Phillips Cable Group

COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Telecommunications Engineers

Networking cable into the future

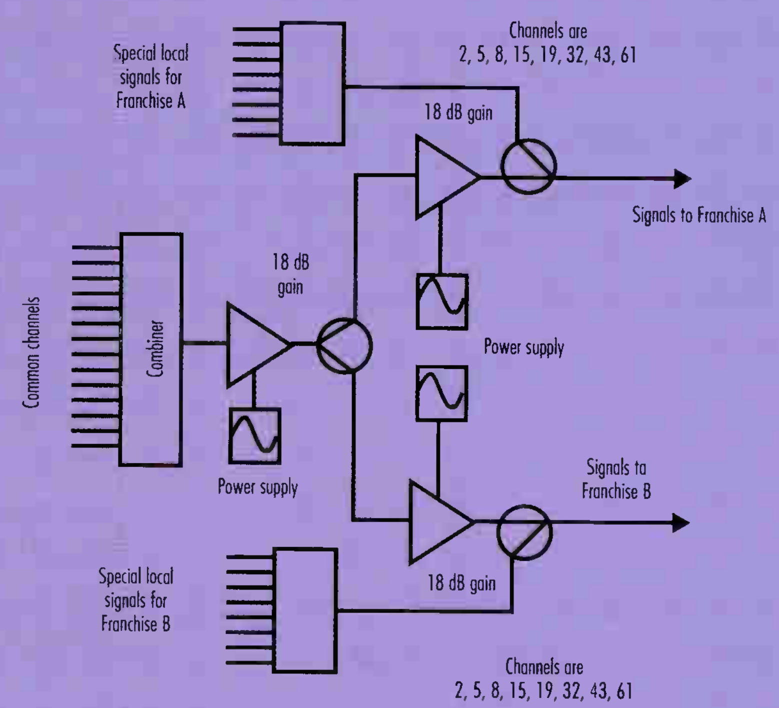
Heading off headaches with PM

Prime ... laser ...

***************3-DIGIT 551
0667325 CT 5 613 P 1014
0667325
FRED E MCCORMACK
PO BOX 65666
SAINT PAUL MN 55165-0666

October 1995

Figure 4: Good headend isolation

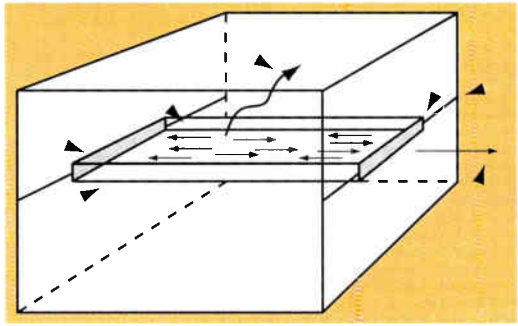


-4 dBmV for the highest frequency channel. Federal Communications Commission cable regulations specify that the signal shall not go below *0 dBmV*. If 5 dB of output slope is desired, the equalizer will drop the input at 50 MHz to *-9 dBmV*. This will hurt your C/N badly. Remember that most hybrids have noise figures in the 6 to 7.5 dB range.

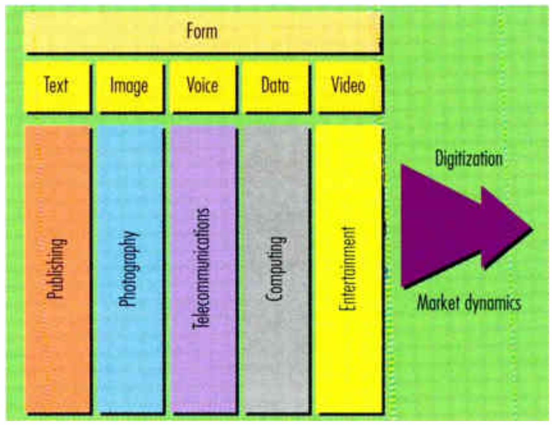
The headend is another place with applications for low-gain single hybrid amplifiers. I get calls from cable operators with headend combiner problems that can be resolved by a low-gain amplifier better than a high-gain amplifier. In headend applications, a low-gain, power-doubled amplifier with a built-in directional coupler at its output can eliminate cross-talk co-channel problems and use less jumper cables. Channels that are common to all franchise areas served from a single head-end are split then combined the local area specialty channels, government and local access, etc. Insufficient isolation of the directional couplers and splitters can create a co-channel

CONTENTS OCTOBER 1995

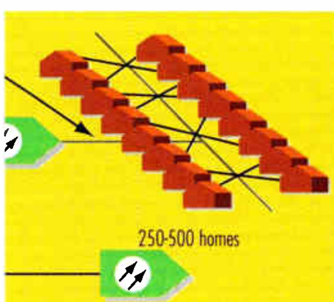
DEPARTMENTS



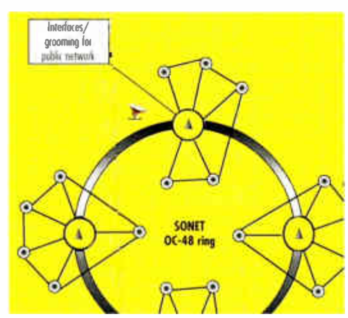
Correspondent's Report • 20



Management Portfolio • 28



Hybrid networks • 34



Integrating HFC • 42

FEATURES

© 1995 by Phillips Business Information Inc., a subsidiary of Phillips Publishing International Inc. All rights reserved. Contents may not be reproduced without permission. *Communications Technology*™ (ISSN 0884-2272) is published monthly by Phillips Business Information Inc., 1201 Seven Locks Road, Suite 300, Rockville, MD 20852, USA. Editorial and sales offices located at 1900 Grant St., Suite 450, Denver, CO 80203 USA, (303) 839-1565. October 1995, Volume 12, Number 8. Second class postage paid at Rockville, MD, and additional mailing offices. POSTMASTER: Send address changes to *Communications Technology*, Phillips Business Information Inc., 1201 Seven Locks Road, Suite 300, Rockville, MD 20852.

Tragedy

Over the years I've written about a lot of things in the pages of *Communications Technology*, but what I have to share with you this time is particularly difficult. The headline on page 5A of the Aug. 25 edition of Denver's *Rocky Mountain News* simply read, "Cable worker slain on job."

According to Lakewood, CO, police, Tami Leigh Krizman, a 37-year-old technician with TCI's Denver-area operations was stalked and gunned down by a former co-worker. The suspect, who turned himself in to the Lakewood police immediately after allegedly killing Krizman, told police he did it because he had been fired and she was promoted and given a company vehicle.

