feeder cable can be used in the same way, creating discrete serving areas within the reach of a single optical receiver. Many operators, for example, use fiber-to-the-feeder (FTF) designs featuring a 2,000-home optical serving area. Multiple express feeder runs (four, for example) then might be used to deliver signals to four subsidiary tapped feeder serving areas of about 500 homes each. In the United Kingdom, TeleWest Communications Inc., the joint venture between US West Communications and TCI, has taken this technique one more step, using a "hub divider" concept to allow each 500-home area to use the full 25 MHz return. The point is that effective return bandwidth of an FTF/FSA network is partly a function of serving area size.

Figure 2: FSA/FTF creates optical serving areas if 2,000 homes, each with access to its own 25 MHz return bandwidth



Among the important changes brought about by FTF/FSA designs, then, is that plant is designed in a different way. Where tree-and-branch network design begins at the headend and works outward until noise and distortion specifications no longer can be met, an FTF/FSA network essentially stands the process on its head. Only after the serving areas have been designed can optical receiver locations and fiber cable routes be chosen. In essence, the design process is turned around. It begins with feeder plant and leads from there to trunk plant design.

Feeder and drop plant impact

Feeder plant issues also have been changed by fiber and higher bandwidth. For one thing, larger-size cables (up to 1 inch) now are used in the feeder plant, where half-inch was the prior standard. Designers also make extensive use of "backfeed" and "express feeder" techniques (though these techniques were available before, neither was as widely used). In its early exploration of 1 GHz networks design (the company has changed its mind since then), Rogers Cablesystems developed the "superdistribution" concept for feed-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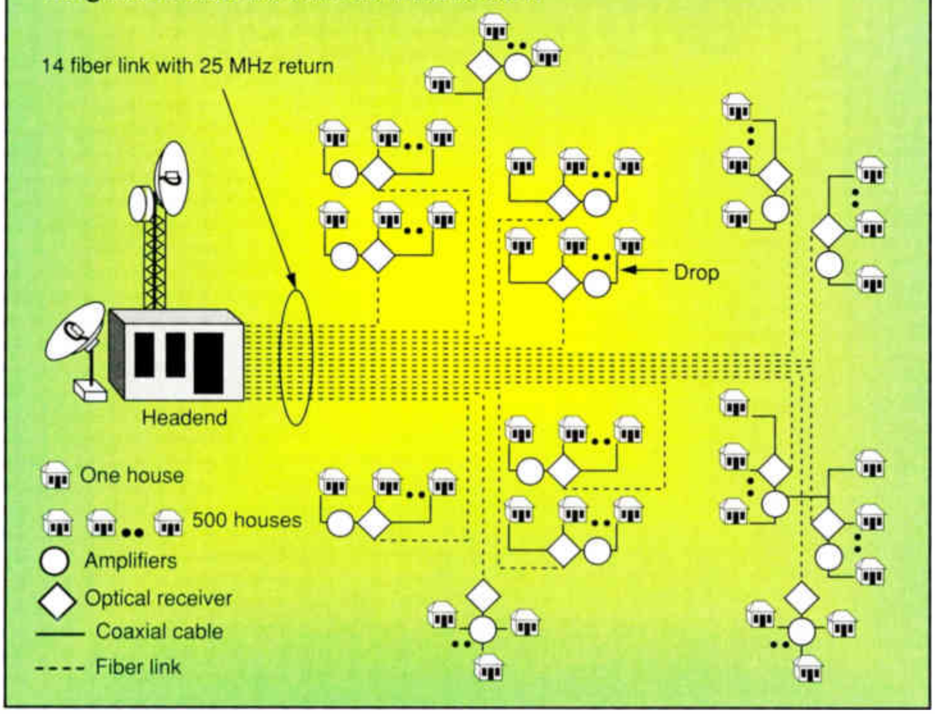
er plant, eliminating the need for power-passing multitaps and their internal chokes. That improves reliability by avoiding power-related faults caused by blown fuses and intermittent connections. It also helps reduce hum modulation and reduces signal attenuation because multitap flat loss is reduced. Frequency response is flatter and potential sources of signal reflections are reduced as well. Where the conventional tapped feeder would put 48 connectors between the bridger location and last customer, the superdistribution design requires only 23.

Even where active bandwidth is set at 550 MHz, though, the use of the FTF or FSA network design creates new requirements for signal amplification, including the use of distribution amplifiers featuring noise and distortion performance more nearly equivalent to trunk amplifiers than line extenders. FTF also creates new needs for signal amplification at the tap and drop level, as well as the use of lower-loss drop cable. FTF might be thought of as a network design that runs fiber directly from the headend to an optical receiver, which in turn feeds a bridger amplifier and a short cascade of distribution or line extender amplifiers. The FSA design might be thought of as using a non-tapped express feeder run between the optical receiver location and the start of the tapped feeder network. In either case, the predominant trend is to match optical receiver locations with a serving area containing 400 to 2,500 homes, segmenting the larger serving areas into subsidiary clusters of 500 to 650 homes.

Figure 3: 500-home optical serving area gives each neighborhood its own 25 MHz return



When the FTF or FSA design is used, as is virtually always the case for new-build and rebuild plant, and active bandwidth of 550 MHz is anticipated, the implications for drop plant design are significant, when compared to a standard tree-and-branch network operating at 330 MHz. A 150-foot, RG-59 drop, for example, with two splitters in-line, can be expected to cause drop loss, at 550 MHz, of about 9 dB. (See Figure 4 on page 101.) The two splitting stages add another 8 dB. So the total drop loss is about 17 dB. Compare this to the same drop, but only activated to 330 MHz. The same 150-foot, RG-59 drop, with two splitting stages, would experience about 14 dB of drop loss, including about 7 dB of cable loss and 7 dB splitting loss (3.5 dB from each of two splitter assemblies).

So the required tap output level at 300 MHz, to provide a subscriber connection of 3 dBmV, is about 17 dBmV. That's the level at which the drop loss

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is exactly compensated for. But at 550 MHz, the tap output level, to provide a 6 dBmV input, is 23 dBmV.

FTF/FSA and higher bandwidth therefore mean that operators must pay more attention to subscriber interface input levels, signal equalization issues and drop length. Use of RG-6 drop, for example, reduces loss by 1.58 dB for 150-foot drop length.

In its early work on the Brooklyn-Queens 1 GHz system, Time Warner likewise found it had to modify its traditional approach to the drop plant. Because of the high attenuation characteristics of signals above 550 MHz, Time Warner found that tap amplifiers, and in some cases additional house amplifiers, were needed to overcome losses at 1 GHz, over a 100-foot drop, of as much as 8 dB (.08 dB per foot). Splitter loss at 1 GHz could be as much as 4.4 dB, and since the input to the subscriber terminal was pegged at 3.6 dBmV, a tap amplifier supplying 16 dBmV was required. The important point to remember is that as you are planning for, and designing, your high bandwidth network, drop attenuation and tap cascade issues will be critical.

As a general rule, FTF/FSA networks create the need for:

- Use of larger drop cable.
- Adjusted tap output level by neighborhood where possible.
- Use of house drop amplifiers where necessary.
- Use of the largest feasible feeder cable.
- Use of low-distortion, high gain distribution amplifiers using feedforward or parallel hybrid technology.
- Use of express feeder.

Cable Act impact

Though a well-designed and maintained cable system should have no problem complying with Federal Communications Commission proof-of-performance standards, which call for a minimum 3 dBmV signal level at the end of a 30-meter (100-foot) drop cable, that might not be the case for all drops if a complex splitter array is put into place to comply with anti-buy through and customer friendliness provisions of the new Cable Act.

Though typical design parameters for lower bandwidth systems call for a minimum of something on the order of 5 dBmV signal level at the end of the drop, a customer interface featuring multiple signal splits and use of filters to trap out expanded basic signals (for a customer ordering the most basic level of service and then one or two premiums) could devour enough level to pose a potential problem. Though such situations should hopefully occur only rarely, they nevertheless may cause headaches for at least some installations on some systems. A network rebuild obviously is the long-term solution to such problems, however operators may, in some cases, find that the use of drop amplifiers is a short-term solution. Again, the parameters change significantly when the upgrade is to 750 MHz or higher.

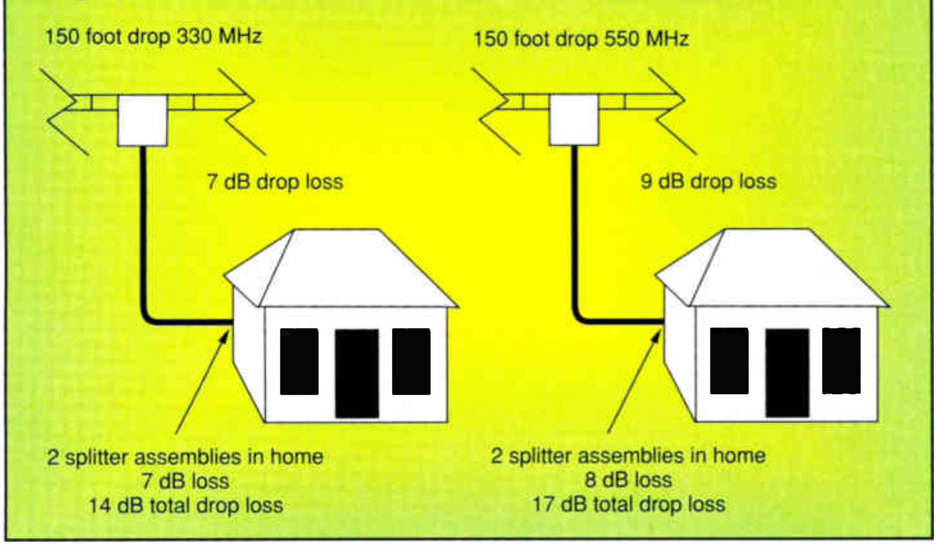
Conclusion

Higher bandwidth and extensive use of optical fiber technology have altered traditional industry thinking about how to design and build headends, trunk plant, feeder plant and drop. Among other changes, headend location will increasingly be less constrained by physical location. Each headend will feed a larger number of households, possibly using subsidiary hub sites or eliminating some hub sites and smaller headends altogether and replacing them with optical transceiver equipment.

Coaxial cable trunk is disappearing, replaced by passive optical cable runs with no active in-line optoelectronics required. In some cases, where a signal repeat station is desired, the only active equipment between the headend transmitter and the optical receiver or node is the repeat station.

Networks now are designed using the serving area concept, creating the basis for a more flexible, high-capacity network platform to support new services. Feeder plant designs now feature the use of bigger cables, distribution amplifiers and designs that minimize the need for power-passing multitaps. At the drop level, higher bandwidth networks will require bigger cables, and possibly tap or house drop amplification. **CT**

Figure 4: Drop loss vs. frequency



Hams in CATV

(Continued from page 67)

Name	Call	Company	Location
Tash, Gill	WB6WNN	Times Mirror	Irvine, CA
Tauiliili, Sumatala	WH6CDN	Time Warner Cable	Honolulu, HI
Taxdahl, Tax	W7KCZ	Telecomm. Assoc.	Ferndale, WA
Taylor, Jim	K9JT	The Video Term	Milwaukee, WI
Taylor, Tim	N7PQZ	TCI	Rawlins, WY
Packet address: @WD4MYL.WY.USA.NA			
Thomas, John	VE3BVX	Lindsay	Lindsay, Ont
Thomas, Ray	N0NNX	Cablevision Systems	Richmond, MO
Thompson, Mike	KA0WJQ	Time Warner Cable	Kansas City, MO
Timberlake, Herb	W5TQI	Sammons	Fort Worth, TX
Tinggaard, Neil	WA0HJI	TCI	Englewood, CO
Tobin, Greg	WA2SFT	Paragon	Torrance, CA
Todd, Stephen	WB6ELD	Multivision	Lemoore, CA
Tonge, Tim	KA0MWA	Time Warner Cable	Englewood, CO
Troutman, Edwin L.	WA3TFX	Adelphia Cable	Winchester, VA
Tschirner, Alan	KA0TQH	Time Warner Cable	Kansas City, MO
Turner, John	WB5IRM	TCI	Muskogee, OK
Tyler, Mike	N5OLP	Weather Scan	Olney, TX
Tyrrell, George	K0CPT	H-P	Englewood, CO
Ulrich, Dale	N4BZZ	Multivision	Rohnert Park, IL
Unverzagt Jr., John R.	N8MCQ	Pioneer Comm.	Columbus, OH
Van de Mosselaer, Wim	ON1BMV	Electro Service	Mechelen, Belgium
VanBuren, R.H.	W5ILH	Cablecom	Kirksville, MO
VanDamme, Michael M.	N6MOF	Heritage	San Jose, CA
VanDyke, Dave	KF2DT	Cable TV of Jersey City	Jersey City, NJ
Vaughan, Jim	K4TXJ	Storer	Louisville, KY
Vaughan, Ray	KD4BBM	Dynamic Cable	Hialeah, FL
Packet address: @W7LUS.#HWDFL.FL.USA.NA			
Voiles, Art	N5BZL	Texscan	Fort Dodge, IA
Voorman, Jim	WA2GSX		
Vyverberg, Chuck	WB7NNF	Cox	Spokane, WA
Wagenblast, Rich	WA2BWP	Falcon Cable	Big Bear Lake, CA
Wagner, John S.	N3IYN	Service Electric	Pottsville, PA
Walker, Dane	WB6JNP	Hughes Aircraft	Torrance, CA
Packet address: @WB6YMH-2			
Wallpole, Bill	VE3WNW	Maclean Hunter	Owen Sound, Ont
Wanderer, Bob	AA0CY	TCI	Denver, CO
Warburton, Peter	G8UGK	ARCOM	Syracuse, NY
Warren, Larry	N4ZE	ANTEC	Bensenville, IL
Wasleske, Bruce	WB9YVT	Crown	Wausau, WI
Watt, Philip	KB7IQO	TCI	Anaconda, MT
Weber, Scott	KD4SHZ	Columbia Cable	Woodbridge, VA
Weeks, Randy	KB9BFZ	DH Satellite	Prairie duChien, WI
Whelan, Daniel	WB2WHD	NY Cable Comm.	Albany, NY
White, Thomas	KB9ACX	Heritage	South Bend, IN
Wicks, Wayne	WA2KEC		Littleton, CO
Wightman, Gary	WA8MCD	Cablevision MI	Kalamazoo, MI
Wilke, Allen	KE0EN	Time Warner Cable	Kansas City, MO
Williams, Paul	WB4GVY	John Weeks	Beauford, GA
Williams, Robert T.	K5BFT	Century Comm.	Johnstown, PA
Williams, Steve	KA1WAM	Continental	Beverly, MA
Williams, Thomas	KD9KR	Continental	Centerville, OH
Williams, Tom	KD9KR	Continental	Centerville, OH
Wiltshire, Dan	KB8BKF	Pioneer Comm.	Columbus, OH
Winn, Al	KA9CAS	Time Warner Cable	Terre Haute, IN
Witherspoon, Brian K.	KB4RAB	Alert Cable TV	Clayton, NC
Witt, Scot	N9AZI	Col. of Dupage	Glen Ellyn, IL
Wolcott, Mike	WB4OEX	Scientific-Atlanta	Atlanta, GA
Wolford, James	WB8FAX	Texscan	El Paso, TX
Wonn, Jim	W3GCZ	Avantek	Folsom, CA
Woods, Emmitte	KA7NEH	Cooke Cablevision	Cle Elum, WA
Wouw, Tony	VE7CCI	ComLink	N. Vancouver, BC
Wyatt, Tim	KA0TYE	Time Warner Cable	Kansas City, MO
Yorks, Sal	WD4NZX	Philips	Manlius, NY
Young, Mark	N2MTT	Philips	Manlius, NY
Young, Scott	N4HLA	Time Warner Cable	Memphis, TN
Younker, Dennis	NE6I	Jones	Spring Valley, CA
Zeidler Sr., David H.	WB6TBT	LucasFilm	San Rafael, CA
Zerrenner, Robert	WA2RDH	Cox	Santa Barbara, CA
Zhorne, Brent	WB9FHI	TCI	Galesburg, IL
Packet address: @N9GQR.#WCIL.IL.USA.NA			

AC power quality

(Continued from page 70)

for sensitive equipment powering. Technology has moved forward rapidly and powering equipment needs to evolve as well to support the new requirements.

"Due to the cost and reliability requirements of the test equipment used in service vehicles, many operators have recently focused on the issue of reliable AC power for the tools and test equipment used in mobile applications."

AC-to-DC inverters

Electrical inverters also have been available for many years. Starting with the old "buzz-boxes," which were oscillating relay contacts driving step-up transformers for powering tube radios in cars, to the first transistorized inverters that plugged into the cigarette lighter socket to provide a square wave output about 120 volts for powering electric razors, soldering irons, etc.

Inverters have evolved over the years as transistors and integrated circuits have improved in cost, efficiency and reliability. A major breakthrough was the invention of the FET (field effect transistor) that provides high current switching at high frequency with very low losses for good efficiency. An inverter consists of basically the same circuit function as you may be familiar with in a standby power supply. In the better quality inverters, a crystal oscillator circuit provides a very accurate 60 Hz reference signal that drives a transistor switching circuit that switches direct current (typically 12 VDC) at a 60 cycle rate into a step-up transformer that has a 120 or 240 VAC output.