The *News* article noted that neighbors said the suspect was "the scariest guy there ever was" and that "he had guns in his car trunk and swastikas on his wall." TCI in May of this year fired him for insubordination. Supposedly he could not get along with co-workers or customers. The article went on to say Krizman's family had worried about her safety because she had been getting hang-up calls that were traced to the suspect, and that he was following her on her work routes. Police found photographs of Krizman inside the suspect's apartment. Ironically, the victim was scheduled to meet with TCI's security experts and lawyers the day after the murder to deal with the alleged stalking and harassment. Another irony is that Krizman's brother, a suburban editor of the *Rocky Mountain News*, has handled several stories on fatal obsession. He had told his sister, "This guy fits the mold."

As of this writing, the suspect is being held without bond for investigation of first degree murder.

My heartfelt compassion goes out to the family, friends and co-workers of Tami. I can't imagine their grief over this senseless killing.

Maybe this could have been prevented. I don't know. Maybe she could have been given different work routes. (The company had suggested this, but she declined.) Or maybe she could have been reassigned to do other tasks until authorities had a chance to deal with the suspect's alleged harassment. Maybe.

We'll never know.

Maybe prevention has to go back to the hiring process. This might include:

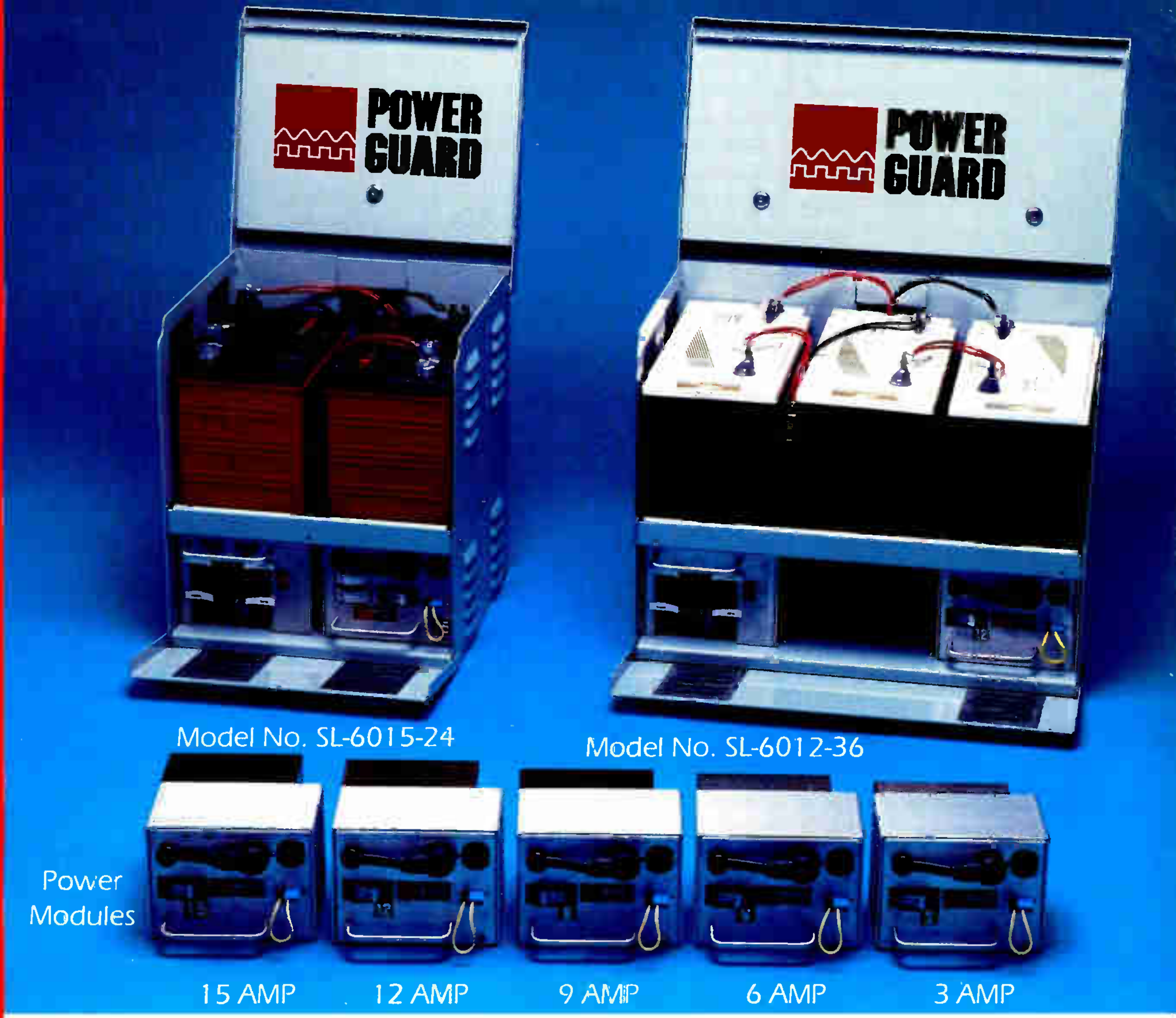
- *Criminal background checks:* This is a possibility, although the suspect in this case had previously been a security guard. I don't know if he has a criminal background or not. This information hasn't been released to the public. If nothing else, conducting criminal background checks during the hiring process can help weed out obvious bad guys.
- *Personality tests:* I've taken these before and while they often can provide a general overview of an individual's personality, I've also heard that some can manipulate these tests to produce just about any desired results.
- *Reference checks:* These days, it's getting harder and harder to find out anything beyond employment dates and simple confirmation that someone did in fact work at a previous job. Good luck getting a former employer to come right out and say that someone was fired for being a troublemaker, thief, etc. You'd need a private investigator to dig up that kind of information.

Would any of this have prevented Krizman's tragic and unnecessary death? This, too, we'll never know. Please join me in a moment of thought for Tami Leigh Krizman.

A fund has been established in memory of the victim for education of her nieces and nephews. Contributions can be sent to: Tami Krizman Memorial Fund, Colorado National Bank of Cherry Creek, 200 University Blvd., Denver, CO 80206.

Ronald J. Hranac
Senior Technical Editor

Power by Design



Standby Power Supplies Engineered for Today's Cable TV Networks

Small Simple Standbys™ from Power Guard will save you money, short and long term.

Since SSS™ is available in 3-6-9-12 or 15 amp ratings and in two or three battery configurations, you can maximize efficiency and reduce your power bills and battery costs by choosing the right model for each power supply location. If your power requirements change - simply upgrade the power module. Small Simple Standbys™ will grow with you.

And because our studies have shown that most power supply locations actually use less than 9 amps of power - we strongly recommend that you consider our 24 volt units for those locations. You get an immediate 33% savings in battery costs and still have up to four hours of standby run time.

Small Simple Standby™ - The right product at the right time for the right price. No wonder we continue to be the fastest growing power supply company in Cable TV.

1-800-288-1507 **POWER GUARD** FAX 205-742-0058

Reader Service Number 7

Reader Service Number 202

Reader Service Number 203

COMMUNICATIONS TECHNOLOGY

A CT Publications Product

Editorial Director, Alex Swan
Consulting Editor, Toni I. Barnett
Executive Editor, Wayne H. Lasley
Managing Editor, Laura K. Hamilton
Assistant Editor, Eric Butterfield
Senior Technical Editor, Ronald J. Hranac
East Coast Correspondent, Lawrence W. Lockwood
West Coast Correspondent, George Lawton
Technical Consultant, Michael Smith

Publisher, John O'Brien
Associate Publisher, Charles M. Castellani
Account Executives
Mike Elmer, (303) 837-8601, ext. 233
Tim Hermes, (301) 340-7788, ext. 2004
Rebekah Markheim, (303) 837-8601, ext. 204
Joel Goron, (301) 340-7788, ext. 2106
Director of Marketing, Nancy Umberger
Marketing Manager, Gail Stouffer
Executive Assistant, Cindy Tandy

Director of Operations, Blair Richards
Production Director, Bill Wynne
Graphic Designer, Brad Hamilton
Advertising Production Team Leader and Administrator, Leona B. Russell
Advertising Production Assistant, Ian Coleman
Circulation Director, Maxine Minar
Subscription/Client Services
(800) 777-5006

CT Publications Corp.
A division of Phillips Business Information Inc.
CT Sales and Editorial Offices
1900 Grant St., Suite 450, Denver, CO 80203
(303) 839-1565 Fax (303) 839-1564
e-mail: CTmagazine@aol.com

Advisory Board

Paul Barth, United International Holdings
Austin Coryell, Time Warner Cable
Richard Covell, Texscan Corp.
Len Ecker, The Len Ecker Corp.
James Farmer, Electronic System Products Inc.
Robert Luff, Scientific-Atlanta
Tom Osterman, Comm/net Systems Inc.
Dan Pike, Prime Cable
William Riker, Society of Cable Television Engineers
Clifford Schrock, CableBus Systems Corp.
Michael Smith, Superior Electronics
A.H. Sonnenschein, Consultant
Raleigh B. Stelle III, Philips Broadband Networks
David L. Willis, CATV Consultant
Doug Wolfe, Siecor

SCTE Board of Directors

At-Large Directors
Wendell Bailey, NCTA
Tom Elliot, TCI
Wendell Woody, Sprint

Regional Directors
Patrick O'Hare (Region 1), Viacom Cable
Steve Johnson (Region 2), Time Warner
Andy Scott (Region 3), Columbia Cable
Rosa Rosas (Region 4), Lakewood Cablevision
Larry Stiffelman (Region 5), CommScope
Robert Schaeffer (Region 6), Star Cablevision Group
Terry Bush (Region 7), Trilithic Inc.
Steve Christopher (Region 8), CommScope
Hugh McCarley (Region 9), Cox Cable Communications
Michael Smith (Region 10), Superior Electronics
Dennis Quinter (Region 11), Berks Cable
John Vartanian (Region 12), Viewers' Choice

SCTE National Headquarters
(610) 363-6888 Fax (610) 363-5898

Corporate Offices

Phillips Business Information Inc.
1201 Seven Locks Road, Suite 300, Potomac, MD 20854
(301) 340-1520 Fax (301) 340-0542

Paul R. Levine, Senior Publisher
(303) 839-1565

David J. Durham, Senior Vice President/Group Publisher
Thomas C. Thompson, President
Phillips Business Information Inc.

Thomas L. Phillips, President
Phillips Publishing International Inc.

Phillips Cable Group SCTE BPA INTERNATIONAL

The TVM550 expands bandwidth to make agile modulation hotter than ever.

Standard's TVM450 was a revolution – the first frequency agile, PLL-controlled, broadband heterodyne modulator capable of near-crystal performance without heavy post-filtering.

Now the TVM550 is making agile modulation hotter than ever.

With the TVM550, you get a re-broadcast quality modulator with noise- and spurious-free RF output and ultra-stable, artifact-free agile PLL synthesized tuning anywhere from 54 to 550 MHz. So you can cover a much bigger slice of the broadband spectrum with one device.

And if that's not enough to make the TVM550 sizzle, there's more.

Talk about integration.

Short on rack space (and who isn't)? The TVM550 is designed to accept the seamless integration of options, including the CSG60 BTSC/MTS stereo generator and automatic high-level I.F. switching. By eliminating separate components for these functions, the TVM550 saves

rack space, external wiring and AC power requirements, and reduces heat generated in the headend.

A few refinements.

The TVM550 also offers some very refined, practical features to make operations simple and obvious.

Video and RF test ports, a seven-segment deviation meter and BTSC indicator are all conveniently located on the front panel, while preprogammed FCC frequency offsets are microprocessor controlled for exact system requirements. The TVM550's advanced circuitry, slim-line design and high level performance characteristics make it the hot choice of cable MSOs.

Get it while it's hot.

When you add up all the TVM550 can do, it's easy to see why it's becoming a very hot seller. But you don't have to take our word for it. Call us, and we'll send you complete specs and pricing. And if that's not enough to convince you, we'll set it up and show you – in your facility or ours.

Call today. We want to prove the TVM550 is one hot idea where you won't get burned.

The Right Technology for Right Now.

Standard
® Communications
SATELLITE & BROADBAND
PRODUCTS DIVISION

P.O. Box 92151 • Los Angeles, CA 90009-2151
310/532-5300 ext. 280 • Toll Free 800/745-2445
Fax: 800/722-2329 Toll Free • 310/532-0397

Canadian Address: 41 Industrial Pkwy S., Units 5 & 6
Aurora, Ontario Canada L4G-3Y5
905/841-7557 Main • Fax: 905/841-3693
Sales: 800/638-4741

Hot idea.

Reader Service Number 13

Cablevision constructs new fiber network

Cablevision Systems said it will spend more than $243 million over the next two years to complete construction of its new fiber-optic cable system in Connecticut. The 750 MHz network will run parallel to the company's existing cable plant, with the side-by-side systems providing an infrastructure capable of delivering nearly 200 channels (including existing as well as digitally compressed channels).

Construction of the network began in April in Fairfield County, CT, where it currently passes several thousand households. This month, the company plans to launch Video Direct, a video-on-demand service developed in partnership with AT&T.

• • •

NOTES

• In response to budget constraints, **Federal Communications Commission Chair Reed Hundt** announced a 10% reduction in personnel and the closing and consolidation of several field offices, regional offices and monitoring stations. The **Cable Services Bureau** will shoulder the brunt of the FCC's Washington office reductions, with a staff reduction of 15%, from 223 to 190.

• **US West Communications** began its video dial tone test in Omaha, NE, one day after receiving permission to do so from the **FCC's Common Carrier Bureau**. The 12-month market test is serving approximately 50,000 households under the name **US West TeleChoice**. Seventy-seven analog and up to 800 digital video channels will be made available to programmers, delivered directly to cable-compatible TV sets and VCRs without the need for a set-top.