The more sophisticated inverters utilize high-frequency switching technology to essentially "synthesize" a sine wave output waveform that is both very stable in voltage output and frequency. This type of design is impervious to load changes and input voltage changes because it uses a "closed-loop" system that compensates for voltage, frequency and waveform changes several thousand times for each cycle of the 60 cycle output. Sudden load changes, inrush current and even short circuits are compensated by the solid-state control circuitry.

Inverter output waveforms

Many of the inverters manufactured for the vehicle market offer the choice of either a sine wave output, quasi-sine wave or square wave outputs. (See Figure 3, page 69.) The best choice are the sine wave versions because they most closely provide power to what you get from the utility grid and thus the power that most equipment was to designed to operate from. The crystal-controlled sine wave inverters provide frequency regulation that can be better than the utility grid can offer (less than .5% over the operating range). The output distortion is less than ±5% THD and voltage regulation is better than ±5% over all load and voltage conditions.

Load power factor

A few of the newer sine wave inverters have the capability to operate loads that have "high power factor" characteristics. Power factor is the ratio of true RMS power-to-apparent power (VA or volt-amps). Without going into AC circuit theory, loads can be inductive in nature ("lagging power factor"), capacitive ("leading power factor") or resistive ("unity power factor," where voltage and current are in phase and consistent in waveform). Leading or lagging refers to whether the current draw leads or lags the voltage phase relationship. Motors tend to be inductive or a lagging power factor with the VA of the motor draw higher than the watts. Power supplies in electrical equipment tend to be capacitive or a leading power factor due to the input rectifier and filter capacitors.

The VA of the equipment draw is higher than the true power or watts. Lights' heating elements are mostly resistive, which is a unity power factor — VA and watts are equal. Most engine and motor generators have to be derated when powering high power factor loads. There is usually a limitation on the power factor capacity as well. The newer sine wave inverters, because they utilize solid-state circuitry to "recycle" reactive energy from high power factor loads, can tolerate almost all load conditions without derating or degradation of the output specifications.

"Most test equipment and fiber-optic devices, such as fusion splicers, require stable voltage and frequency for reliable and accurate operation."

Quasi-sine wave inverters are lower cost and are perfectly safe for powering most test equipment. Quasi-sine wave inverters simulate the peak and average voltage ratio of a sine wave without being a complete low distortion sine wave. The waveform looks similar to a square wave with "stepped" sides.

The final choice, square wave inverters, can be used for some power tools, resistive loads such as lights, soldering irons, heaters, etc., but should be avoided for test and video equipment.

Vehicle power system

Inverters are available in power sizes from 100 to over 5,000 watts. The larger size inverters (above 2,400 watts) typically require an up-sized vehicle alternator to provide enough current to operate both the vehicle battery charging system and provide current to the inverter. In this type of installation, an extra battery is usually installed as well to provide extended inverter runtime when the vehicle engine is not running. With the use of a battery isolator diode, the extra battery can be charged by the vehicle alternator but also be completely discharged by the inverter without draining the vehicle starting battery, which means the engine can be started without any problem. (See Figure 4, page 69.)

Inverters are almost silent when operating and can power all of the tools and test equipment safely and reliably without the noise that engine or motor generators create. Most inverters have a low battery disconnect circuit that shuts down the inverter when the battery is discharged to prevent over-discharge damage to the battery. They also have a very sensitive load sensing circuit that when idling only draws about

1 watt of battery power. When a load is connected or turned on, the inverter immediately provides full output. This feature is unlike the motor generators that require much more current draw before turning on, which can be a problem because some pieces of test equipment only draw about 40 to 50 watts and don't trip the load sensing switch to turn on the generator.

For aerial lift trucks that are using an engine generator to run the lift hydraulic pump, a DC motor can be installed instead that operates from the vehicle's battery system and drives the pump when the lift is operated. An inverter can then be used to supply reliable AC power for all of the power tools and test equipment used on the vehicle.

Safety

Another common feature available on some of the sine wave inverters is a GFCI (ground fault circuit interrupter) protected AC outlet. This is a very important safety feature for personnel operating power tools and AC equipment outdoors in damp or wet conditions. If there is moisture present in the extension cord connections or in the tools, or if a cord is dropped in water accidentally, the GFCI outlet very quickly senses the current flowing back through the ground conductor and trips a circuit breaker, disconnecting power output from the inverter. GFCI outlets have saved many lives over the years by preventing electrocution. (Most local electrical codes require them in kitchens, bathrooms and outdoor outlets).

> **"Cable TV service vehicles that carry test, video and fiber-optic equipment can be more economically, safely and reliably powered by a DC-to-AC inverter than an engine or motor generator."**

Due to the solid-state switching circuitry, the inverters have operating efficiencies in excess of 80%. This translates into longer operation from battery power, in some cases twice as long as the motor generator. The inverters selected for pickup trucks and small vans for test equipment powering are typically 600 or 1,000 watt units, while the aerial trucks use 2,400 watt or larger units. This provides enough capacity for tools and test equipment and occasional operation of standby or non-standby power supplies in the outside plant during extended utility outage conditions. In most cases, inverters are less expensive than generators when you consider the lifetime operating costs of fuel and maintenance in addition to the purchase price.

Conclusion

When reviewing your AC powering strategy for service vehicles, keep in mind the recent changes in your test equipment inventory on each vehicle as well as the safety and reliability requirements of powering the equipment. Measurement accuracy, repeatability and reduced equipment down time are important goals.

Cable TV service vehicles that carry test, video and fiber-optic equipment can be more economically, safely and reliably powered by a DC-to-AC inverter than an engine or motor generator. **CT**

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June 1993

BACK TO BASICS

Troubleshooting the distribution system

The training and educational supplement to Communications Technology magazine.

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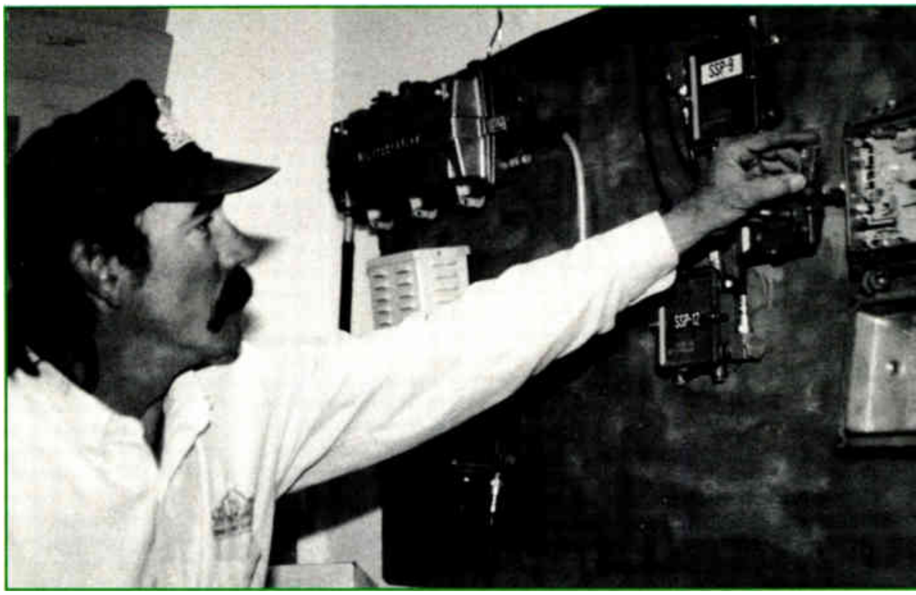
The learning lab: A troubleshooting tool

By Pam Nobles
Senior Staff Engineer/Technical Training
Jones Intercable

There is a big concern in the cable TV industry about providing hands-on troubleshooting experience for service technicians. Techs can attend meetings and talk and talk about what the service problems are and what one might do to fix them, but hands-on experience is needed to ensure the knowledge is retained.



Steve Jenkins, maintenance technician in Jones Intercable's Jefferson County, CO, system, demonstrates how easy it is to create troubleshooting problems.

System learning lab

Creating a mini distribution system in your office as a training tool can help provide this hands-on experience for service technicians and new hires. Mark Erbland, installation supervisor in Jones Intercable's Augusta, GA, system, recommends that a "learning lab" be used to train new hires before they go into the field. This way, distractions that hinder the learning process are minimized, and bad habits aren't picked up from "seasoned" associates. All aspects of the plant can be built into this learning lab. Drop, feeder, trunk and even fiber systems can all be fabricated to teach and practice installations, repair and troubleshooting techniques.

Associates in Jones Intercable's Jefferson County, CO, system have recently activated their learning lab. Dave Farren, maintenance technician in Clear Creek, began building the mini system in his garage. Farren and Steve Jenkins, maintenance technician in Jefferson County, provided their thoughts on developing this training tool.

Getting started

As with any great endeavor, start with a great plan. Decide what it is your techs need to know. Ask your employees to provide a list of topics they'd like to be trained on.

After reviewing your training needs, decide where you're going to put your lab. It is preferable to have your training system mobile, so it can be moved to various training rooms to accommodate your students. You may choose to mount it on the wall, and store coils of cables above the ceiling or under a bench. Availability of office space and your budget will dictate your lab's location.

Equipment

Include in your plan a trunk amplifier, line extender(s), power supply and inserter. (Use a small power supply if you have one so it won't take up too much room.) Also include cable, splitters, directional couplers, taps, strand, installation hardware, ground blocks, house boxes, and "spare stuff" such as various pads and equalizers. Have your techs save any shorted face plates, "odd ball" problems, or anything else they may find to build into and test on the training system.

Design your learning lab to be an exact replica of your cable system — the more realistic the better. Plan for levels at the amplifiers and taps that would actually be measured in your system. Calculate what attenuation you'll need between devices to attain these levels. Determine what cable lengths you'll need to give you the proper end-of-line specifications. Don't forget to write down your specs — and keep a copy handy. Sketch out your plan before beginning construction. Design your lab so service problems can be easily inserted, as can different vendor equipment.

When creating the attenuation, it would be best to use the exact cable used in your system so the characteristics are the same — but you might not have the space or the money to store reels of .500 feeder cable! If this is the case, one option is to use drop cable to simulate your system, but keep in mind that the characteristics will differ from hard line cable. You also could use attenuators and true tilt networks to replace the cable.

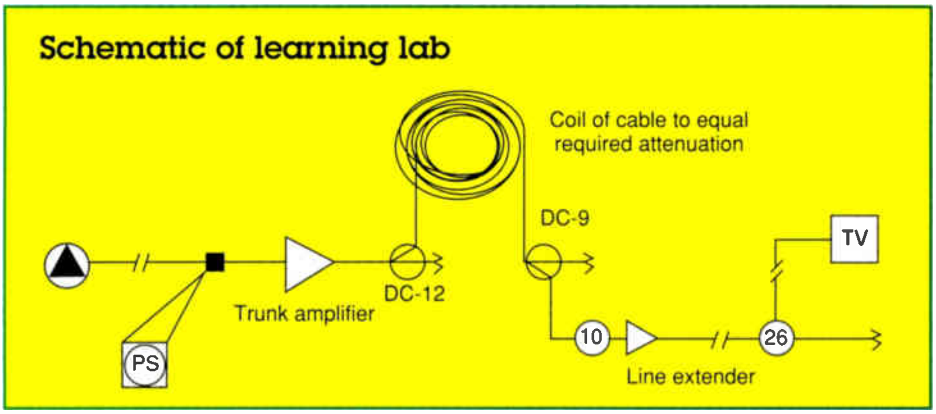
The schematic of Jefferson County's learning lab is supplied in the accompanying figure. This active system includes a sample of all equipment from the headend to an active subscriber drop.

Before the installation of the mini distribution system, test your equipment. Make sure you know what you have before constructing it, or you'll really be troubleshooting! Decide what basic types of trouble problems you'll want to reproduce, such as low signal, distortions, egress and ghosts. Recreate actual problems typical in your system. Also plan for the really difficult problems your techs will bring in to recreate.

Prepare for training

There are numerous ways to use your learning lab. Tech classes can include formal, planned classes, presented by maintenance techs or the system trainer. Impromptu classes can happen as service techs bring in "problems" to be reconstructed. You also might consider having service techs build your mini distribution system as part of their training.

There are different levels of experience and positions, from installers to ad-



vanced techs, who may use this training. Prepare your associates for the level of training they will receive. For example, you may want to create troubleshooting problems geared toward the existing service tech who needs to refine his or her troubleshooting skills. In this case, be sure they have an understanding of the basics of RF and power signals. In addition to basic theory, map reading and symbol interpretation should be understood, as well as basic troubleshooting. All the components of the learning lab and the effects on frequency response should first be studied individually.

One-on-one training may be best for some situations, small groups for others, depending upon what you plan to accomplish. Also prepare whoever is doing the training with what is needed to accomplish the objectives; the training will only be as effective as the person administering it. Following is a summary of some of the uses for your learning lab:

- New installers. Installers can easily practice the basics of installations and track drop problems, from tap to TV.
- Existing installers. More experienced installers can review their skills and learn about new products. Training can be done to prepare installers for new positions.
- New service techs. Introduce them to their job. Meter reading and calibration can be done together, and levels verified as a group. Also teach employees how to identify test points on amplifiers.
- Existing service techs. Use the lab to cultivate service technicians' troubleshooting skills. Have them practice using test equipment, such as a signal level meter, volt-ohm meter or time domain reflectometer. Get creative — and challenging! You can create some real tough situations.
- Maintenance techs. The lab also can be used to plan for your system's future. Use it to review equipment when planning for system rebuilds or upgrades, prepare for proof-of-performance testing and hands-on sweeping practice.
- Customer service reps. Introduce the CSRs to the system and demonstrate how the problems relate to what they might hear when customers call.
- This controlled environment also can be used to test knowledge or provide qualification. Time management, or knowing when to ask for help or when to proceed, also may be reviewed using the learning lab.

Make it real

Be sure to simulate in the training how someone actually would troubleshoot. It may be too easy, with the line extender just a few feet from the trunk bridger, to forget about the actual troubleshooting process. You may want to send the tech out of the room to simulate going around the block, dealing with the dog in the next backyard, or review system maps before continuing. Otherwise, important troubleshooting steps may be skipped. Observe to make sure the tech is following the troubleshooting procedure, such as checking RF levels where appropriate, and using the "divide and conquer" method of determining where the signal is good, where it's bad, and divide the system in half.

Make it real as well as fun — it's the next best hands-on troubleshooting experience to actually being there. **BTB**

The author would like to thank Mark Erbland, Dave Farren and Steve Jenkins of Jones Intercable for their input on this article. Research is proceeding on two new interactive videodiscs: "Customer Service Through Troubleshooting," and "The Troubleshooting Challenge." These programs, produced though the Mind Extension Institute, will help develop a common troubleshooting vocabulary, consistent customer communication, troubleshooting guide and teamwork. The training is planned for completion in early 1994.

Understanding and using "on-channel" tests to measure C/N and hum

By Jack Webb
CATV Product Manager, Sencore

The measurement of carrier-to-noise ratio (C/N) and hum are signal quality tests that relate to the picture being delivered to the customer. Poor hum or C/N will quickly be spotted by customers since the "interference" will typically affect all channels. C/N is the difference in level between the RF carrier and the noise in the system over the 4 MHz bandwidth of the video information.

Poor C/N performance will produce "snow" or graininess in the picture. Figures 1 and 2 illustrate a 34 dB C/N compared to a >45 dB C/N. A poor C/N can be caused by many sources in the CATV system. Any component that passes the RF signals could affect either the signal level or the noise content and therefore affect the C/N.

Noise originates in every active device through which signals pass and can never be reduced, only increased as the signals are processed and distributed through the system. Even a 75 ohm impedance generates noise caused by random electron motion. This low level signal is amplified along with our desired signals. The amplifier's noise figure also is added to the input noise level. These levels will be discussed later. Components such as splitters and cable, which can develop higher than normal losses, can further degrade the system's C/N performance. Likewise, active components can generate excessive noise, which can add to the signal's noise content and decrease the overall C/N.

Hum is the unwanted low frequency AM distortion of the video signal. This distortion includes all AM disturbances below 400 Hz. This distortion may be incurred on the baseband video signal at the headend prior to the modulator or, as is more often the case, it may be caused by power supply-induced amplitude modulation in the system trunk and feeder amplifiers. Strictly speaking, hum is any low frequency AM disturbance that is summed with the video signal causing picture degradation.

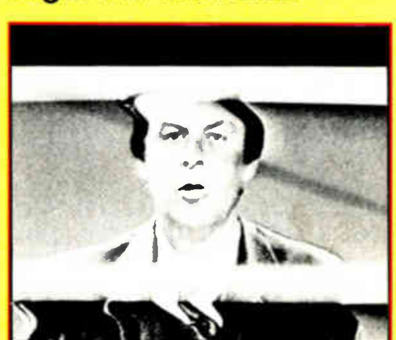
Figure 1: A 34 dB C/N

Figure 2: A >45 dB C/N

Hum results in picture distortion as is illustrated in Figure 3. The hum bars will roll vertically through the picture as the hum signal varies in phase relation to the vertical interval. The most common AM distortions are 60 Hz and 120 Hz hum. These added to the composite video signal will typically produce one or two black bars whose intensity is proportional to the amplitude of the AM hum distortion.

Hum may be caused by several different types of problems in the CATV system. These are: unwanted AM modulation in the video processing equipment or modulator; power supply ripple in the system amplifiers caused by low line voltage, improper power supply settings, overloaded power supplies or failing components in the DC power supply; or by corroded connections in the RF network acting like a mixer diode.

Figure 3: A 5% hum



These different causes can be isolated by testing and by the location of the hum problem. Hum present at the headend, as well as the rest of the system, must be generated at the headend. Hum characteristic of a particular channel is typically generated in the headend baseband video processing equipment. Hum present only in the downstream section of one leg or downstream from sections of the system powered by a common power supply is caused by a bad DC supply or low line voltage to that power supply. In the DC supply, 120 Hz hum usually indicates low line voltage, a wrong voltage setting or a failing filter capacitor, while 60 Hz hum will typically indicate a blown diode. Hum at 60 Hz also can be generated when corrosion at a loose connector forms a diode junction from the oxidized aluminum and copper sulfates in the corrosion. This diode junction will act like a mixer modulating the RF signals with the 60 Hz signal from the 60 V square wave power supply signal.

Once a hum problem is identified,

the volt-ohm meter function in your field strength meter can be used to troubleshoot the AC and DC power supplies to isolate the source. Often the 60 V AC line voltage can be measured directly through the RF input connector. AC or DC voltages can be measured using the external voltage probes.

C/N and hum measurements

C/N and hum are actually two of the easiest signal quality measurements that can be made on an operating system. Since these measurements can be made at almost any point in the system, they should be part of your standard practice. Measurement of only the signal level will only tell half the story. The signal levels could be perfect and yet poor signals could be delivered to the customers.

Automatic gain control (AGC) and automatic slope control (ASC) operation can correct for a bad amplifier or excessive passive losses and restore the signal level after just a few amplifiers. However, severe degradation to C/N can occur.

Hum caused by low line voltage, low power supply setting or failing DC supply components often can be detected through hum measurements before the hum is viewable on the customers' TV set. This is especially true of a failing capacitor in the DC supply since excessive leakage causes ripple in the DC supply before the capacitor totally fails. Since hum will typically run 1.5 to 2% and is not visible to the customer until it reaches 4 to 5%, making regular measurements will let you locate most hum problems before they are noticed by any viewer.

Measuring C/N is not quite as simple as measuring the two levels with your signal level meter or spectrum analyzer and subtracting the difference. C/N is defined as the ratio of the RMS (root mean square) of the peak modulated RF carrier to the average power of the noise in a 4 MHz bandwidth. Note that we are comparing the RMS of the peak of the carrier to the average of the noise. Also note, the noise is "measured" in a 4 MHz bandwidth.

When we measure the level of the RF carrier, our normal instruments are calibrated to properly make this measurement. However, the noise measurement is much different. Our instruments will not have a 4 MHz bandwidth — certainly not a perfect 4 MHz even if we tried to build one. We will have to address both the bandwidth and the shape factor. Additionally, since our instrument's detector is calibrated to measure the peak signal level, we will need to compensate to measure the average noise level.

The following formula can be applied to correct the bandwidth limitations of our instrument:

$$CF_{BW} = 10\log(BW_1/BW_2)$$

Where:
CF_{BW} = Correction factor
BW_1 = Desired measurement bandwidth
BW_2 = Actual measurement bandwidth

Figure 4 illustrates the bandwidth compensation. In addition, because the formula assumes a perfect IF shape factor, an additional correction factor must be used to correct our actual IF shape factor to an ideal shape factor as illustrated in Figure 5. If the lower lobes contain more energy than the missing portion from the ideal square topped response, the compensation

Figure 4: Bandwidth compensation (C/N correction factors)

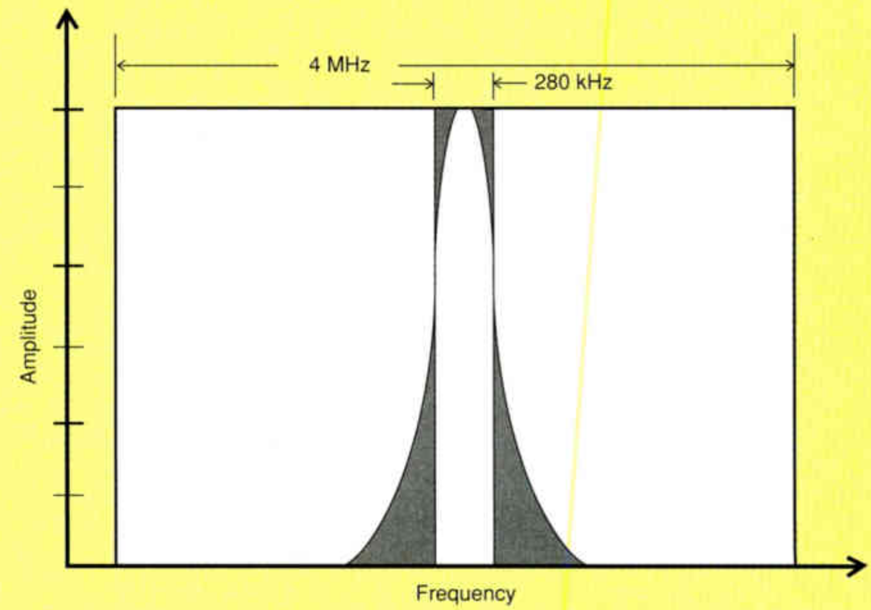
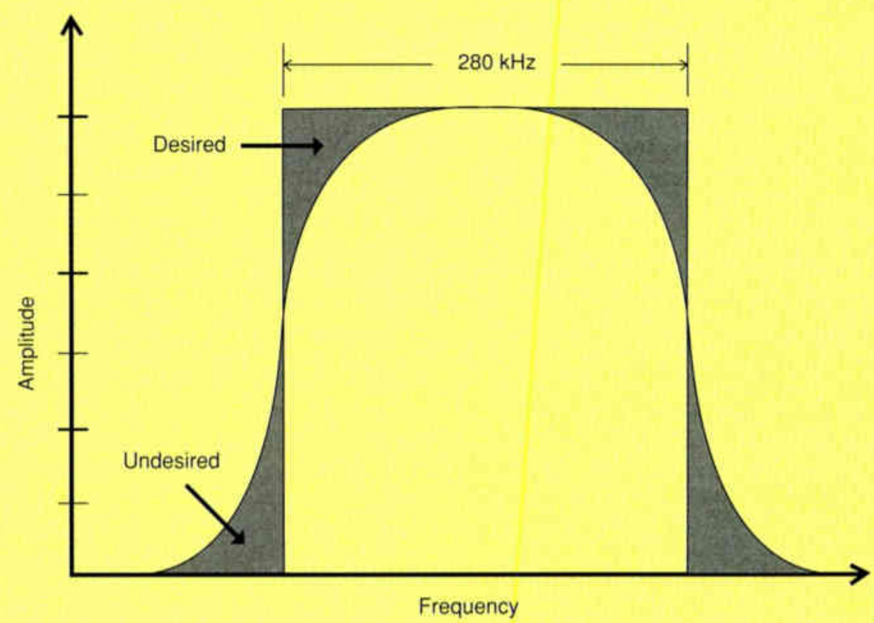
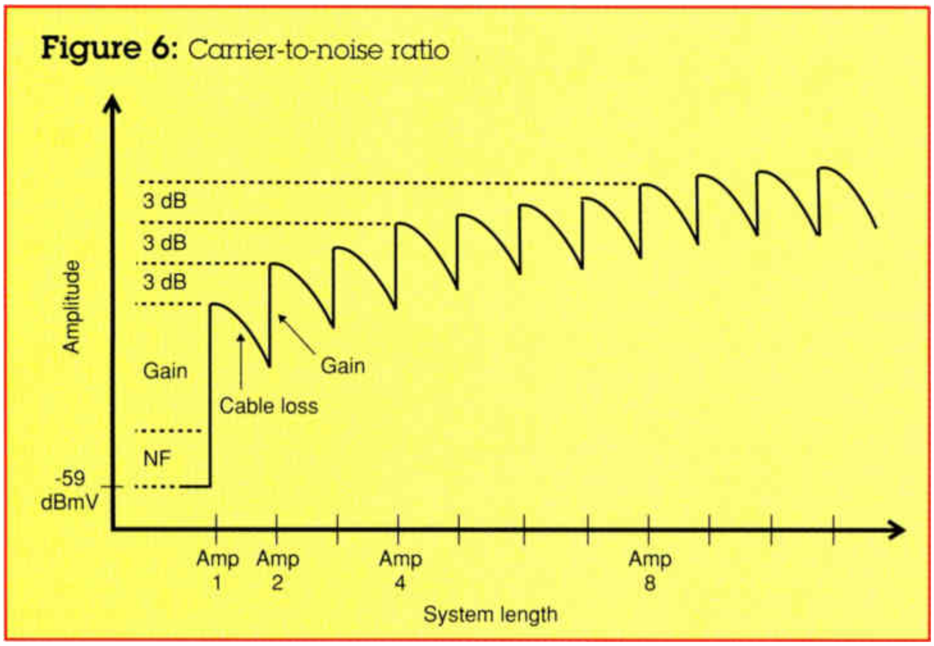


Figure 5: IF shape factor correction (C/N correction factors)





factor will be negative; subtracted from the total correction factor. If the missing top portion contains more energy (area under the curve), then the actual readings will be low and the correction factor will add to the noise reading. Thus:

$CF_T = CF_{BW} + CF_{SF}$

Where
CF_T = Total correction factor
CF_{BW} = Bandwidth correction factor
CF_{SF} = Shape factor correction factor

One other correction must be made to our measurement if we use the same detector to measure the peak carrier and the noise level. If we use a peak detector to measure the noise, then the average noise level will be approximately 3 dB lower than the peak:

$V_C = 20\log(V_1/V_2)$
V_C = 20log(ratio of RMS of peak to average)
$V_C = 20\log(.707 * 1/.5)$
$V_C = 20\log(1.414) = 3$ dB

While the shape factor and peak vs. average correction factors can be calculated from data sheet information and some basic testing of the instrument's IF and peak detector, the most accurate method to determine the total correction factor is through an empirical experiment. Results of such an experiment should be available from the instrument's manufacturer or have been included in any automated noise measurement procedure.

The Federal Communications Commission instituted new rules in '92 that require the C/N to be 40 dB as of 1993 and improved to 43 dB in 1995. This measurement must be made at or equivalent to the customer's terminal. Since the nominal signal level will be 0 to +10 dBmV, a preamplifier usually will be required to make a C/N measurement because the uncorrected noise measurement will equal the carrier level minus the C/N minus the correction factor:

$V_N = V_C - V_{C/N} - CF_T$

Where:
V_N = Uncorrected noise measurement
V_C = Carrier level
$V_{C/N}$ = Carrier-to-noise ratio
CF_T = Total correction factor

If we assume a 0 dBmV carrier level and a minimum C/N of 40 dB then,

V_N = 0 dBmV - 40 dBmV - 10 dB
= -50 dBmV

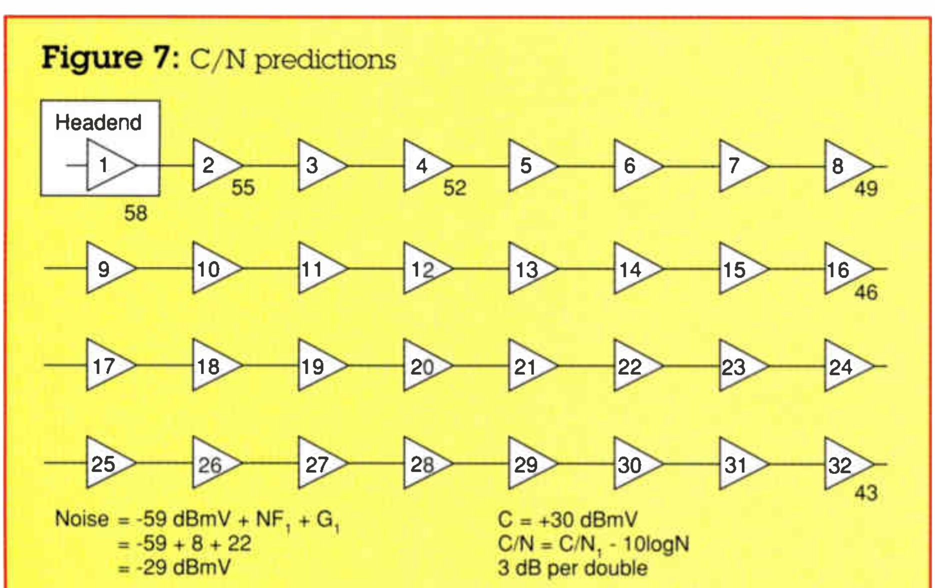
Thus, we need sufficient sensitivity to measure the uncorrected noise at an anticipated level of -50 dBmV or lower. A preamp is required with most instruments to gain the additional sensitivity.

The C/N can be predicted at any point in the system. In the headend, the C/N at the modulator or processor will be very high, assuming no problems with the signal source or equipment. The passive devices following the modulator do not add to the noise in the system. Passives will have the same loss effect on the noise that they have on the RF signals. Amplifiers, however, will add to the noise and therefore reduce the C/N.

The thermal noise floor is ≈ -59 dBmV (4 MHz bandwidth) in a 75 ohm system. This is, therefore, the lowest possible noise level. As we amplify signals on the system we also amplify the noise, thus the output of our first amp will increase the noise level as well as the signal level by its gain. The amplifier also will add its own internal noise to the system. This is called the amplifier's noise figure. Thus we can predict the noise level at any part of the system. The noise level at the output of the first amplifier will be:

$V_N = -59 \text{ dBmV} + V_G + V_{NF}$

Where:
V_N = Uncorrected noise measurement
V_G = Gain of the amplifier



V_{NF} = Noise figure of the amplifier

If the noise figure is 8 dB and the gain of the amplifier is 22 dB, then the noise level will be:

V_N = -59 dBmV + 22 + 8 = -29 dBmV (corrected)

The C/N will then be the difference between the corrected noise level and the carrier level. Typical trunk amplifier output levels would be +30 dBmV, thus providing a 59 dB C/N for one amplifier. The C/N also can be predicted at any other point in the cascade of amplifiers. For similar amplifiers in cascade we can use the following formula:

$C/N = C/N_1 - 10\log N$

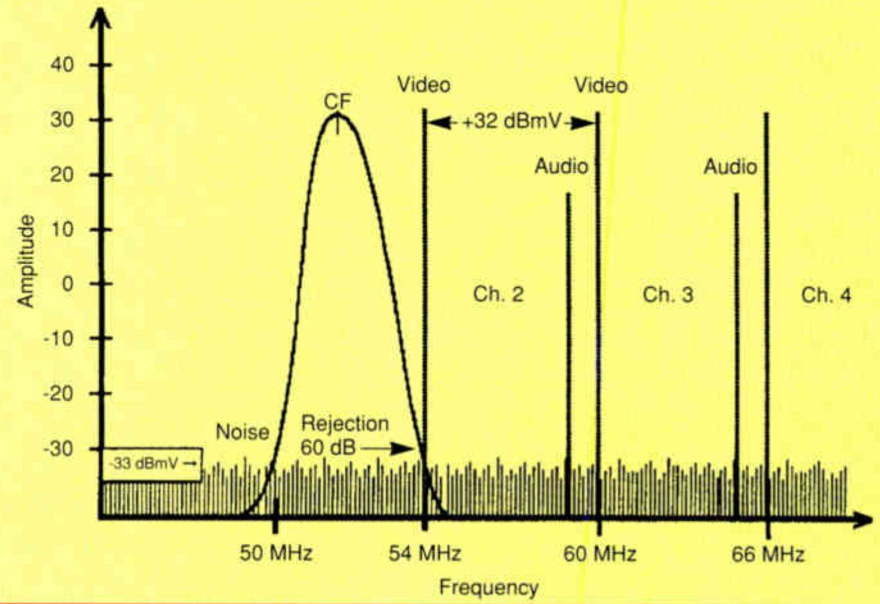
Where:
C/N = Carrier-to-noise ratio
C/N_1 = C/N at the first amplifier
N = Number of amplifiers in cascade

Note that this equation will yield the C/N and that every time we double the cascade the C/N degrades by 3 dB. (See Figure 6.) This should make predicting (Figure 7) the approximate C/N ratio easy at any point in the system.

The typical test method for measuring C/N is to measure the carrier level and note the reading. Secondly, the noise level must be measured. Whether using a signal level meter or a spectrum analyzer, the manufacturer will provide a similar test procedure for measuring the noise floor. Some of these procedures include automated functions, which may include the correction factors previously discussed. In general the correction factor will vary from instrument to instrument depending on the resolution bandwidth, the IF shape factor and the type of detector utilized. Refer to the specific instructions of the manufacturer when making noise measurements to get the required correction factors or to see if they are built-in to a special noise measurement routine.

With any instrument one common requirement is to tune the device so that only the noise is measured without interference from carriers on the system, beats on the system or beats produced by the measurement instrument. The measurement instrument will need 60 dB of rejection at all carrier frequencies, in reference to the frequency of the noise measurement, for a 40 dB C/N if the correction factor is 10 dB and a margin of 10 dB of the measurement to other signals is desired (1 dB accuracy). This can be difficult to find in the CATV spectrum if all channels are in use. Typical methods include tuning below Ch. 2, tuning to an unused midband channel, or shutting off the modulation on one channel during the test. No matter which method is used, the rejection of the other signals will have to be 10 dB greater than the uncorrected noise measurement as depicted in Figure 8.