• **Continental Cablevision** filed a petition with the **California Public Utilities Commission** requesting permission to offer local telephone service in 10 California counties. If approved, the company will invest at least $700 million in converting its existing cable systems into broadband telecommunications networks.

Correction/clarification

The table in "A quick field strength primer" on page 80 of the August issue of *CT* was missing the 20 µV/m and 50 µV/m column headings. The table should have run as follows. We apologize for any misunderstanding the omission might have caused.

Conversions for common midband frequencies in aeronautical spectrum

	20 µv/m		50 µv/m	
Channel	µV	dBmV	µV	dBmV
98 (A-2)	8.72	-41.19	21.79	-33.24
99 (A-1)	8.26	-41.66	20.65	-33.70
14 (A)	7.85	-42.10	19.63	-34.14
15 (B)	7.48	-42.52	18.71	-34.56
16 (C)	7.15	-42.92	17.87	-34.96

LOW PROFILE

HIGH PERFORMANCE

With the **DIR-747 integrated receiver/descrambler,** you get a 1¾" IRD that brings low profile to the next generation of performance. And, it's from the industry leader ***DX Antenna***.

For us, it wasn't just producing a thin receiver, we needed to produce the best receiver, period! And, we have done just that.

The **DIR-747** is a combination of the space saver you need when adding channels and the best technology available today. Also, it includes a long list of features from an integrated VCRS® descrambling module, to front panel controls and a video test port.

Easy is a key word when working with the **DIR-747**. It's menu driven with an LCD display that makes selecting the many options simple. When combined with the all new **DSM-180** modulator, your subscribers will receive 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

The DIR-747 Satellite Receiver

Reader Service Number 86

feedback path (Figure 3 on page 75). The modulators that use the same channel frequencies on the various trunk outputs to franchise areas will interfere with their corresponding channels in the other trunk or fiber outputs.

Rather than have a single high-gain, high-performance amplifier to drive through all the combiner losses, use several low-cost, low-gain amplifiers strategically placed to optimize channel isolation and provide gain as well. A single hybrid will typically provide reverse isolation equal to the forward gain of the hybrid plus about 5 dB. This isolation combined with a good directional coupler with 30 dB of "tap to output" isolation can provide more than 50 dB total reduction in signal feedback paths. These types of isolation amplifiers can be mounted on the side wall or rear of equipment racks without using front panel rack segments. See Figure 4 to verify the feedback paths and ways to improve the isolation.

"The desired output of a single hybrid amplifier, minus the gain of the hybrid, always dictates the input level."

Here's a quick thought about directional coupler isolation: When testing any passive device for isolation, the typical RF bridge and "good" terminator used in the test will have return loss of around -30 dB. Most passives have return loss of -16 dB. Looking at the headend lash up diagram shows that two or more passives are linked directly together or to amplifiers that have return loss in the -16/-20 dB range. Using these lower range impedance matched components, the true "operational" isolation desired may not be the 30 dB shown while testing with an RF bridge and precision terminator. With an active hybrid amplifier, the isolation is real.

After 25 years in the cable business, I seem to hear some of the same questions about amplifiers quite a bit.

"How much gain do I need?"

"Is power-doubling good enough to keep down my composite triple beat levels?"

"More gain is better, right?"

Wrong! As the old homespun saying goes, "the right tool for the right job"—or in this case, the right amplifier for the right job. **CT**

New national HQ groundbreaking held

The Society of Cable Telecommunications Engineers held a groundbreaking ceremony July 18 on the site of its new national headquarters facility in Exton, PA. (See SCTE President Bill Riker's comments on page 94 in "President's Message.") The new building will afford the Society greatly increased office space to allow it to better accommodate the growth that SCTE has experienced in recent years, both in terms of increased membership and the staff necessitated by the growing numbers of members.

On hand for the ceremony were National Chairman and Region 12 Director John Vartanian, Region 11 Director Dennis Quinter, President Bill Riker and the SCTE national headquarters staff. Those in attendance were given a tour of the lot explaining the plans and layout for the new headquarters building.

Plans call for the building to cover 15,000 square feet. Current plans call for it to be completed in early 1996. It will offer on-site warehouse space to house the many publications and videotapes offered by the Society. The new building also will house a conference room to accommodate board and committee meetings, as well as a classroom to hold training seminars. An additional highlight of the building will be a room displaying artifacts from periods throughout the industry's history showing the progress of broadband communications since its inception.

The new site is only minutes away from the Society's present location, which will afford the Society the convenience of being able to retain the services of local vendors.

In related news, the Society's Ohio Valley Chapter, which is based in Columbus, OH, presented a check for $1,500 to the national Society at Cable-Tec Expo '95 in Las Vegas, NV. The donation will be applied toward the purchase of furnishings for the new SCTE national headquarters building.

BES of India: Friendship agreement

In an effort to expand the scope and variety of SCTE's affiliations, the Society recently forged a relationship with the Broadcast Engineering Society of India, which has its headquarters in New Delhi. The two societies will exchange mutual promotional support in order to further the development of both organizations.

To cement this relationship, SCTE President Bill Riker and BES (India) President H.M. Joshi recently signed an official "Honorary and Friendship Agreement" between the two societies, confirming the spoken commitment. The agree-

ment calls for various cooperative activities, including:

1) Exchanging visits and views between the members of the two associations in order to promote market access and trade between the United States and India and the further development of the broadcast manufacturing industries in both countries;

2) Maintaining a regular exchange of key publications, newsletters and other information to ensure each is informed of the other's key concerns and activities;

3) Encouraging the members of each association to exhibit or participate in the broadcast exhibitions or seminars sponsored by the other association;

4) Stimulating consultations and discussions by and between the members of the two associations with regard to possible cooperative activities;

5) Providing training and education materials useful to the members of the two associations; and

6) Pursuing such other cooperative activities as may be necessary and appropriate.

The BES (India) holds an annual trade show, Broadcast Cable and Satellite India, which is reported to be the only international exhibition and conference held in India. This show is organized in cooperation with Exhibitions India for the purpose of promoting development and knowledge in the country's television, cable and satellite industries.

According to EI President Prem Behl, EI and BES (India) "bring together in a single forum users and providers of broadcast services, academics, engineers, scientists, policy makers, planners, regulators, etc."

"I am very pleased to see the Society continue to broaden its international horizons," commented Bill Riker after signing the agreement. "SCTE's increasing visibility and participation in the international arena will benefit the Society greatly through increased cooperation and communication, which in turn will benefit the members."

International membership tops 650

The Society's international membership has increased 29% since last year, and as of July 1, 1995, SCTE has over 650 international members.

Over 50 people living outside the United States joined the Society during Cable-Tec Expo '95, establishing this instance as the largest boost in international membership this year.