Figure 8: Rejecting unwanted signals



In making hum measurements, we want to measure the low frequency AM distortion of a video carrier. This is easiest done as a post-detection measurement. That is, a measurement after detecting the video information. The best approach to measuring hum is to pay careful attention to the definition of hum. Hum is simply the ratio of the peak to peak amplitude of the unwanted AM modulation to the peak of the video signal, as shown in Figure 9 and the following formula:

$Hum = V_{PP}/V_P$

Where:
V_{PP} = Peak to peak AM distortion
V_P = Peak of the video signal

Note that hum is not the same as

Figure 9: Hum modulation

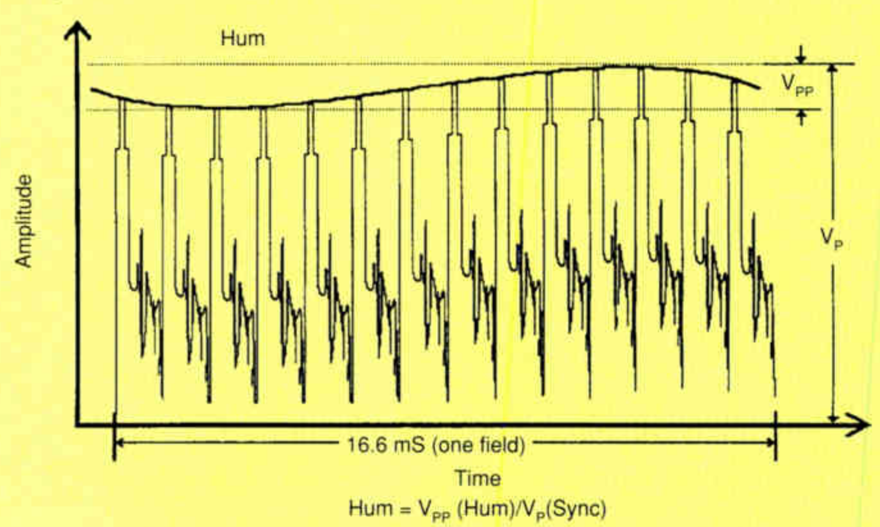
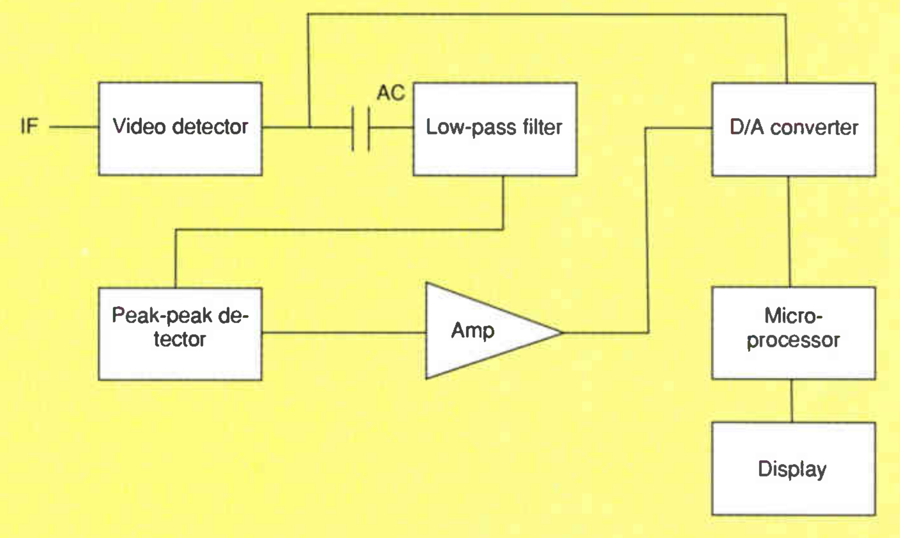


Figure 10: Hum measurement block diagram

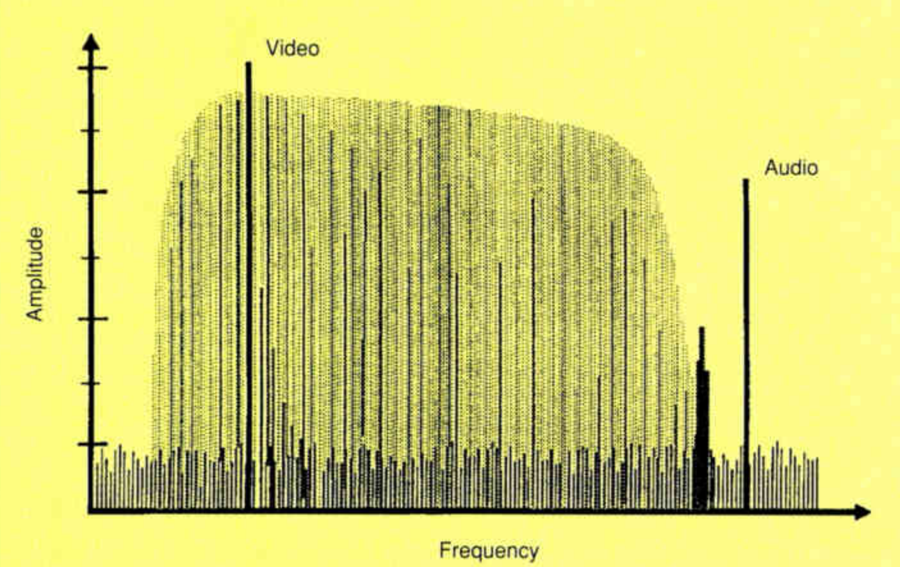


percent AM modulation, but approximately twice the percent AM. Measuring the baseband video signal level at the maximum level of the video signal and comparing that level with the amount of variation in successive measurements will provide very accurate hum measurements. The problem with this technique is that you can not distinguish between the wanted and the unwanted low frequency AM modulation unless the measurement is made on an unmodulated carrier, except with an FFT analyzer.

The FCC's '92 rules require the hum to be less than 2.5% at the customer's terminal. This is an easy specification to meet. As mentioned earlier, hum will typically run 1.5 to 2.0% on a properly operating system. Readings higher than 1.5 to 2.0% will indicate that a problem exists, which can be easily isolated to the component or module causing the problem. Hum is not like C/N or other distortions in that it is not built up through the cascade. Since hum is typically the result of low power supply voltage or a failing component in the AC or DC supplies, the problem occurs at the point of that failure and remains relatively constant through the remainder of the cascade.

Hum is typically measured by demodulating the test carrier and comparing the peak level of the demodulated signal with the low frequency AM "riding" on that signal. See Figure 10 for a basic block diagram. This is done by first using a standard video detector to measure the baseband peak signal level, then AC coupling a low-pass filter to the video detector, peak to peak detecting the low frequency signal and adding a calibrated high-gain amplifier to provide a measurable DC component signal. The difficulty lies in measuring the very low level AC low frequency signal. This method provides good measurement results, but has one key drawback — a CW test signal must be placed on the system for the measurement or the modulation must be turned off.

Figure 11: One channel spectrum display



Live "on-channel" tests

Testing without interference to the system's operation and without adding additional test signals should always be our priority. Interference to the picture quality is the reason that we test the system. Having the tests interfere with system operation is somewhat contrary to our objective.

Adding carriers to perform our tests utilizes valuable spectrum that could better be used for revenue purposes. Single test carriers do not require much spectrum, but also provide only limited test data. The solution to these problems is simply to develop a test method and instruments that will perform these measurements on an active system without adding test carriers. The goal would be to make the tests on all of the live video carriers on the system. This also would provide us the capability to test the C/N and hum on all of our channels. Hum and C/N problems that occur at the headend in processors, modulators, receivers or strip amps can be tested if the tests can be performed on live carriers.

While signal level meters and spectrum analyzers measure signal levels across the frequency spectrum, no attention is paid to the timing of those measurements. If we were to analyze a channel's spectrum over time, we will find that the energy from the modulation process is dispersed in the spectrum from ≈ -0.75 to +3.5 MHz around the carrier. This typical vestigial side band modulation is shown in Figure 11.

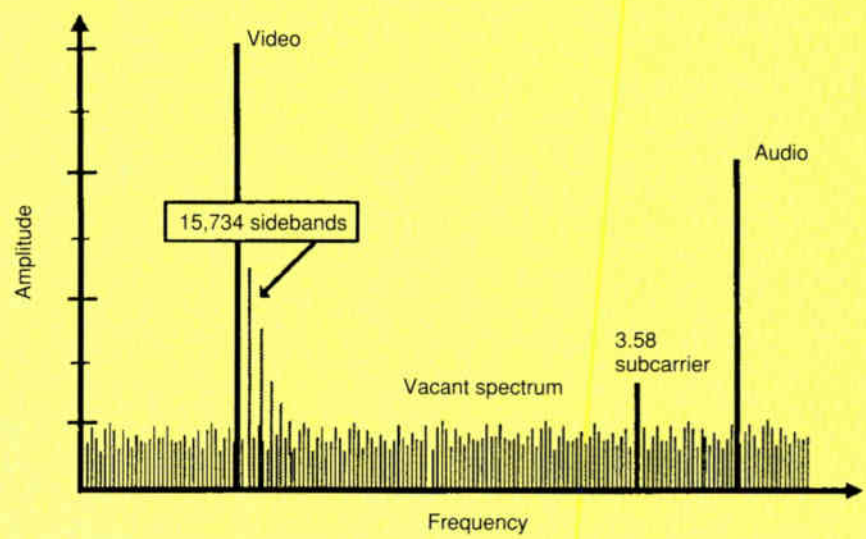
Measurements can be made in the time domain of the video signal. If we break time down into small increments and take snapshots of the energy dispersed in the channels' spectrum, we would be able to break each horizontal line down into a discreet pattern associated with that line of video in the picture. Similarly, we could look at the time increment during the VBI (vertical blanking interval). During the VBI the equalizing and sync pulses are present, however the video is blanked or at the blacker than black level. This time increment during the VBI when the sync is at its peak level will produce a spectrum display that would contain the video carrier and the sync sidebands at 15,734 Hz intervals. (See Figure 12.) The key here is that the balance of the spectrum is empty during this short period of time. Obviously, if our instrument could measure the noise floor between the video and audio carriers during this time period there would be no video signal interfering with the measurement and we would not have to turn the modulation off or tune to an unused frequency.

Similarly, if our hum measurement could be timed so that each measurement is made on the peak of the horizontal sync pulse during the VBI, the wanted low frequency modulation can be distinguished from the unwanted AM distortion. Making successive measurements gated to correspond to the sync pulses allows us to measure the deviation from the expected signal and thus determine the hum content in a live video signal.

Measurements made by these patented techniques are done in a similar manner to the manual or automated testing techniques used by other manufacturers except for the gated timing, which allows the measurement to be made "in-channel" during a time increment when no "interference" is present. Measurements of this type will exactly duplicate the results used by the other methods for "off-channel" testing.

C/N tests will correlate to the standard off-channel tests or the method requiring the modulation to be removed. Discrepancies in measurements between methods will only occur when there is a real C/N problem specific to a particular channel. Hum tests will correlate to the other methods of testing since the method is identical except for the gated timing of the measurements.

Figure 12: Spectrum display of VBI "snapshot" measurement



Modern instruments provide these on-channel capabilities as well as off-channel capabilities that will allow comparison between other instruments. Either the on-channel or off-channel C/N technique may be selected from the front panel controls. Built-in automatic software provisions should automatically accommodate the off-channel test technique when no modulation is present on the test carrier.

In the on-channel C/N measurement the noise measurement should be made between the video and audio carrier at a frequency that will minimize the effect of the carriers on the measurement. In an instrument utilizing a 280 kHz IF with a 4:1 60 dB shape factor, 2.70 MHz is the ideal offset from the video carrier as shown in Figure 13. The meter should automatically tune 2.7 MHz above the video carrier and trigger its measurement circuitry during the horizontal sync pulses of the VBI so that the C/N measurement can be made on a live video carrier. The appropriate noise measurement correction factors are incorporated in the measurement by the microprocessor and the C/N is displayed digitally.

In the off-channel mode, the measurement is made without the gating circuits. The carrier level is measured, the noise is measured at the programmed frequency, and the correction factors are applied such that

Figure 13: VBI "snapshot" measurement of C/N on-channel

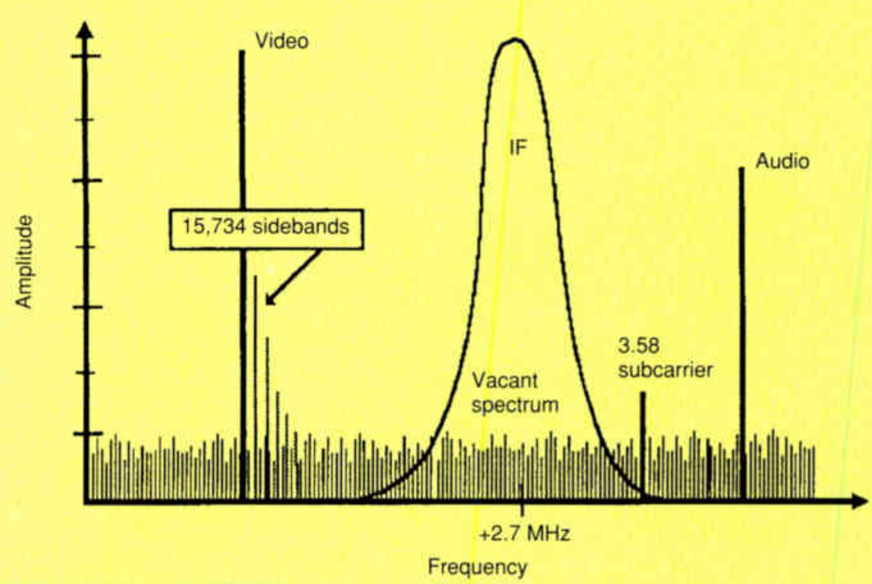
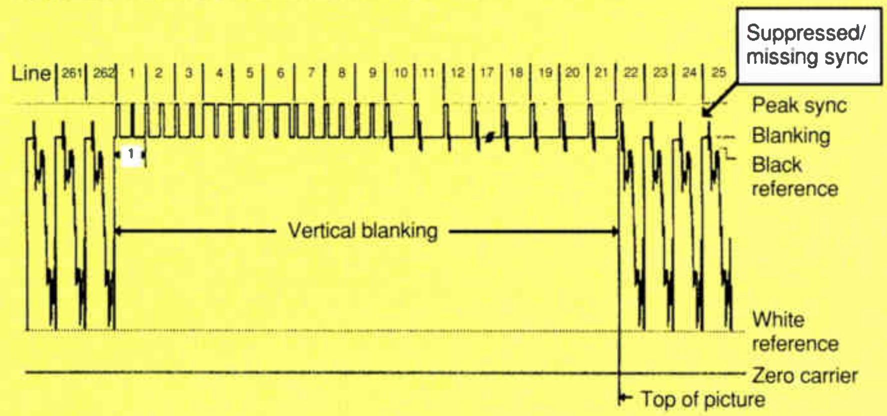


Figure 14: Scrambled channel video



the C/N is displayed on the LCD.

In this type of sophisticated instrument, hum can be measured on- or off-channel. The presence of video can be detected and modes switched automatically. In the on-channel mode the gating is controlled by the video's sync, while in the off-channel the gate is controlled by the instrument's microprocessor.

Avoiding errors

As with all measurements, care must be taken in making these measurements. Although a great deal has been done to automate many measurements, there are always pitfalls available to cause erroneous readings. The best method to avoid these pitfalls is to thoroughly understand the measurement procedure, the technique employed by your instrument and as much of the criteria about the signals on the system as possible.

To avoid errors in making the C/N measurement we must be concerned about accurately making two measurements: the carrier level and the noise level. Possible sources of error in measuring the carrier depend heavily on the ability of the instrument to measure the carrier level accurately, whether it is a CW carrier (unmodulated), a standard video carrier or a scrambled channel carrier (and what type of scrambling).

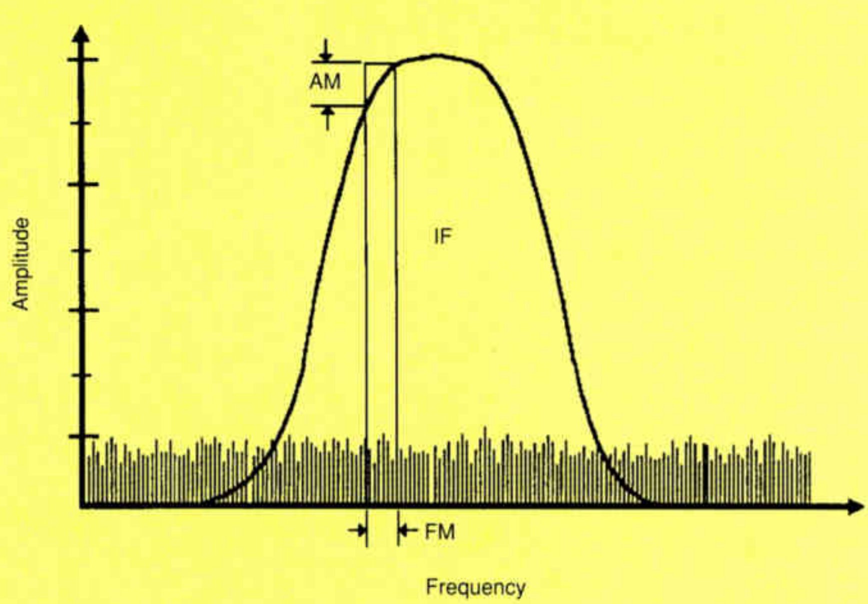
CW carriers are typically the easiest to measure since they are the simplest. Most modern signal level meters respond equally well to a CW and a standard video modulated signal. Small differences of 0.5 dB should be expected with most meters. In using a spectrum analyzer, the measurement should be straightforward. The only pitfall is to avoid scan loss. To avoid scan loss, slow the sweep rate until the maximum amplitude is achieved while using a resolution bandwidth of 500 kHz or less.