The international members come from 55 countries worldwide, including: Argentina, Australia, Austria, the Bahamas, Barbados, Belgium, Belize, Brazil, Brunei, Canada, Caribbean, Chile, China, Columbia, Costa Rica, Denmark, the Dominican Republic, England, Finland, France, Germany, Grenada, Guam, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Paraguay, Peru, Philippines, Portugal, Puerto Rico, Scotland, Singapore, South Africa, South Korea, Spain, St. Lucia, Sweden, Switzerland, Taiwan, Thailand, Venezuela, the Virgin Islands and the West Indies.

channel Surfing

New

MicroStealth Multi-Channel Testing -- for under $900

The Faster, Easier, Comprehensive signal level meter for cable TV installers.

Multi-Featured... For the first time, installers can check all channels quickly and accurately-ensuring FCC compliance and reducing subscriber callbacks. MicroStealth's scan mode displays multiple channels simultaneously on a single screen. Plus, measure up to 890 MHz for today's high bandwidth cable systems.

Easy Viewing... View the signal levels on a detailed, high resolution LCD display -- a feature, up until now, only available on higher priced signal level meters.

Easy to Use... With the press of a single button, cable installers can easily get a snapshot of the system's performance. There is even a one button *Go/No-Go* function so you can be sure you are within FCC compliance on every installation. MicroStealths are lightweight, rugged and water resistant, to withstand the abuse of every-day field use.

MicroPriced... The new MicroStealths are yours at unbelievably low prices. Even the enhanced MicroStealth MS1200 with 890 MHz frequency extensions, full scan mode, FCC *Go/No-Go*, and printer driver capability, is about half the price you would expect.

All the accuracy, speed and ease of use at a price you expect from a leader.

Call 1-800-622-5515

Wavetek...partners in productivity for over 25 years.

WAVETEK

Reader Service Number 55

By Bob Luff, Chief Technical Officer, Broadband Group, Scientific-Atlanta

Part 2 — Future set-tops: Who will own this valuable asset?

Legislation is underway that could potentially expand who can sell and own CATV set-tops or other devices that will work in your system. Its impact on the industry, especially the technical community, may be significant. Part 1 ("Communications Technology," September 1995) briefly traced the strategic role set-tops have played in the competitive growth of the broadband industry and some of the resulting problems that have never been fully addressed. This part will address the regulatory motivation and various industry concerns regarding the pending legislation to allow retail sales of set-tops compatible with your system by local consumer electronic stores.

The broader issue is that the current enabling regulatory statutes for telecommunications is badly in need of overhauling. The majority of the Communications Act of 1934 is unresponsive to today's more complex telecommunications industries. Of course, once you open the process, advocates from all directions understand the significance of getting their concerns addressed in the so-called new "Telecommunications Bill."

One key advocate is the consumer electronics industry. Its perspective is that cable's continuing advancements in programming, two-way, video-on-demand (VOD), games, digital, interactive and Internet access are creating potential consumer demand for various new products and upgrades that retail stores are unable to participate in because of the current "bundled" functions of signal security and otherwise consumer features such as remote channel and volume control or electronic program guide to name just a few. Some future concepts range from component TV (purchasing monitors, audio system and the "brains" separately) to fully integrated high-end TV sets with all set-top descrambling and features built-in.

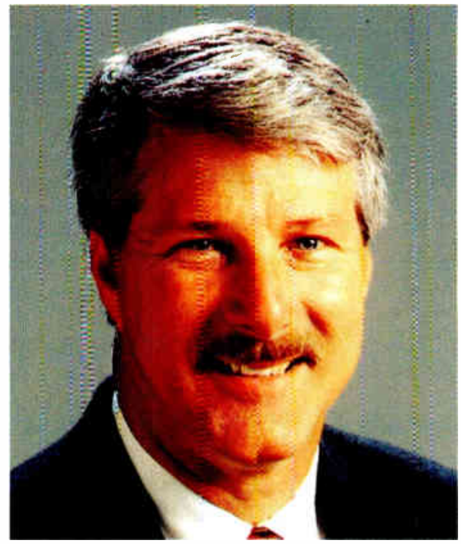
Bundling of security and features

It is generally recognized this bundling of security and features is a result of sincere interests on the part of both operators and set-top manufacturers to keep hardware connections simple and costs as low as possible. Hence, subscriber monthly service bills are kept as low as possible and critical signal security is maintained. Nonetheless, consumer electronics retailers feel unable to participate in what some feel is a future market potential equal to the PC boom. Regardless of past inadvertent barriers, they want a level competitive hardware environment going forward. Open competition and direct public access to various content providers and hardware option choices is the overriding philosophy of the new Telecommunication Bill initiative and what most observers believed fueled the enormous growth of the PC industry.

Industry security concern

Signal security is the bedrock of the cable industry. It ensures that everyone continues to pay their subscription fees for services watched. As in any business, loss of control of your inventory and cash register quickly spells disaster! It is the main differentiator between cable and over-the-air broadcasting and responsible for cable's impressive growth of programming and services.

The chief industry concern is that signal security could be severely compromised with so many local and national manufacturers and retailers able to sell set-tops with descrambler technology compatible with industry systems. While many feel future digital encryption methods and two-way interactive systems would withstand broader public access to digital-based security cable products, nearly everyone agrees that the current nature of analog video security and "broadcast" mode plant architectures result in serious issues to be considered. Even with today's tight controls signal piracy is estimated to be nearly $4 billion loss per year. It's no wonder that the majority of the cable industry is very concerned about retail sales of analog-based, descrambler-compatible set-tops.



Packaging hardware and services

Another key broad retail issue is potential "packaging" of hardware and monthly subscription fees by both telephone and cable operators. Such packaging may be necessary to soften the public sticker shock of more costly advanced digital network consumer devices.

The practice of "hiding" some or all of the initial hardware cost by increasing the "bundled" monthly program usage or service fee is a well-used concept. It is commonplace in the cellular telephone industry. But, here too, some consumer electronic retailers feel that they are in a hardware marketplace disadvantage having to sell cellular phones at actual high retail prices relative to telephone network operators who can market a "$59 plus $19.95/month package."

Impact to tech departments

While the legislative concern and outcome are not certain at this time, most observers believe that the cable industry will end up with some requirement to embrace retail entry of products compatible with cable system security. This may not necessary mean descrambler set-tops. A compromise might be to offer an option to the consumer known as the "set-back" security device where the system still controls and provides the security set-back mode and

the consumer is able to select from a number of various TV set models that would support the set-back security interface.

In any event, it is very likely that cable technical departments will encounter a whole host of new products being sold at the retail level and connected by subscribers to their drops. This will impact plant operations in many ways. Following are a few specific issues raised as examples of the range of impact and are not intended to be a comprehensive account. While any actual legislation change effective date is likely to be some time in the future it is hoped that these points will stimulate more comprehensive discussions specific to your system's details and allow time for proper preparation and training.

Consumer confusion

It is likely that the lack of a full complement of industry standards will result in retailers inadvertently selling hardware that in fact will not be compatible with your system. Of course, the consumer is just as likely to blame you as the retailer. Certainly the Federal Communications Commission, National Cable Television Association, multiple system operators (MSOs), Society of Cable Telecommunications Engineers, Electronic Industries Association, set-top manufacturers and others will work hard to minimize such problems. However, the current misunderstanding over "cable-ready" consumer products is likely to be just a tip of the iceberg.

Who pays for service calls in the future?

Many cable systems are already reviewing their service call fee policy. Certainly the franchise authority or the public cannot expect the cable operator to continue to service for free hardware that it does not own. Or would they? Franchise agreements often specifically address this issue and take time to change.

Signal leakage

There is no question that retail sales and more subscriber self-connection of additional products to your drops will increase your work load to maintain compliance of your signal leakage requirements.

Troubleshooting

What has always been a challenge will become even more difficult. Now system customer service representative (CSRs) and installers will be faced with "no service" or intermittent complaints on subscriber equipment they have never seen and have no background or training on. While not the most efficient admittedly, how many installers troubleshoot by substituting another box? Different retail equipment may have different sensitivity to noise or levels and have been known to have direct pickup or interact with other nearby equipment.

Two-way operations

While not totally clear in the current legislation language, the spirit of the bill would seem to also allow retailers to sell devices that "talk back" to the headend using your upstream spectrum. If a unit that you own malfunctions, say transmits continuously, bringing the whole return network down, you would quickly replace it. What are the customer relations issues when the interfering device you are disconnecting is owned by the customer?

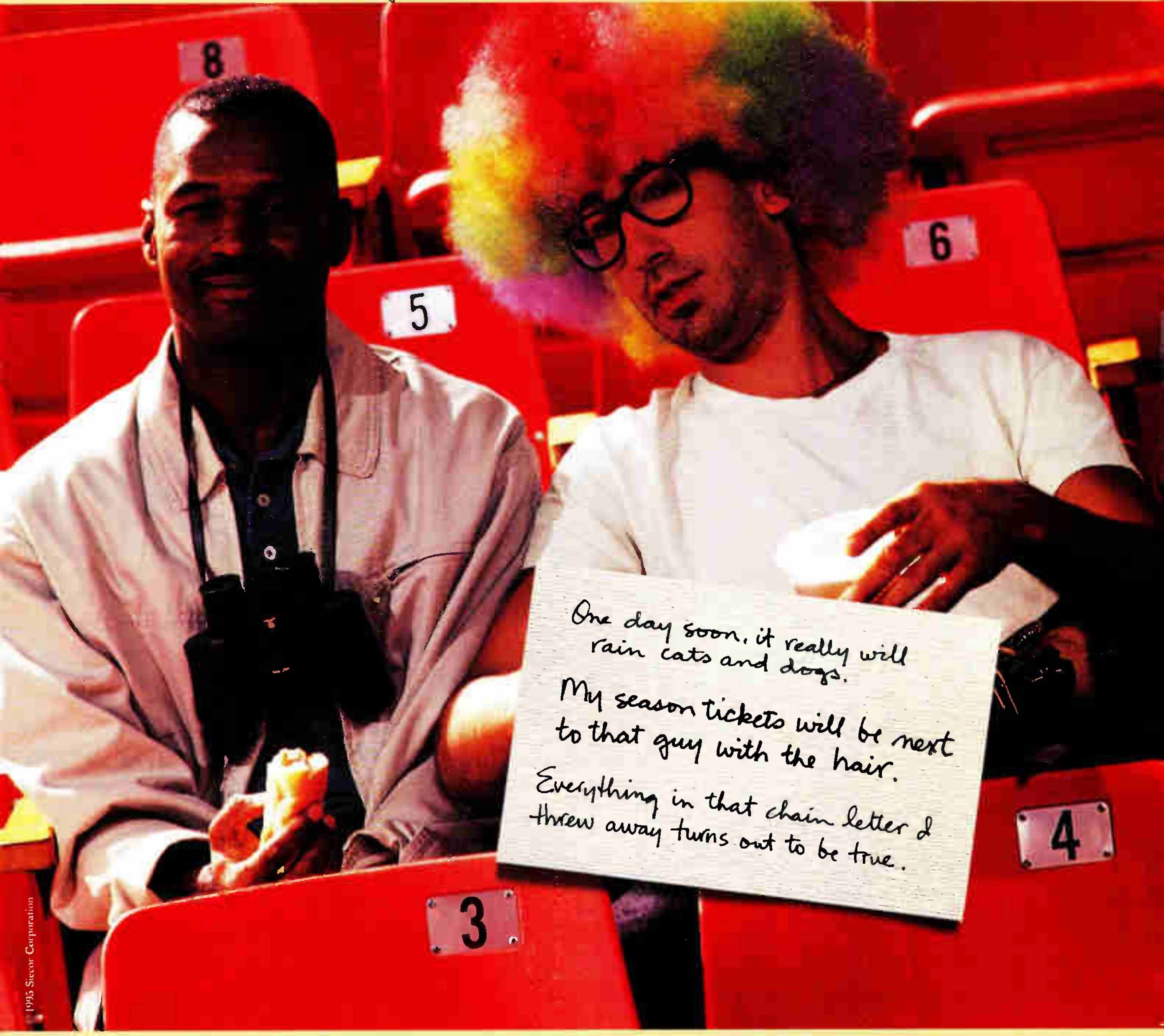
Local system differences and future system upgrades

It is a reality that current local systems use different technologies. Consumers and retailers are surely going to mix up devices across franchise boundaries and have connection troubles. What happens when you upgrade your system in the future and subscribers find that their consumer products no longer work in your new frequency plan or security system?

Conclusion

While the outcome of current Washington, DC, legislation is unclear, most industry observers believe that the final version will contain provisions supporting consumer electronic retail sales of cable set-top-like devices or functionality. The primary issues are maintaining system signal security, adjusting service call policies, and preparing service personnel, especially CSRs and installers, for a much more complex customer equipment future environment. While the impact to the cable industry may initially appear challenging, depending on the specific outcome, let's remember that open competition and direct public access to content and hardware were the cornerstone of the PC revolution! **CT**

THE FEARS OF Roger Wallace, CATV NETWORK TECHNICIAN



NOTICE HOW HE ISN'T WORRIED ONE BIT ABOUT KEEPING HIS NETWORK RUNNING SMOOTHLY.

The fact is, Roger would be wigging out if he wasn't using Siecor to help tackle his CATV network. Because Siecor gives him tailored solutions. Not just cookie-cutter solutions originally designed for other applications.

For instance, when Roger needed his cable jackets striped so they wouldn't be confused with other cables, Siecor started striping. When he requested a 19-inch fiber distribution frame instead of a standard 23-inch frame, Siecor began building. And when Roger sought an easier way to control his network, Siecor supplied him with network management software that gives detailed information on every component in his network. Basically, Siecor has come up with every tailored solution Roger could hope for.