Since video modulated carrier measurement is the primary function of a signal level meter, its accuracy should be the best on a modulated carrier. In utilizing a spectrum analyzer care should again be taken to avoid scan loss, not only of the RF but of the sync peaks. A different resolution bandwidth and sweep rate will be required for measuring the noise than for measuring the carrier level.

Modern scrambling has complicated the measurement of carrier levels. The correct level reading for a scrambled channel is the level that would be present if the scrambling were turned off. Some meters are capable of reading the correct level and some others will read 4 to 6 dB low and may "drift around" in their reading according to the scene of the picture since they can not accurately measure the peak level during the VBI. (See Figure 14.) Consult the manufacturer for the effectiveness of any particular instrument on your specific type of scrambling. Instruments utilizing gated measurement capability will provide the correct level measurement on all scrambling techniques that do not change the level of the horizontal sync pulses during the VBI. Most popular scrambling techniques do not affect the VBI sync pulses. Again, with a spectrum analyzer use the maximum resolution bandwidth and slowest sweep speed reasonably possible, but be sure you have maintained sufficient selectivity. A peak hold function set for several seconds will "catch" a horizontal sync pulse at the true peak and therefore provide a correct peak measurement.

As noted previously, measuring the noise level is much more complex than measuring the carrier level and therefore requires greater care to ensure an accurate measurement. The primary concern when making the noise measurement is to be sure that the instrument is tuned to the noise. Most other aspects of the

Figure 15: Hum FM-to-AM conversion



"Although most sophisticated instruments avoid many of the possible sources of error and automate the measurement process, there is no substitution for care and knowledge about the specific system under test."

measurement are automated, however the tuning is often left to the operator, except on a few modern instruments. When tuning to the noise with a meter or a spectrum analyzer, the major concern is the selectivity of the instrument. In order to get a good noise measurement the instrument must reject the other signals on the system. Note that a narrower resolution bandwidth or IF bandwidth is a trade-off. While improving the selectivity it also raises the correction factor requiring greater sensitivity for the same C/N. When in the on-channel mode 70 dB of video and audio carrier rejection is required for a 50 dBc C/N, where a 10 dB correction factor is used and a 1 dB accuracy is desired.

The instrument used to make the noise measurement must have a noise figure or noise floor that is 10 dB below the noise level that you are measuring (for <1 dB error). A preamp can be used in front of the instrument if additional sensitivity is required. If you do this, be sure that the preamp noise figure is significantly below the noise level you are measuring and that the preamp will handle the signal load without distortion.

When measuring the noise another source of error can be beats generated by second or third order distortion, not only in the system but in the instrument itself. When using a meter, tuning for the minimum noise level or listening for the clear noise are the easiest methods to avoid beats. When using a spectrum analyzer you must distinguish between the noise and the beats' appearance. Newer automated test techniques actually make this more difficult. If you have difficulty avoiding the beats a preselection filter on the instrument's RF input is required. A gated measurement at 2.7 MHz above the video carrier is advantageous since no beat or distortion is commonly found at this frequency during the measurement time frame. Distortions within the instrument must still be avoided, though.

Caution must be taken when making C/N measurements on a positive trapped system with the SL750, since, the "interfering carrier" is placed between the video and audio carriers. On this type system the C/N is best done with the interfering carrier turned off or measured using the off-channel technique.

Hum only has a few possible sources of error. Since this is a baseband measurement few RF phenomena can affect the measurement. Keep in mind that measurements can only be made on a CW carrier with most instruments. Instruments employing the gated measurements outlined here will make accurate measurements on any video modulated carrier or any CW carrier. With all instruments the key is to be sure you are tuned to the peak of the carrier to avoid any FM-to-AM conversion in the instrument, producing drastically erroneous readings. The tuning step size and accuracy of the tuning can play an important role in the accuracy of the hum measurement. Figure 15 depicts an instrument that is slightly mistuned and the resultant slope detection.

Summary

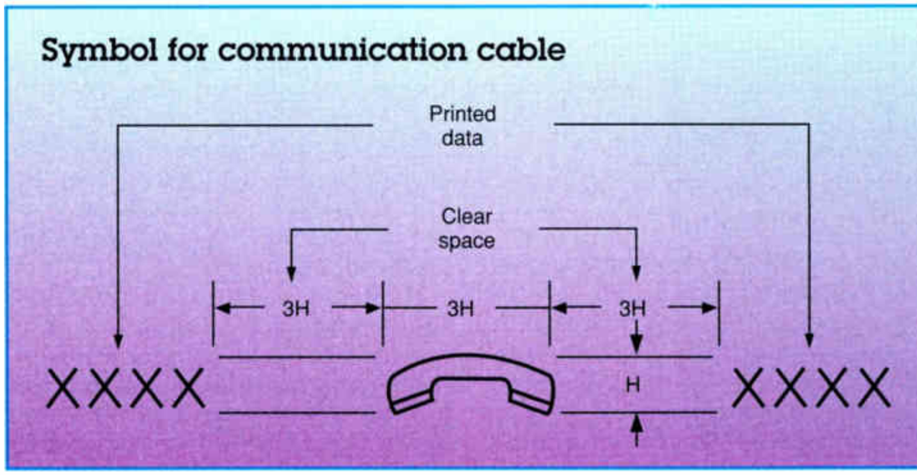
Although most sophisticated instruments avoid many of the possible sources of error and automate the measurement process, there is no substitution for care and knowledge about the specific system under test. As technology increases, system complexity and regulations burden the technical staff. The only solution is more sophisticated test equipment that does more, faster and at the same time is easier to use. The on-channel tests represent such advances. Testing on-channel greatly simplifies the operator's task and increases his ability to thoroughly test the system without the paradox of shutting off channels or inserting test carriers. **BTB**

The 1993 electrical codes and cable TV

By Robert E. Baker
Chief technician, TCA Cable TV of Clovis

Changes have occurred in the new 1993 versions of both the National Electrical Code (NEC) and the National Electrical Safety Code (NESC). These changes are most probably not common knowledge to all in our industry, nor have they, in all cases, been easy to adapt to. This article will explore some of these changes and attempt to interpret how they may be met. It also will provide a refresher for those who have not looked at the codes recently and assistance to those who cannot find their way around inside them.

It is appropriate to point out that the basic application of and differences between the NEC and the NESC are in the fact that the NEC applies mainly to electrical circuitry within or on structures, while the NESC pertains to the circuitry outside the structures. There is, of course, a meeting of the two, and some conflict in these areas.



The main grounding electrode

The first area of concern is the main grounding electrode for the structure. While the previous editions of the codes made provisions for the use of concrete-encased electrodes (NEC 250-81(c) and NESC 94A.3), this type of electrode was not frequently used until the past few years. It is now fast becoming popular for economic reasons. Basically, the codes allow the use of the steel reinforcing bars (rebar) within the concrete foundations of the structure as the grounding electrode. In these cases, no outside driven ground rod is available for bonding to by CATV.

Typically, the end of a rebar is brought to the surface of the concrete at a point such that it will be present inside the wooden wall frame. In most cases, after the electrician has completed the prewire, the rebar is of insufficient length for additional ground rod clamps and/or it is totally inaccessible to the CATV personnel when the time comes to do the new installation. This problem is further complicated by the use of PVC power risers, and the fact that most new homes have the riser and most of the meter box recessed into the finished building wall surface.

The PVC riser prevents the use of the usual grounding straps, and recessing the riser and meter box also may prevent the use of other available alternates such as meter box corner clamps or grounding lugs. The real solution to this problem lies in obtaining mutual cooperation from the city/state inspections personnel and the local building contractors association, to which most electrical contractors are members. If the electrical contractor will provide a AWG-12 solid copper grounding bond to the outside of the structure during the prewire, your problems are solved. The usual practice (and most common mistake made) by CATV personnel, is to connect the drop ground (grounding block) to a ground rod driven by the installer at the most convenient location at the point where the cable drop enters the building. This error is compounded when this rod is not bonded to the power ground (NEC 820-40(D)) using AWG-6 solid copper as required. Driving your own rod is permitted only when there are no grounds available as described in NEC 820-40(b)(1) or 820-40(b)(2), which is very rare indeed. Nowhere in the code does it state (but perhaps it should) that these grounds be easily accessible; but if they exist, it is mandatory that they be used.

If you must drive your own grounding electrode (rod), what is the correct size? Good question! The NEC 820-40 refers you to NEC 250-81, which eventually sends you to NEC 250-83(c). Therein you are informed that the minimum length is 8 feet and the diameter is 5/8 inch for iron or steel rods. This same specification is echoed in NESC 94.B.2.a. However, reading on in the NESC, one comes to Section 99, "Grounding Methods for Telephone and Other Communications Apparatus on Circuits Exposed to Supply Lines or Lightning," of which I believe CATV is included.

Looking at NESC 99.A.3. "Exception," the use of a 1/2-inch diameter, 5-foot rod is allowed. Since the NEC's application is to structures and the NESC mainly to outside plant, I believe that a rod driven to ground at the entrance to the structure (NEC 820.33), falls under NEC 250-83(c) and should be 8 feet in length. Other rods driven to ground outside plant, such as at amplifiers, ends of lines or other areas where no other bonding means exists, fall under the NESC 99.A.3 and may be 5 feet in length. (Note: In my opinion, where conflict exists, use the safest specification — i.e., always use an 8-foot rod when in doubt.)

The whys of driving a rod

It may be appropriate here to stop and discuss the "why" behind not driving your own rod and "why" if you do, it must be bonded to the power company's ground. Our whole purpose in grounding CATV lines is to place the coaxial cable sheath (shield) at the same potential as the electrical power ground, whether it be outside plant or subscriber drops. This is necessary to prevent potential fire and electrical shock hazards. We cannot rely on the earth solely to provide equipment grounding because it does not have the low impedance path required. This is especially true in arid climates where obtaining ground resistances less than 20 ohms is difficult to say the least. Further, NEC 250-91(c) specifically prohibits using the earth as the sole equipment grounding conductor.

Both the electrical utility company's and CATV's outside plant are subject to current surges. These surges may be a result of induced voltages from lightning in the area or from switching operations in the electrical utility. If both the electrical system and the CATV system are not bonded together by a low impedance path, these surges can raise the potential differences between them to voltages up into the thousands of volts. (Ohm's law: Voltage = current x resistance.) This, in turn, may result in fire hazards from arcing wherever the CATV sheath contacts a grounded part; or in an electrical shock hazard if an individual should come in contact with the sheath and provide an additional path to ground. What usually occurs, is damage to the subscriber's consumer electronics that may be connected to our services (TV sets, VCRs, stereos, etc.). Hence the reason for grounding at the entrance to the subscriber's residence.

The problem with mobile homes

Let's move on to another problem area, mobile homes. The 1993 NEC has a complete new area covering this topic, NEC 820-42. Mobile homes have long been a problem with regards to proper and adequate grounding. At the risk of offending some mobile home park owners, I must state that not all internal park wiring always meets code standards. Problems are rooted in the fact that most mobile homes simply "plug" into outlets provided, and no actual power company service exists. Many parks have "master" meters that bill for bulk usage. The parks, in turn, provide their own distribution system, often without further metering, including electrical charges in the lot rent. There are usually no individual ground rods and often the point at which the mobile home "plugs" into does not have a valid ground on the metal enclosure. Grounding is available only through the electrical cables.

NEC 550-11 requires that the metal frame and non-electrical parts be connected to a grounding bus in the mobile home distribution panel board. This bus is required by code to be connected to the service ground. Therefore, the new NEC 820-42 states that when there is no mobile home service equipment or disconnecting means per NEC 820-42(a), or where the mobile home is supplied by a cord and plug, then CATV may bond to the mobile home metal frame with an AWG-12 copper wire. How do we bond to the frame, you might ask? We do not drill holes. Several companies manufacture clamps specifically designed to clamp the mobile home "I-beam" frame work. These clamps bite into the metal and provide a means to safely connect your bonding wire from your drop grounding block. These special clamps are available from almost all CATV hardware vendors and range in price from just over $1 each to as high as nearly $5 each, depending on your application. The more expensive clamps will take AWG-6 wire, while the cheaper ones only take AWG-14 or AWG-12. All that I have seen are "UL approved."

Changes in the NESC

That about covers the NEC changes, but there are a lot more changes to review in the NESC. Let's now take a look at some that affect the CATV industry.

NESC 224 now permits communications lines to be located in the area previously reserved for electrical supply lines. They must be installed by "qualified" personnel, have the same clearances as neutrals, be supported by a grounded messenger and in general should not be "above" energized lines. Special provisions apply for communication circuits when they are located above energized supply lines. In any case, they are always treated as though they were energized (safety and handling, and construction practices) and transitions between the "supply" space and the usual communications space may only occur at a single structure (pole) and not mid-span. This is a new provision and makes way for expanded communications facilities on already crowded joint-use poles. It, of course, applies also to the telcos.

Vertical clearances above ground (NESC Table 232-1) have been lowered to 15.5 feet above "roads, streets and other areas subject to truck traffic" and "driveways, parking lots and alleys." Clearances above "spaces and ways subject to pedestrians or restricted vehicle traffic" have been reduced to 9.5 feet. Guidance from the *NESC Handbook* points out that these clearances are based on actual conflict from below and does not include allowances for such changes as snow accumulation or road resurfacings. It also does not take into consideration the straightness or plumbness of poles "after" installations, or for errors in sags and tensions during construction.

Vertical clearances between communications conductors and cables (NESC Table 235-5) located in the communications space is 40 inches, but may be reduced to 30 inches for supply neutrals; and for cable located in the supply space it is 16 inches, but no clearance is specified between a neutral and an insulated communications cable supported by an effectively grounded messenger.

Separations between supply and communications conduit systems (NESC 320.B.2.c) is 12 inches of well-tamped earth. Lesser separation is required for concrete and masonry. Lesser separations may be used where all parties concur.

Separations between supply and communications cables that are direct buried must be 12 inches (NESC 354.A.1). However, they may be buried at the same depth with no deliberate separation provided all parties involved are in agreement (NESC 354.D). (It should be noted that some restrictions apply.)

Beginning on Jan. 1, 1994, all direct buried communications cable shall be indented or embossed in the outermost cable jacket, at a spacing of not more than 40 inches with the symbol shown in the accompanying figure (NESC 350.G). Cable not meeting this marking requirement but in stock prior to January 1994 may be used only for repairs. **BTB**

References

1) *National Electrical Code 1993*, ISBN 0-87765-383-6.

2) *NEC Handbook 1993*, ISBN 0-87765-384-4.

3) *1993 National Electrical Safety Code*, ISBN 1-55937-210-9.

4) *NESC Handbook, Third Edition*, ISBN 1-55937-211-7.

CT DAILY

From *Communications Technology* magazine — Cable-Tec Expo Product Wrap-Up

Advanced Power Conversions Power Play: New DC-to-AC Inverters

A new line of DC-to-AC power inverters (GEN-X) designed for network trunk applications was at the Advanced Power Conversions booth. Built-in safety features include: regulated output of 60 Hz 118 VAC RMS for safe operation of sensitive test instruments and computers; input and output circuit breakers, reverse polarity protection; and an intelligent shunt-trip to safeguard the equipment being powered and the primary source.

The GEN-X converts DC input power-to-AC power with an efficiency rating of 85-93%. Its soft start feature starts a higher and wider variety of induction loads. **Reader service #268**

New Transmitter Fresh From Cable AML

A new microwave solid-state transmitter has been added to Cable AML's line of indoor broadband transmitters.

The Model ITX-015 is designed to implement high-quality, high-power microwave links for transporting up to 80 TV channels. In a typical application, the transmitter can feed four receivers simultaneously at distances in excess of 15 miles each, depending on channel loading and local climatic conditions.

The product uses the latest Gallium Arsenide power amplifier technology and also is offered in a double and quadruple redundant configuration. **Reader service #207**

Long Systems Tracks Out New Service Inventory System

Long Systems introduced its Service Inventory System (SIS) software and hardware package to track cable service inventory. The package includes inventory software, a hand-held computer and bar code printer.

The software allows the user to track inventory for multiple warehouses and for trucks. Project accounting allows you to capitalize new plant. Parts can be allocated for projects. And, SIS contains a full-featured purchase order module. **Reader service #206**

CLT Debuts Differential GPS Package

Cable Leakage Technologies released its new Deltawave. The product signals the end of bothersome, inconsistent GPS data due to the Department of Defense's intentional degradation of the GPS signal, referred to as Selective Availability, or S/A.

The Wavetracker allows the user to enjoy street width accuracy, or better, through a post-processed correction factor supplied by the differential base station. This system is sold complete with a PC workstation and stationary GPS unit. **Reader service #205**

Unattended S-2000 from Videotek Does Hundreds Of NTSC, PAL Tests

Headlining Videotek's exhibit was S-2000, a video analyzer that automatically and unattended performs hundreds of both NTSC and PAL systems tests. It performs automatic measurements in

NTSC (FCC, FCC/Cable, RS-170A, RS-250C, NTC-7, ICPM) and in PAL CCIR (473, 567, 569, 624, ICPM) plus common basic measurements for both formats.

Full user control of the four video inputs is achieved through any standard PC in defining and scheduling an unlimited series of tests at predetermined intervals. Any test can be performed instantly "at the press of a button." **Reader service #204**

Power Guard Extends Battery Line For Extended Battery Life

A newly designed standby power supply with a unique battery compartment designed to extend battery life was shown by Power Guard. It is mounted on an underground vault that contains the batteries. This configuration is said to allow for much cooler battery temperatures thus increasing battery life substantially.

The supply uses the same modules that are utilized in other Power Guard power supplies. The physical form factor is essentially the same as the existing non-standby meter pedestal that is approved by several utility companies. The system has a built-in breaker box that comes prewired from the factory. Once the utility connection and plant connection are made, all that is necessary is to plug in the modules and turn the unit on. **Reader service #203**

Alcoa Fujikura Gets The Dirt Out of Fiber Connections

Alcoa Fujikura displayed its hand-held, self-contained ferrule cleaner for optical fiber connectors that assures totally dirt-free, lint-free field connections for positive optical signal transmission. The device contains a special dry woven polyester film belt for fast removal of dust, dirt, oil and gels from fiber and ferrule end-face without using alcohol or solvents. It can clean up to 1,000 ferrules before disposal.

The PREP Connector Cleaner is designed for simple, one-hand operation. A thumb-activated, spring-loaded door mechanism advances the film belt and exposes a fresh film section through two round holes and two elongated slots in the top of the housing. Holding the device in one hand, the operator inserts and rotates the ferrule tip in Hole #1, wipes it in Slot #1, then rotates it in Hole #2 and finish-wipes it in Slot #2 to completely clean the ferrule end-face. **Reader service #202**

Convert To Broadband Microwave With Hughes AML

Hughes AML announced a broadband microwave conversion program. A single Hughes AML indoor broadband transmitter can replace an entire MTX-132 or STX-141 system. Features of the transmitters include up to 80-channel capability within a single 6-foot rack; increased power for supertrunking applications in excess of 25 miles; built-in self-test features; and local distribution and clustering services, located in headend.

Advantages of broadband equipment, according to Hughes, are: compatible performance to channelized equipment; simplicity of installation and operation; connection to existing channelized array in hybrid configurations with minimal system rebuild and without sacrificing performance; flexibility (new channels may be added without system reconfiguration or special channel location assignments); capital cost savings; and operating cost savings — power consumption, cooling requirements. **Reader service #201**

Harmonic Lightwaves Adds YAGLink Plus

Harmonic Lightwaves had its newly announced YAGLink Plus (YL+3200) on display. The product extends the reach of a standard YAGLink System, transmitting 80 channels of AM VSB video, to 50 km with an end-of-line carrier-to-noise ratio of +50 dB, an increase of 9 km.

The YAGLink Plus enhances the C/N link performance of a YAGLink transmitter and receiver system by as much as 3 dB and improves CSO specs by as much as 6 dB. **Reader service #194**

Earthvision Broadens Its Cygnet Vision

Earthvision Systems expanded its Cygnet line of products to include an agile TV demodulator and a four-channel FM modulator. Building on the platform of the Cygnet AMBO agile TV modulator and Cygnet SR-CK satellite TV receiver, the new products share a common packaging, racking and powering systems and take advantage of similar circuit technologies.

The Cygnet TD-VUC agile TV demodulator features front panel selectable synthesized tuning of any VHF, UHF or CATV TV signal in the 50-800 MHz frequency range, with T-channel tuning as an option. Either composite video or separately synthesized, it is set by internal DIP switches. **Reader service #196 (TD-VUC), #195 (FM modulator)**

Doubled Drop Amp Performance From Electroline

The DropAmp subscriber drop amplifier was introduced by Electroline. The unit features a 3 dB noise figure and operates at 1 GHz bandwidth. According to the company, the unit delivers high-quality signals from a fiber-to-serving-area or fiber-to-feeder network after being amplified at the customer premises.

Designed for 550 MHz to 1 GHz networks, the unit provides 14 dB output and 23 dBmV output per channel. It is powered from the home and boosts levels to feed homes with numerous outlets, multiple TV sets, VCRs and other devices connected to the drop, or when a very long drop is encountered. **Reader service #175**

New Drop At Belden

The Belden Division of Cooper Industries announced the Series 1000 line of drop cable that the company says guarantees sweep testing to 1 GHz on all the company's drop cable manufactured since July 1, 1992, and guarantees the lowest published structural return loss values at 20 dB for Series 59, 6, 7 and 11.

Sweep testing is conducted at both ends of the cable to provide the industry's most extensive readings on any SRL periodicity or attenuation problems. The company's manufacturing and quality assurance methods allow the customer to use bandwidth to 1 GHz. **Reader service #191**

Arcom Universal Encoder: The Next Generation

Arcom Labs introduced the second-generation AGE-2000 universal encoder for use in the Arcom Gaussian encode/decode system as well as traditional positive trap systems. The AGE-2000 has several improvements over the previous Gaussian encoder. The new unit features a variable AGC and variable frequency control, both of which are used to minimize adjacent channel effects. The company conducted a live demonstration. **Reader service #193**

Rack Mounting, Silicon Avalanche Advantages of New NTI Surge Suppressors

Northern Technologies Inc. showed a new addition to its full line of transient voltage surge suppression systems. The products combine the convenience of rack mounting with the benefits of silicon avalanche technology.

This technology is said to offer faster response time and lower clamping levels than traditional technologies such as MOVs or gas tubes. Also, silicon-based protection devices will not degrade, ensuring consistent reliable protection of your critical equipment for years to come, according to the company. **Reader service #192**

Manage Your Network With Broadband Networks

Broadband Networks Inc. introduced the EDCOMM network management and switching system for interactive video applications, which allows for point-to-point, point-to-multipoint and video-on-demand conferencing via a metropolitan area fiber-optic network.

The system uses both RF and baseband techniques in a distributed architecture so that it is cost-effective compared to conventional centralized switching approaches, according to the company.

In addition to conference switching, the system allows users to schedule year-long conference curriculums, provides different conferencing formats for business or education users and provides billing information to the service provider. Network management features allow analog and digital transmission links to coexist and be controlled by a single software package. **Reader service #178**

IF Matrixes And More From Monroe

Monroe Electronics' new Series 3000 IF matrix switcher was on display. The modular design combined with power divider modules allows field configurations from 2x2 through 8x8. According to the company, internal amplifiers enable the user to select one input to multiple outputs with no signal loss.

Also on display was the company's new Model 624 video sensor, which provides 2x1 audio/video switching. **Reader service #177 (switcher), #176 (sensor)**

Viewsonics Rolls Out Mini Amps

Viewsonics Inc. displayed a new line of high performance miniature broadband amplifiers with a frequency range of 45 MHz to 1 GHz.

The company used its traditional small pattern two-way splitter housing for the single output 10 dB gain mini amp and the 3/4-way splitter housing for the 2-output 10 dB gain mini amp. The four-output 10 dB gain and the single output 20 dB gain mini amps are housed in a slightly larger version. Ports are parallel to the mounting surface on all models. **Reader service #174**

Telecrafter's Plastic Clip Gun Is Lighter, Stronger

Telecrafter Products introduced what it says is the first non-metallic percussion hand tool. Using advances in plastic technology, this tool is an improvement on the company's RB-2 clip gun used in the installation of drop cable. It is manufactured almost entirely from high tech plastic and is 40% lighter, stronger and less expensive than its predecessor. The tool uses the same RB-2 cable clips as the existing Model RB-2E. **Reader service #172**

Tek Develops Cable Signal Set Option With MSOs For FCC Testing

Newly introduced by Tektronix was Option 02, the cable signal set option to the TSG 120 TC/NTSC generator and VITS100 generator/inserter.

With the option, the two generators can perform tests required by the FCC: cable multiburst, cable sweep, FCC composite and NTC7 composite. Option 02 on the TSG120 also delivers utilities designed to make thorough cable system testing easier. This includes cable matrix that combines five test signals (cable multiburst, cable sweep, (Sin x)/x, FCC composite, and five-step staircase) into a single test signal matrix.

The company also demonstrated its new 2707 external tracking generator. The 2707 attaches to a Tektronix 2711, 2712 or 2714 spectrum analyzer to form a compact signal tracking and scalar analysis package. Together, the 2707 and spectrum analyzer perform standard analyzer functions plus the frequency-swept measurements essential to transmission system maintenance.

This scheme is said to not only simplify setup, but also allows the combined devices to be computer-controlled as a single automated instrument via GPIB or RS-232.

The combined 2707 and spectrum analyzer provide swept measurements from 100 kHz to 1.8 GHz. The system's 100 dB dynamic range shows filter ultimate rejection or circuit isolation characteristics. The unit's output can be set in steps as fine as 0.1 dB, maximizing control over amplifier compression testing.

Also, demoed for the first time was the company's CSS500 cable system software. **Reader service #180 (Option 02), #179 (tracking system), #142 (CSS500)**

New Microwave Receiver Line At Cable AML Display

The new ORX series of broadband microwave receivers from Cable AML was on display. A two-piece receiver configuration eliminates the need for connecting waveguide between the antenna and receiver. The small downconverter unit of the two-piece receiver is normally attached directly to the antenna feed at the back of the antenna, while the VHF unit can be placed at the base of the tower, indoors or near the downconverter. The two units are interconnected by standard cable. Diagnostic and status monitoring can be performed at the VHF unit's monitor interface connector. Receivers are available in several options with different noise figures and VHF and/or microwave AGC. **Reader service #171**

Dimensions Intros Three Units For Power Demands

Dimensions Unlimited says the three models it introduced into the video and cable TV markets cover nearly all power demands. Continuous power output ratings range from 1,400 to 2,100 watts. These inverters have a smaller than usual profile and footprint of 15.5 by 16 by 7.5 inches that take up little truck space. The smaller dimensions are due in part to a recent patent awarded to the manufacturer for its cooling method. A single fan forces air into, under and behind the inverter's housing. **Reader service #170**

Cable AML Intros Highest Power Microwave Broadband Transmitter Available

Said to be the most powerful CARS band broadband transmitter available, the Model ITX-1260 was on display at Cable AML. The transmitter has the output power equivalent to that of a linear 1,260 watt amplifier, a substantial jump over the previous high power of 500 watts.

Features include a thoroughly modular design with easy-to-read diagnostics and an inherently reliable fail-soft architecture that allows service restoration at lower power levels without interrupting service. **Reader service #168**

New From Videotek: Combo Waveform Monitor/Vectorscope

Among the new products from Videotek was the TVM-675 full-featured half-rack width combination waveform monitor/vectorscope and audio monitor engineered to observe either composite or component analog signals. Stereo audio phase and levels may be monitored via the easy-to-read Lissajous display. The audio may be displayed alone or in any combination with waveform and/or vector displays.

The unit permits the observation of three paraded video sources plus audio simultaneously, eliminating the need for multiple instruments. It also can overlay up to three composite waveform or vector displays to simplify timing adjustments and compare input signal levels. All three composite inputs may be displayed simultaneously with flat, low pass and chroma filters. **Reader service #163**

EXPO BRIEFS ...

• **Mega Hertz** has developed a booklet presenting an overview of the requirements for FCC proof-of-performance testing. Information is included for the tests involved and for equipment available to perform testing both at the headend and subscriber's terminal. **Reader service #141**

• **Comm/net Systems Inc.**, the Seattle-based representative of Dynamote Corp., introduced the "Brutus" sine wave output DC-to-AC inverter for mobile vehicle applications test equipment powering. The Dynamote solid-state inverters are said to provide a reliable solution to the recent concerns regarding powering expensive test gear for accurate FCC proofs. **Reader service #147**

• **Comm/Scope** is offering a fiber feeder cable in its Optical Reach fiber-optic cable product line. The new product is designed for CATV applications to provide a more cost-effective link between fiber trunk and coaxial cable feeder than prior designs, according to the company. **Reader service #146**

• In order to meet operator demand for more rack space at the headend, **Contec International** has introduced the Shrink Rack. The unit is a downsized chassis that houses a standard Video-Cipher in half the space originally required. The operator is now free to add additional equipment to enhance signal transmission and generate additional revenue. **Reader service #145**

Electroline's Vision Of Pay-Per-View

Electroline introduced its Dial-A-Vision impulse pay-per-view system for hotel, resort, campus and hospital applications. The system lets customers order movies or other programs instantly by touching the keys on their in-room telephones. An automated voice response unit then guides callers through the ordering process without an operator. Billing statements are generated automatically for property management.

The system can be used as a stand-alone system or as part of a wider addressable control system for basic, expanded basic and premium tiers. **Reader service #162**

RMS Debuts: Taps, Passives, Stripping Tool, Splitters

RMS Electronics had several new products on display. First was a new line of 750 MHz taps and trunk passives to complement and expand its existing series of 600 MHz taps and trunk passives. Next was a new cable stripping tool for RG-7 and RG-11 cable. The tool can be used in host of applications including 4.9 mm-11 mm coaxial cable, power cable, even telephone cable jacket stripping.

Also new was a line of 1 GHz splitters, HFR Series. These two-, three- and four-way splitters have an RFI rating of -120 dB and come with a grounding block. **Reader service #161 (taps and passives), #160 (stripper), #159 (splitters),**

Frequency Agility From Standard

Standard Communications showed the TVM850P frequency agile, PLL locked high-band heterodyne processor, whose core is designed around the TVM850 frequency agile RF output circuit.

The TVM850 Series RF output circuits employ a PLL locked, four-stage conversion process to accomplish a broadband noise and artifact-free output. This is performed without the use of post-filtering on the broadband output. The OAP890 input tuner is a new 50 to 890 MHz frequency agile design that utilizes two PLL locked, dual conversion, hybrid synthesizers that can automatically track the input frequency. This can be achieved over a wide input dynamic range (-10 to +1 dBmV). According to the company, the unit is the first all channel in, all channel out agile processor.

The input tuner can be programmed to receive any VHF, UHF or CATV (up to 890 MHz) frequency by rotating the channel selector with the output channel numerically indicated on the front panel. The OAP890 module is preformatted by a user-defined EPROM for all domestic off-air CATV channels. **Reader service #153**

Create Your Maps With Cadix

The AD-4001 automatic digitizing system shown by Cadix, converts manual drawings and maps into CAD-ready vector data in minutes, according to the company. Distortion and noise are automatically corrected and the drawing image is available for immediate viewing or editing on the workstation.

Correction capabilities include automatic grid correction, line recognition, horizontal and vertical line correction, corner and intersection correction, arc recognition, text recognition, mark and symbol recognition and trace angle correction. **Reader service #157**

Wavetek Adds Three New SLMs

Wavetek Communications announced the addition of three new signal level meters. Replacing the SAM 1500, the new SAM 1550 installer meter incorporates all basic functions of its predecessor while providing a full channel sweep mode that detects when adjacent and overall levels are out of programmable limits.

Joining the 1550, the new SAM 3030 supports all of the 3000's functions, while featuring hum and C/N measurements, as well as full channel sweep with limits and multiple channel plans.

Lastly, the company introduced its latest innovation focused at FCC 24-hour testing requirements, the SAM 1650. The unit performs all of the SAM 1500's functions, but includes a six-hour interval test with a power saving "sleep" mode. **Reader service #156 (SAM 1550), #155 (SAM 3030), #154 (SAM 1650)**

Sink Cable Pirates With dB-tronics

dB-tronics Inc. announced a due diligence service called "Sink Cable Pirates," designed exclusively for cable TV companies to help them fight cable pira-

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- ☐ 5. MDS, STV or LPTV Operator
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- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
- ☐ 9. Cable TV Investor
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4	23	42	61	80	99	118	137	156	175	194	254
5	24	43	62	81	100	119	138	157	176	195	255
6	25	44	63	82	101	120	139	158	177	196	256
7	26	45	64	83	102	121	140	159	178	197	257
8	27	46	65	84	103	122	141	160	179	198	258
9	28	47	66	85	104	123	142	161	180	199	259
10	29	48	67	86	105	124	143	162	181	200	260
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18	37	56	75	94	113	132	151	170	189	208	268

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3	22	41	60	79	98	117	136	155	174	193	253
4	23	42	61	80	99	118	137	156	175	194	254
5	24	43	62	81	100	119	138	157	176	195	255
6	25	44	63	82	101	120	139	158	177	196	256
7	25	45	64	83	102	121	140	159	178	197	257
8	27	46	65	84	103	122	141	160	179	198	258
9	28	47	66	85	104	123	142	161	180	199	259
10	29	48	67	86	105	124	143	162	181	200	260
11	30	49	68	87	106	125	144	163	182	201	261
12	31	50	69	88	107	126	145	164	183	202	262
13	32	51	70	89	108	127	146	165	184	203	263
14	33	52	71	90	109	128	147	166	185	204	264
15	34	53	72	91	110	129	148	167	186	205	265
16	35	54	73	92	111	130	149	168	187	206	266
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cy. It is comprised of a two-part program that can help cable companies track, organize and manage due diligence activities prior to the disposal of surplus addressable converters/decoders.