Except maybe, some good-sized hair clippers.

SIECOR

What can we do for you?

HAVE NO FEAR. CALL 1-800-SIECOR-4 FOR MORE INFORMATION.

Reader Service Number 67

By Lawrence W. Lockwood, President, TeleResources, and East Coast Correspondent

Lasers — Performance basics

It was in 1966 that C.K. Kao and G.A. Hockman (working at the Standard Telecommunications Laboratories in the United Kingdom) postulated the use of glass fibers as optical communications waveguides. The glass fiber attenuation had to be reduced to less than 20 dB/km, and in 1970 workers at the Corning glass works in the United States produced a fiber with the required attenuation. This development led to the first laboratory demonstrations of optical communications with glass fiber in the early 1970s. The advent of the semiconductor laser in 1962 meant that a fast light source was available. The material used was gallium-arsenide, GaAs, which emits light at a wavelength of 870 nanometers (nanometer = 10^{-9} meter = 1 billionth of a meter = 40 billionths of an inch). Various materials also were investigated to produce devices for operation at 1.3 and 1.55 µm (µm = micron = 10^{-6} m = 1 millionth of a meter = 40 millionths of an inch).

Physicists measure light in wavelengths while Engineers measure RF in frequency. Why? Well, c = fl where c is the velocity of light, f is the frequency and l is the wavelength. Since the velocity of light is a constant, then the shorter the wavelength, the higher the frequency. The lower edge of Channel 4 is 66 MHz and thus the wavelength is 4.5 meters. In the case of 1.3 µm light the frequency is 230.2599877 x 10^{12} Hz = 230.2599877 THz (terahertz) or 230,259.9877 GHz. It is much easier dealing with the smaller numbers of the wavelengths than the much higher numbers of the frequencies of light.

Figure 1: Semiconductor laser

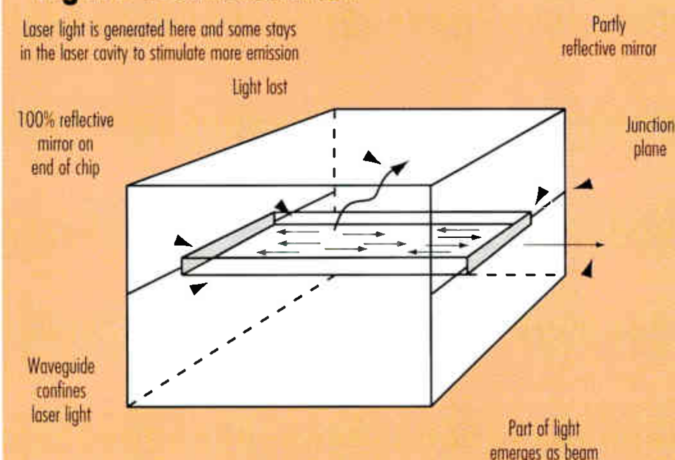
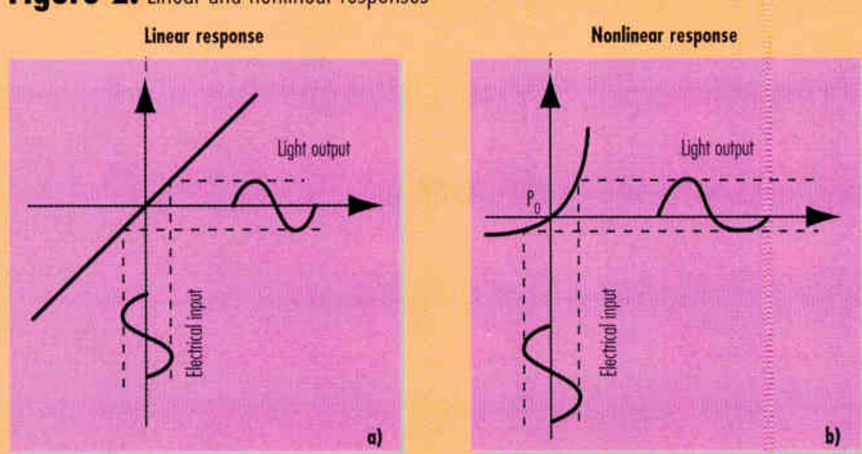


Figure 2: Linear and nonlinear responses



Laser beam formation

The laser beam is formed by a resonator that confines light and makes it pass again and again through the excited medium. As shown in Figure 1 for a semiconductor laser, this resonator can be a pair of mirrors, one at each end of the recombination region.

Long before lasers, in 1897, French scientists Charles Fabry and Alfred Perot devised an instrument to study light. It was called a Fabry-Perot Interferometer and a version of it is the dual-mirror resonant cavity — hence the Fabry-Perot laser.

Light emitted straight toward one mirror will be reflected back and forth, stimulating emission from electrons ready to recombine as it passes through the junction plane. Light emitted in other directions will leak away. Thus only the light traveling back and forth along the laser stripe will be amplified and build up into a beam.

Laser linearity

Two effects limit the use of direct intensity modulation for analog transmission. One is source nonlinearity, which is particularly important for frequency multiplexing, because intermodulation products give rise to interchannel interference. In addition, the

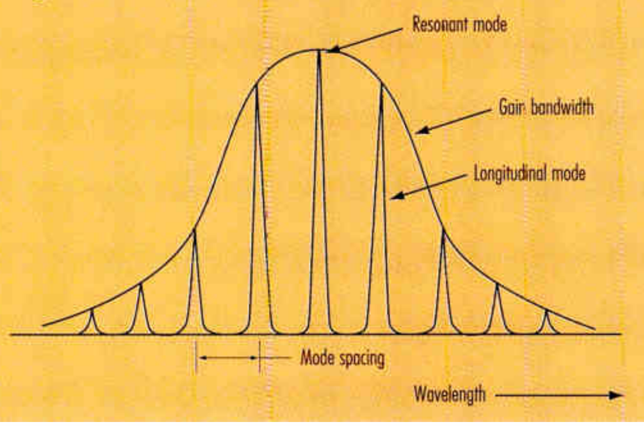


Figure 3: Fabry-Perot spectrum

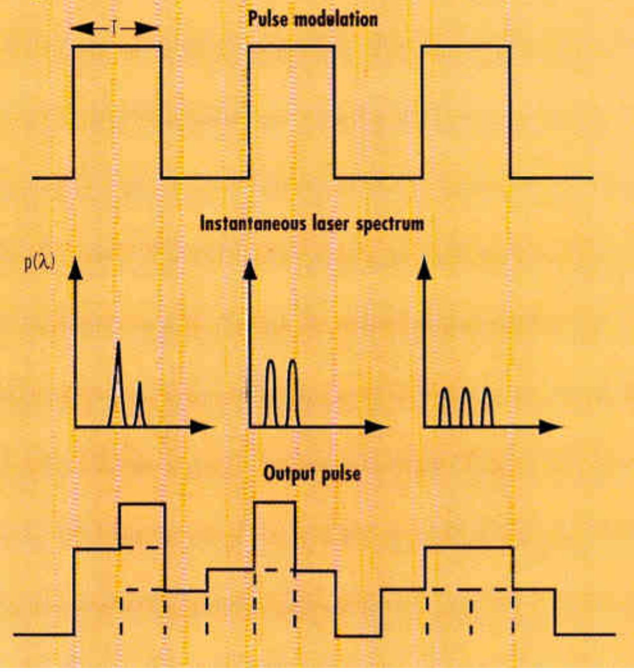


Figure 4: Qualitative effect of laser-mode partition noise

transmission of color TV is sensitive to small amounts of phase distortion.