Sink Cable Pirates is comprised of a clearinghouse in which dB-tronics brings together legitimate, qualified buyers and sellers and a software tool designed to assist cable companies with conducting due diligence. A nationwide converter clearinghouse is maintained at dB-tronics' Wellford, SC, location. The clearinghouse is a data base that matches cable companies with surplus equipment with other cable companies requesting similar types of equipment. **Reader service #152**

Zenith Talks Addressability With Dialog Editor, New Decoder Meets New Cable Law Head-On

Zenith Cable Products demonstrated the HT-2000 addressable subscriber system, including its Dialog Editor software, used to program the on-screen information system. It allows operators to create custom screens and screen interoperability activity to be sent to their subscribers for a variety of purposes, including global or individualized promotional messages, personal greetings or even payment reminders.

The Dialog Editor assists in formatting dynamic information from a variety of sources, such as electronic program guides or other data services, which is then translated into a format the HT-2000 decoder can interpret.

Also, a new broadband addressable decoder, developed to address the equipment compatibility requirement of the Cable Act of 1992, was demoed by the company.

The new BOS (broadband on-screen) decoder builds on two subscriber-friendly technologies developed by Zenith: the HT-2000 and the Shadow broadband decoder. **Reader service #150 (HT-2000), #149 (BOS decoder)**

Audio Level Control From Channelmatic

Channelmatic unveiled the Audio Level Control. Addition of the ALC provides a means of automatically maintaining a consistent audio level on a given channel or network. Use of the ALC amplifier circuits on multiple channels allows the audio levels to remain constant, even when a viewer tunes from one channel to another or during transitions between local commercial breaks and back to network programming again.

The ALC monitors input levels from -24 dBm to +14 dBm and provides a constant output range of -2 dBm to +2 dBm with a total harmonic distortion, which does not exceed 0.25%. Frequency response if flat between 20 Hz and 20 kHz. Each ALC 3001A module can provide control for stereo input with discrete right/left audio inputs and outputs for two independent monaural audio channels. Modules for up to 12 stereo channels or 24 mono ones can be incorporated into a single 3000 series frame. **Reader service #143**

Calan's Comet Integrates Performance Monitoring

Calan Inc.'s Comet family of remote line monitoring systems was introduced. The Comet system includes products from Philips Broadband Network and AM Communications, plus the integration of software and additional hardware developed by Calan.

The Comet family consists of three levels of system functionality: Comet I — signal level monitor, which monitors RF levels under workstation control; Comet 1+ — signal level monitor plus, which monitors RF levels plus under local intelligent control; and Comet II — multimoded monitor and control, which monitors RF levels, frequency response, distortion, other system parameters and controls system functions plus providing FACTS, the fully automated compliance test system. **Reader service #148**

Fresh Videotek Fare: Rack-Mount Frame Architecture, Audio Program Monitor

Videotek introduced several new products, including the Omniframe rack-mount frame architecture and the APM-800 program monitor.

Any combination of Videotek's current or future modules may be installed in Omniframe to meet a variety of applications. Video and audio distribution amplifiers, plus sync and test signal generator all reside in Omniframe, saving valuable rack space and having to buy multiple frames, according to the company. Up to 80 audio and/or video outputs can be installed in one Omniframe. Each module has a self-contained power supply so there is no single point of failure as with common power supply frames.

Another new product, the APM-800 audio program monitor, is engineered for dual aural monitoring of up to eight inputs, either balanced or unbalanced. **Reader service #140 (Omniframe), #132 (APM-800)**

Utili-GARD Surge Protection

Utili-GARD, developer of the UG60 headend and hub surge protector, introduced the 120PS-SP for AC surge protection of standby power supplies. When used at the disconnect on the load side of the breaker, the Utili-GARD 120PS-SP will stop AC power line transients primarily caused by utility switching and secondary lightning strikes that cause unnecessary outages and damage customer relations. The 120PS-SP features an on-line indicator, 840 joules at 19,500 peak amps of protection and is said to eliminate costly service calls due to breaker or fuse outages. **Reader service #144**

New Coupler Packaging Hardware for CATV

Porta Systems Corp. announced a new line of packages (modules, trays and panels) for couplers that provide total fiber management. These new coupler packages offer hardware solutions for the unique requirements of the CATV network.

Couplers are concatenated at the factory and packaged in a variety of 1x2, 1x3, 1x4 and 1x6 modules. The new packages are said to dramatically save rack space, labor and material costs. **Reader service #151**

New Splice Enclosures, Converter From ANTEC

ANTEC Network Systems introduced the Fiberpak fiber-optic splice enclosure, designed and engineered specifically for cable TV applications. The enclosure features express cable entry on four ports and knockouts for eight cable ports. It accommodates fiber counts of up to 216 fusion or 152 mechanical splices.

Also, the company has added to its Regal product line the RR-92 550 MHz basic converter and the CRP-10 backwards-compatible hand-held remote. The RR-92 is an 83-channel unit that passes separate audio program signals and is fully BTSC (MTS) stereo-compatible. The remote is backwards-compatible, enabling Regal RC-83 converter users to choose an alternative remote control. **Reader service #137 (enclosure), #136 (converter)**

Zenith Helps Thwart Thieves

New technology to foil would-be pay TV program thieves is at the heart of new addressable decoders from Zenith Cable Products. The new enhanced security technology takes advantage of the Dialog Processor in Zenith's HT-2000 decoder. Called SSAVI+, the encryption technology further strengthens Zenith's sync suppression and active video inversion system. A dynamic "control seed" is sent to the HT-2000 via in-band data, directing the decoder to the location of dynamic scrambling commands that can be located in several places in the vertical blanking interval. The control seed can only be interpreted if the proper decryption algorithm has previously been received through the out-of-band data channel, which normally receives informational data for the on-screen display.

On any encrypted channel, the encoder will send false data, causing non-authorized decoders to rapidly alternate between video inversion and non-video inversion. Alternatively, illegal decoders can be authorized to descramble a special channel prompting them to call the cable operator. **Reader service #139**

Cable Plant Installation Demo At Siecor

Siecor Corp. exhibited a variety of products, depicting a typical cable TV fiber-optic cable plant installation from the headend to the optical receiver nodes. Enhancements to the company's high-precision M90 fusion splicer were announced.

The unit's profile alignment system (PAS) program is now much faster, according to the company. The splicer also incorporates the LID-SYSTEM unit to optimize and measure fiber alignment and splice loss.

Additional program improvements make it possible to simultaneously store parameters for different types of fibers and still use either fuse time optimization or profile alignment for high-quality splices. The unit also automatically evaluates the cleaved fiber ends. Unacceptable results are shown on the new high-contrast, color display screen. To improve visibility of splicing parameters, two views of the fibers are shown simultaneously. Splice loss averages 0.02 dB, with return loss measurements typically greater than 60 dB.

Integrating the splicer with the company's FBC-005 fiber cleaver, the Crimp & Go splice protector or heat-shrink oven, and splicer tools provides craftsmen a complete working environment in one package.

Also introduced was the OS-210 Series hand-held single-mode laser source. **Reader service #133 (PAS), #132 (OS-210)**

New Fiber-Optic Trunk Cables Carted Out By Cooper/Belden

The Belden Division of Cooper Industries introduced new fiber-optic trunk cables for CATV. The cables are available in armored and all-dielectric versions and meet Bellcore (TR-NWT-000020) and REA (PE-90) standards.

The Belden multifiber per tube design consists of four to 240 single-mode fibers contained in loose, gel-filled, color-coded buffer tubes. The fiber tubes are cabled around a dielectric central strength member and the interstices are gel-filled to impede water penetration. In the armored version, the buffered tubes are surrounded by a layer of aramid yarn, an inner polyethylene jacket, and a layer of corrugated steel armor. **Reader service #138**

Third Generation Technology In Dimensions New Inverters

A new family of inverters with third generation technology was introduced by Dimensions Unlimited. Features include wall or shelf mounting, easy AC connection and an improved waveform stabilizer circuit.

A new "Video Wave" option has been developed especially for the CATV market. This provides a correct AC waveform for distortion-free video monitor viewing. The inverters are UL-listed to comply with all NEC and OSHA standards. **Reader service #166**

S-A Features Digital Video Compression System

A Scientific-Atlanta digital video compression system, identical to those now being installed by Viacom International Inc. and StarNet Inc., was on display.

Advantages include: secure and simultaneous transmission of multiple video, audio, data and text signals while still addressing and controlling each signal individually; compact disc quality audio; modular design of hardware, software and network architecture. **Reader service #135**

Alcoa Fujikura Shows Off Hard-Working Cleavers

The CT-100 series optical fiber cleavers were at Alcoa's booth. The new CT-103, CT-104 and CT-107 high-speed, high-precision mechanical cleavers are said to be especially valuable for high-production single-fiber and mass fusion splicing applications in the field. They can accurately score and cleave single-mode or multimode optical fibers with average cleave angle of less than 0.5°.

A base unit, CT-100, features a scriber blade and improved anvil for fast, consistent cleaves of individual fibers or up to 12-fiber cables in single operation. The T-S switch allows instant positioning of the blade, for cleaving normal silica fibers or titanium-coated silica fibers. **Reader service #134**

MFC Offers Filters: Fiber High Pass, Low Pass, Band Splitting, New 1 GHz

Microwave Filter Co. showed its band splitting filters that have been designed to increase carrier-to-noise ratio performance on split band fiber systems.

The high pass has a passband extending from the frequency cutoff, the video carrier of the lowest passband channel, to 550 MHz. The low pass has a passband of 50 to 525 MHz. Specifications common to all three units are 4 dB maximum passband loss and 16 dB minimum return loss; ripple is ±0.25 dB; delay variation, frequency cutoff to audio carrier of the lowest passband channel, is 20 nanoseconds maximum; rejection is 7 dB minimum at the frequency cutoff to 6 MHz, 20 dB minimum at the frequency cutoff to 12 MHz and 30 dB minimum at the frequency cutoff to 18 MHz. Impedance is 75 ohms and connectors are type F female.

Also displayed was a new filter for 1 GHz channel elimination applications. **Reader service #252**

Convert Maps With Cadix

Cadix showed the FX-7001, an integrated drawing management system that stores and manages drawings and maps on compact optical disk storage. According to the company, entire drawing rooms can be stored on optical disk storage for fast and easy drawing retrieval.

Cost savings, productivity and efficiency are achieved by extending the benefits of computer automation to manually created drawings and sketches. Existing drawings and maps can be quickly entered into the system using the comprehensive scanning and raster-based drafting tools provided. **Reader service #251**

C-COR/COMLUX Announces Fiber Scrambling Solution

C-COR/COMLUX unveiled several Series 3000 products that are compatible with RF scrambling and a single-channel digital fiber-optic video transmission system. These products are new additions to the Series 3000 high-speed digital fiber-optic video/audio/data transmission system.

The RF scrambling-compatible products will transport any standard RF scrambled channel through the Series 3000 high-speed digital equipment. Two RF scrambling options are available. The models CL 3803/3804DC (8-bit DC coupled codec) and/or CL3903/3904/DC (9-bit DC coupled codec) can process demodulated RF scrambled channels for transportation over the digital fiber network. The models CL3103/3104DC (10-bit DC coupled codec) and CL3843/3844 (IF downconverter/upconverter) will accept and process scrambled channels at video IF (41 to 45.75 MHz) for transportation over the digital fiber network.

The Model 3300 single-channel digital fiber-optic video transmission system transmits one video and two audio channels over fiber with RS-250C short-haul performance. Additional audio or data channels are options. **Reader service #253**

ME/I's Proof Is In The Course

Mind Extension Institute featured its new training program designed to help cable operators conduct successful proof-of-performance tests and achieve the new FCC standards. "FCC Proof-of-Performance Guidelines" is a 25-minute videotape and workbook course. It is designed for technical managers in systems with more than 1,000 subscribers.

Topics covered in the course include: timeline for conducting system's proof-of-performance; proof-of-performance record keeping guidelines and procedures; and selecting and determining proof-of-performance test points.

Mind Extension Video Training Here

Also, the company released a new videotape training program, "The New FCC Technical Standards," which includes a 20-minute VHS tape and an accompanying workbook. The program is designed to provide cable TV system technical managers with the key information and procedures necessary for them to comply with the new FCC technical standards. **Reader service #256 (POP), #257 (tech standards)**

Field Service Management System In Bull Advanced Telecommunications Pen

Bull Advanced Telecommunications Solutions offered its Field Service Management System (FSMS), a set of products and services that supplies automation systems to increase the productivity of I&R forces.

The FSMS system is a complete end-to-end work force management system consisting of four integrated components: geographic information system (GIS), which maps a company's serving area and superimposes the land base and outside plant facilities required to provision services to the subscribers; computer-aided dispatching (CAD) that fully integrates with the company's existing operations support system for service order entry and trouble ticket generation operations; global position system (GPS) that gives the company the ability to locate all vehicles in a work force; all vehicles are equipped with GPS sensors that can be tracked in "real time" and a mobile data terminal (MDT) that is a portable terminal/computer equipped with wireless communications (either RF or cellular). **Reader service #258**

TSD Television Stereo Decoder At Leaming

Leaming Industries showed its TSD TV Stereo (& SAP) decoder that may be used as a stereo TV audio monitor in the headend, in conjunction with ordinary headend test equipment to make accurate BTSC stereo measurements, or in the field for stereo service calls.

As a headend monitor, the unit accepts a variety of input signals: Ch. 3, Ch. 4, 41.25 MHz, 4.5 MHz, and composite baseband. It provides fixed and variable outputs, and offers several output configurations. **Reader service #259**

Superior Adds To Cheetah Line

Superior Electronics Group Inc. announced the addition of the CEL4650.DM, a cellular telephone equipped remote distortion test and monitoring instrument, to the Cheetah automated remote testing system.

The Cheetah system allows the cable operator to test multiple channels unattended for coherent disturbances of composite triple beat and composite second order, in addition to carrier-to-noise and hum measurements.

The CEL4650 DM, utilizing the CellPack, has been developed to allow portable communications for automated compliance testing with the Cheetah system. **Reader service #260**

Radiant Fiber Products Offered

Radiant Communications Corp. announced the availability of its Series JLBR (V) fiber-optic single-mode low backreflection variable attenuator/jumper. The Series JLBR (V) is said to achieve attenuation from 1 dB to 40 dB at 1,300/1,550 nm while maintaining <60 dB return loss. The attenuator/jumper can be supplied with FC/APC, SC/APC or any single-mode PC-type connector.

Radiant also showed its Series DSF aerial fiber-optic splice box. The splice box, having a 12-splice capacity, is made of fiberglass and is watertight to NEMA requirements 4, 4x, 5, 12 and 13. **Reader service #254 (attenuator), #255 (splice box)**

Test New Proof-of-Performance Software at Long Systems

Long Systems demonstrated its new release software to document technical standards testing. The new version 2.01 of POP has been fully updated to meet the November 1992 Federal Communications Commission clarifications.

POP performs a full pass/fail analysis on all proof-of-performance tests, plus generates a public record. The software also records subscriber complaints, creates work orders and prints FCC required aggregate data. POP works in full cooperation with all manufacturer's test equipment to help operators meet the FCC technical standards regulations. **Reader service #167**

Super Redundant, SLL Standby Power New At Power Guard

"The super redundant power supply is a novel new approach to powering fiber-optic node equipment," reports Power Guard.

The power is supplied from the distribution system power supplies. If there is a line fail, the unit seeks the first active leg of the distribution system. Only the area affected by the outage will not have service. The rest of the system will still be functional.

The new SLL series standby power supply line features ferro and standby modules in a compact pole-mount housing with the ability to install the batteries in a remote underground vault. The supplies are available in 24 or 36 volt DC versions and in 3, 6, 9, 12 and 15 amps. **Reader service #165**

Alpha Shows CableUPS Line

Developed to bridge the gap between the diverse power requirements of fiber network, hybrid designs and conventional coaxial systems, Alpha Technologies' new FP Series power supplies provide uninterrupted AC or DC power with all the important advantages of the AP and XP Series, according to the company.

The series features single ferroresonant transformer design, regulated output under all modes of operation, built-in line conditioning and surge protection. According to the company, the AC version provides high efficiency performance in the 4 to 7 amp range, while the DC power module delivers direct powering of fiber nodes at the auxiliary power port.

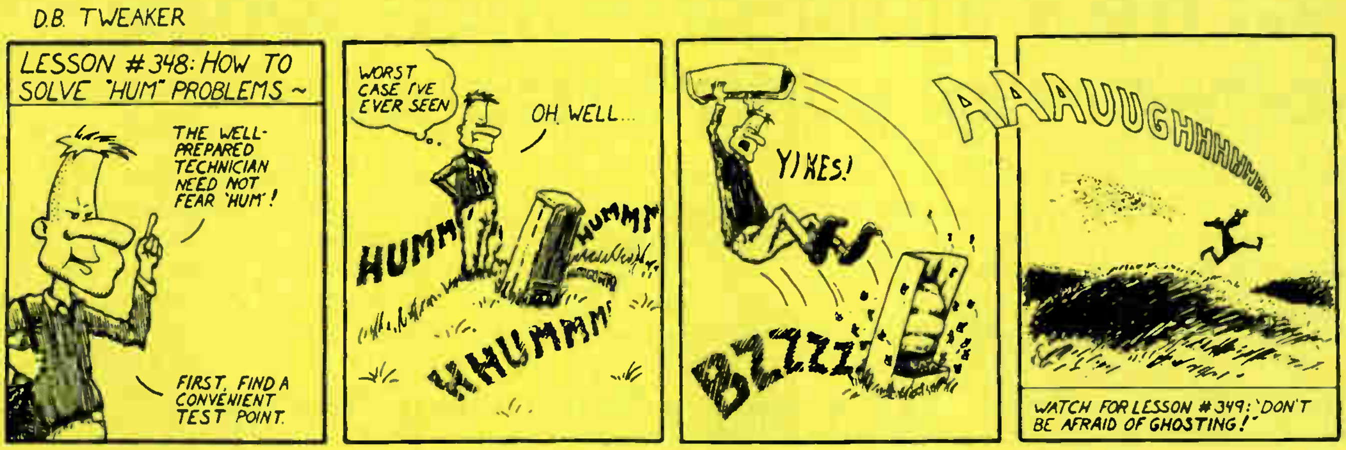
With "quick connects" for batteries and power output, the units also have a remote temperature sensor for precision charging. **Reader service #164**

EXPO BRIEFS . . .

• **Porta Systems** offered its complimentary CATV Network Design Guide that provides detailed information regarding the proper configuration of a CATV network. This comprehensive guide outlines the utilization of couplers, panels and connector assemblies in the CATV network. **Reader service #261**

• **Dimensions Unlimited Inc.** unveiled a new series of power inverters that transform DC battery power to AC current. They are stable enough to drive video monitors without distortion. **Reader service #200**

• **Budco** is stocking an acrylic laminated fiber-optic snap-on cable marker, which is a one-piece construction that snaps onto cable without ties, straps or adhesives. Stock snap-ons are 8 inches long, fit 1/2- to 1-inch cable diameters



Glenn Mueller

and are orange with black copy. Other options are available through special order. **Reader service #199**

• **Electroline**'s new DropAmp, designed for FSA/FTF networks of 550 MHz to 1 GHz bandwidth, provides 14 dB output and 23 dBmV output per channel. The unit, powered from the home, boosts levels to feed homes with numerous outlets, multiple TV sets, VCRs and other devices connected to the drop, or for situations where an extra-long drop is encountered. **Reader service #198**

• **Jerry Conn** had information at its booth on Intelvideo's digital impulse noise reducer. The unit is a state-of-the-art signal processing system that essentially removes all electrical or ignition type impulse noise from NTSC color signals. It also is effective in detecting and correcting satellite or FM link threshold noise that normally appears as "sparkies" or streaks, in effect, a means of extending threshold in FM links. **Reader service #197**

• **AM Communications** showed its new Fully Automated Compliance Test System (FACTS) for performing all FCC system proof testing. Live fully automated measurements for noise, distortion, hum modulation and flatness were demonstrated using AM's newest hardware and software products. **Reader service #208**

• **Cablematic** displayed its CR-EZT assembly tool that assembles Raychem EZF connectors to cable in seconds, according to the company. It has a rugged steel frame with toggle action that allows maximum assembly force with minimal effort. Connector sizes are clearly stamped on the tool and the durable, hot-dipped, full cushion handles will not slide off. **Reader service #262**

• **Eagle Comtronics** had its SIS decoding filters on display that are said to have near perfect descrambling. Other features include high channel applications, video enhancement possible and security improved by high channel usage. **Reader service #263**

• **Lectro** announced a ZTT version of its two-battery UniMax standby power supply. This version, which utilizes a special zero transfer time technique, ensures continuous unbroken power when transferring in or out of standby and features a single ferroresonant transformer designed to run cool and consistent from either AC line or battery power. **Reader service #264**

• **Diamond Communication** demonstrated the advantages of using a drop wire clamp. On display were fiber-optic hardware and underground fiber-optic splice case enclosures, the Optiped. **Reader service #265**

• **Comm/net Systems Inc.** introduced an uninterruptible power supply (UPS) AC power system design and installation service for Alpha Technologies power products in the Northwest and Alaska. The company is offering a complete package including measurement of actual headend electrical load, estimation of future load requirements and installation of the proper sized Alpha UPS system. **Reader service #266**

• **ABC Cable Products** offered several new products within the compatible remote family. These products consist of easy-to-use "Wee Motes," universal and SA8600-DMX remotes. All have cable TV OEM capabilities and are available with prompt delivery at cost-effective pricing, the company says. Also on display was the CBLinX family of RF-to-optical fiber converters. **Reader service #267**

• **AOFR Americas Inc.** displayed its single-mode couplers/splitters and attenuators for the CATV industry. Wideband 1x2, 1x3, 1x4 and larger configurations operate from 1,260 and 1,580 nm with low excess loss, high directivity and low reflectance, according to the company. Standard 1x2 coupling ratios from 5 to 50% and 1x4 splitters are available from stock. **Reader service #173**

• The **Belden Division** of Cooper Industries showed the Enviropak reusable drop cable dispenser, designed to house and protect indoor Series 59 and 6 drop cable. This high-density polyethylene case is environmentally friendly and reduces waste from plywood reels and corrugated boxes. When the cable has been depleted, the user inserts a new coil of cable in the unit and it is ready for use. **Reader service #158**

• **Just Drop** introduced its newest pocket toner, which the company says is the most compact and inexpensive of its kind. Made for identifying drops and checking line continuity, this unit comes with an LED for identifying splitters and has a louder tone than previous models. **Reader service #169**

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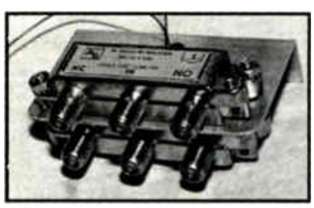

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8: SCTE Desert Chapter seminar, CLI, San Gorgonio Inn, Banning, CA. Contact Greg Williams, (619) 340-1312, ext. 277.
8: SCTE Ohio Valley Chapter meeting, SCTE/CTAM Golf Outing, Foxfire Country Club, Columbus, OH. Contact Weldon Feightner, (513) 941-7000.
8: SCTE Sierra Chapter seminar, customer service training. Contact Steve Allen, (916) 786-2469.
8: SCTE Southeast Texas Chapter meeting, Warner Cable, Houston. Contact Tom Rowan, (713) 580-7360.
9: SCTE Badger State Chapter seminar, installer training, Installer exams administered, Warner Cable, Greenfield, WI. Contact Brian Revak, (608) 372-2999.
9: SCTE Delaware Valley Chapter seminar, Cable Act of 1992, proof-of-performance testing, BCT/E exams administered, Willow Grove, PA. Contact Louis Aurely, (215) 675-2053.
10: SCTE Music City Chapter meeting, Ramada Inn, Nashville, TN. Contact Dale Goodman, (615) 244-7462, ext. 402.
10: SCTE Satellite Tele-Seminar Program, *SLMs: The Technician's Edge (Part One)*, to be shown on Galaxy I, Transponder 14. Contact SCTE national headquarters, (215) 363-6888.
11: Hewlett-Packard Wireless Communications Symposium, Dallas. Contact (800) 765-9200.
12: SCTE Cascade Range Chapter meeting, BCT/E exams administered, Paragon Cable, Portland, OR. Contact Cynthia Stokes, (503) 230-2099.
14: Hewlett-Packard Wireless Communications Symposium, Ft. Lauderdale, FL. Contact (800) 765-9200.
15: SCTE Chattahoochee Chapter meeting, Installer and BCT/E exams administered, Cox Communications, Atlanta. Contact Hugh McCarley, (404) 843-5517.
16: SCTE Florida Chapter seminar, video and audio signal, outage control and data networking and architecture, Holiday Inn, Lakeland, FL. Contact John Tinberg, (407) 747-4998.
16: SCTE North Country Chapter meeting, Sheraton Midway Hotel, St. Paul, MN. Contact Bill Davis, (612) 646-8755.
16: SCTE San Diego Chapter meeting. Contact Kathleen Horst, (310) 532-5300, ext. 250.
16-18: USIMTA Wireless Communications Legislative Conference, Madison Hotel, Washington, DC. Contact Raymond Linsenmayer, (202) 973-2878.
17: SCTE Iowa Heartland Chapter meeting, BCT/E exams administered, Cedar Rapids, IA. Contact Mitch Carlson, (309) 797-2580, ext. 3700.
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19: SCTE Cactus Chapter seminar, headend equipment and maintenance. Contact Harold Mackey, (602) 352-5860, ext. 135.
19: SCTE Upstate New York Chapter meeting, BCT/E exams administered. Contact William Grant, (716) 827-3880.
21: SCTE Rocky Mountain Chapter seminar, subscribers. Contact Ron Upchurch, (303) 790-0386, ext. 403.
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25: Hewlett-Packard Wireless Communications Symposium, Columbus, OH. Contact (800) 765-9200.
28-29: Digital TV: Compression '93, Scanticon Hotel & Conference Center, Denver. Contact (303) 825-2022.
28-30: SCTE Technology for Technicians II Seminar, hands-on technical training program for broadband industry technicians and system engineers, Indianapolis. Contact SCTE national headquarters, (215) 363-6888.
29: Hewlett-Packard Wireless Communications Symposium, Atlanta. Contact (800) 765-9200.

July

1: SCTE OSHA/Safety Seminar for system managers/safety coordinators on maintaining records and developing safety training programs, Indianapolis. Contact SCTE national headquarters, (215) 363-6888.

Planning ahead

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Aug. 16-18: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.
Aug. 25-27: Eastern Cable Show, Atlanta. Contact (404) 252-2454.
Oct. 5-6: Atlantic Cable Show, Atlantic City, NJ. Contact (609) 848-1000.

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8: SCTE Penn-Ohio Chapter seminar, competing technologies, Installer and BCT/E exams administered, Sheraton Hotel, Warrendale, PA. Contact Marianne McClain, (412) 531-5710.
12: SCTE Florida Chapter seminar, headend equipment and combining techniques, set top devices and transportation systems, Holiday Inn, Ft. Lauderdale, FL. Contact John Tinberg, (407) 747-4998.
12: ONI Fiberworks seminar, CATV systems, fiber-optic system training, Denver. Contact (800) 342-3763.
13: SCTE Chattahoochee Chapter seminar, Macon, GA. Contact Hugh McCarley, (404) 843-5517.
13: SCTE Desert Chapter meeting, Installer and BCT/E exams administered, King Videocable, Lake Elsinore, CA. Contact Greg Williams, (619) 1312, ext. 277.
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13: SCTE Wheat State Chapter meeting. Contact Lisa Hewitt, (316) 262-4270, ext. 191.
14: SCTE Badger State Chapter seminar, hands-on fiber optics, Holiday Inn, Fondulac, WI. Contact Brian Revak, (608) 372-2999.
14: SCTE Heart of America Chapter seminar, Kansas City, MO. Contact Don Gall, (816) 358-5360.
15: SCTE Mid-South Chapter meeting. Contact Bob Allen, (901) 365-1770, ext. 4110.
15: SCTE Chesapeake Chapter meeting, Installer and BCT/E exams administered, Rockville, MD. Contact Scott Shelley, (703) 358-2766.
15: SCTE Gateway Chapter meeting. Contact Chris Kramer, (314) 949-9223.
15: SCTE Lake Michigan Chapter seminar, uplink technology. Contact Karen Briggs, (616) 941-3783.
16: SCTE Greater Chicago Chapter "A Day at the Races" social event, Arlington Park, IL. Contact Bill Whicher, (708) 362-6110.
17: SCTE Big Sky Chapter seminar, BCT/E Categories I, signal processing centers, and II, video and audio signals and systems, Outlaw Inn, Kalispell, MT. Contact Marla DeShaw, (406) 632-4300.
17: SCTE Cactus Chapter seminar, fiber-optic architectures and technologies. Contact Harold Mackey, (602) 352-5860, ext. 135.
17: SCTE Chaparral Chapter seminar, fiber optics, Installer and BCT/E exams administered, Albuquerque, NM. Contact Scott Phillips, (505) 761-6253.
19-21: Technology for Technicians II Seminar hands-on technical training program for broadband industry technicians and system engineers, Denver. Contact SCTE national headquarters, (215) 363-6888.
21: SCTE Appalachian Mid-Atlantic Chapter annual golf outing and pig roast, Scotland Community Center, Scotland, PA. Contact Richard Ginter, (812) 672-5393.
21: SCTE Golden Gate Chapter seminar, fiber. Contact Mark Harrigan, (415) 358-6950.
21: SCTE Great Lakes Chapter seminar, digital video and audio, Holiday Inn, Livonia, MI. Contact Jim Kuhns, (313) 445-3712.
21: SCTE Piedmont Chapter seminar, distribution system basics, Installer and BCT/E exams administered, Raleigh-Durham, NC. Contact Mark Eagle, (919) 477-3599.
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23: SCTE Greater Chicago Chapter seminar, cable and government, Holiday Inn, Willowbrook, IL. Contact Bill Whicher, (708) 362-6110.
26: ONI Fiberworks seminar, digital networks training, Seattle. Contact (800) 342-3763.
28: SCTE Iowa Heartland Chapter meeting, BCT/E exams administered, Triax, Cedar Rapids, IA. Contact Mitch Carlson, (309) 797-2580, ext. 3700.
29: SCTE Golden Gate Chapter meeting, Hayward, CA. Contact Mark Harrigan, (415) 358-6950.

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

☛ *Coaxial Cable Transmission Systems/Understanding Decibels/Introduction to Equipment* — This program begins by defining some basic CATV terms, followed by a detailed explanation of the basic theories upon which our systems are designed. Topics covered include wideband transmission, electromagnetic spectrum, coaxial cable transmission and spectrum allocation. This video seminar further deals in depth with the related mathematics by covering ratios, decibels, logarithms, power ratios, the relationship between voltage and power calculations, Ohm's law and dBmVs. The final part of this presentation introduces us to basic CATV equipment, such as amplifiers, power supplies, splitters, directional couplers and other components of a system. (2 hrs.) Order #T-1121, $65.

Note: The videotape is in color and available in the 1/2-inch VHS format only. It is available in stock and will be delivered approximately three weeks after receipt of order with full payment.

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

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

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

Introducing SCTE's new "Health and Safety Manual"

By Bill Riker
President, Society of Cable Television Engineers

Three years ago, the SCTE board of directors asked the national headquarters staff to rewrite and revise the *SCTE Health and Safety Manual* that was originally published in June of 1978.

It soon became obvious that this would not be an easy task. Much of the information in the original manual was out of date, and OSHA was a topic that was an unknown entity at the time of the original publication. A simple rewrite was out of the question, as the revisions required were so extensive that the creation a completely new manual was the only feasible means of accomplishing the Society's goal to provide a viable safety resource for the CATV industry.

This project was given to our director of training, Ralph Haimowitz, who formed the SCTE Safety Subcommittee with a highly talented group of volunteers involved with the issues of safety and health in the cable industry.

The first action taken by this subcommittee was to establish a format for the new manual and identify topics that should be included to meet the needs of the entire industry as it attempted to fulfill OSHA's general safety requirements.

A considerable number of topics were recommended for inclusion in the new manual during this first meeting, and many of them were assigned to subcommittee members for them to research and compile for publication. Suggested topics that were not assigned to subcommittee members were listed to be used as potential future chapters following the first printing of the new manual. It has since been decided that these additional chapters will be added periodically to the manual until all pertinent topics applicable to safety in cable TV have been covered.

The chapters in this initial printing of the manual have been designed to provide safety trainers with the information and materials necessary to educate cable system employees about safety on the job through safety training and department meetings. Although many of the topics are for technicians who work in the field, there are a fair quantity of topics for office personnel, as well. The purpose is to make employees safety conscious and aware of the hazards that exist in the day-to-day performance of their jobs, the elimination of those hazards and the prevention of accidents caused by those hazards.

I am very proud and happy to introduce the *SCTE Health and Safety Manual* as a quality publication that can be of such great value to the entire cable industry. It was a long time in coming and required a tremendous amount of time and effort by many dedicated SCTE members and staff. But, once you see a copy of this manual, I'm sure you'll agree that it was worth the wait.

There is even more good news for the industry. The *SCTE OSHA Information Manual* is in the final stages of editing and illustration, and will be available later this year. This manual provides easy to understand information and examples of what you need to know to comply with OSHA requirements.

I would like to recognize the members of the SCTE Safety Subcommittee who have made this publication possible. The subcommittee consists of Ralph Haimowitz (chairman), Alan Babcock, Gordon Baldwin, Doug Ceballos, Steve Christopher, Mark Clark, Al Dawkins, Brian Gray, Doug Hair, Thomas Harvey, Jim Hurley, Roger Keith, Jim Kuhns, Chuck Minervini, Mike Murray, Pam Nobles, Ray Rendoff, Gary Selwitz, Jim Stilwell and Van Walbridge. Special appreciation also goes to Marvin Nelson and Howard Whitman of the national headquarters staff, who put the whole manual together for printing. **CT**

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