A linear response shown in Figure 2a would produce a light output of the laser that is linearly related to input electrical signal. However, since the response of a laser is nonlinear the light output of the laser is *not* linearly related to the input electrical signal as illustrated in Figure 2b.

The nonlinear response introduces nonlinearity into the process, which in turn exacerbates intermodulation distortions, particularly second-order and third-order intermodulation products. A number of techniques for increasing the linearity of the transmitter have been devised. These include predistortion of the electrical waveform and the use of electronic feedback and feedforward circuits. The problem of predistortion is that once set it cannot easily be varied to adjust for changing source characteristics during life.

Laser modes

The other effect limiting the use of direct intensity modulation for analog transmission is laser modal noise. The output spectrum of a conventional narrow-stripe semiconductor laser is shown in Figure 3.

Although much of the power is concentrated at one wavelength, laser oscillation also produces other wavelengths. The only wavelengths that are amplified in the laser are those for which the round-trip distance between the mirrors is an integral number of wavelengths λ:

$$N\lambda = 2 \times \text{cavity length}$$

where N is an integer. The range of wavelengths where the laser light can be amplified by stimulated emission is much broader than the individual peaks shown in Figure 3. The result is a series of narrow-wavelength spikes, called longitudinal (for along the length of the laser) modes — not to be confused with the modes in an optical fiber.

A typical laser spectrum at 1,300 nm consists of several longitudinal modes spaced about 1 nm apart as shown in Figure 3.

The effect of modal noise on signal modulation of a Fabry-Perot laser is illustrated better by examining a high-speed pulsed signal (digital). The effects on a high-frequency analog signal are the same. Under high-speed modulation a laser diode exhibits multi-longitudinal-mode behavior, and more precisely its spectrum varies randomly from pulse to pulse. (See Figure 4.)

As the typical longitudinal-mode spacing is in the range of 1 to 2.5 nm (at 1,550 nm nominal wavelength), this effect leads to severe intersymbol interference. This phenomenon illustrated qualitatively in Figure 4 is called laser-mode partition noise. An important aspect of this spectral problem is that even though the total power output of the laser is constant, the instantaneous fluctuations of the power distribution among the laser longitudinal modes can be quite large. The combination of these partitioning fluctuations causes random fluctuations in the received signal. Thus such devices may at any given time emit light at any of a number of frequencies in a rapid and unpredictable fashion. The carrier in such a case is not strictly a sinusoid, but rather is a randomly varying waveform contributing to distortions.

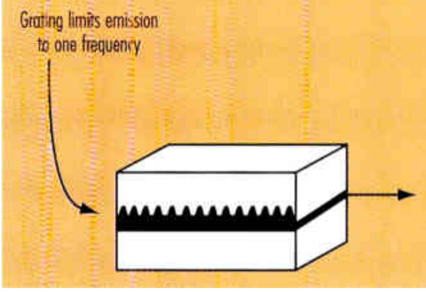


Figure 5: Distributed feedback laser

Distributed feedback laser

Single longitudinal-mode operation can be obtained by modifying the basic Fabry-Perot laser structure so that the cavity loss is different for different longitudinal modes. A laser structure that has been found very effective in obtaining single longitudinal-mode operation is known as a distributed feedback (DFB) laser. (See Figure 5.) DFB lasers were first available in the early '80s.

In a DFB laser frequency-selective feedback is achieved through the use of a diffraction grating etched along the cavity length, which provides reflections (i.e., the feedback is distributed throughout the cavity length rather than located at the mirrors at the cavity ends). This results in unequal cavity losses and, with proper

SCTE ET '97: Tackling data and beyond

The Society of Cable Telecommunications Engineers Conference on Emerging Technologies, which attracted 1,300 attendees last year, is an extension of its annual Fiber Optics seminar first held in 1988. ET '97 is taking place this month (Jan. 8-10) at the Opryland Hotel and Convention Center in Nashville, TN. Featuring presentations on advances in data transmission networks and services in addition to other emerging technologies, it is of vital interest to engineers, managers, manufacturers and consultants involved in broadband telecommunications.

Every attendee is receiving a proceedings manual containing information supplied by each presenter at the conference. Again this year, optional preconference tutorials are being presented on Jan. 8 to give attendees additional background information on the technologies to be discussed during the conference.

The program subcommittee includes the following industry notables:

- Jim Chiddix, Time Warner Cable (Chairman)
- Jim Farmer, Antec
- Earl Langenberg, Consultant
- Dan Pike, Prime Cable
- Bill Riker, SCTE
- Doug Semon, CableLabs
- Pete Smith, Rifkin & Associates
- Tony Werner, TCI

What follows is a preliminary program for ET '97. For more details, contact SCTE national headquarters at (610) 363-6888 or check out your registration package at the conference.

Wednesday, Jan. 7
12-5 p.m.: Attendee registration
1-5 p.m.: Optional preconference tutorials. These optional are designed to give attendees detailed background information on several of the technologies that will be discussed over the next two days. They include:
• "ISO Model Introduction and Ethernet Overview" with Jim Stratigos, Media4
• "What is TCP/IP?" with Mostafa Ammer, Georgia Tech
• "What is ATM?" with Mark Dellavalle, Cisco Systems

6-8 p.m.: Welcome reception sponsored by General Instrument and CommScope

Thursday, Jan. 9
8-8:30 a.m.: Continental breakfast sponsored by Scientific-Atlanta
8:30-9 a.m.: Opening remarks by SCTE President Bill Riker
9 a.m.-12 p.m.: Session A: Data Services Over Cable—The Technology. Moderator: Dan Pike, Prime Cable. The morning session explores the enabling emerging technologies to allow efficient data transfer across the cable system. Security, distribution, trafficking, ATM and fast Ethernet will be discussed. Presentations include:
• "Issues in Broadband Data Transfer" with Tim Kwok, Microsoft
• "Broadband Architectures and Trafficking" with Dan Minoli, TCG
• "Optimal Transport of Data on Cable Plants" with Matt Diethelm, Intel
• "Attacks on Emerging Hybrid Fiber/Coax Services" with Bob Rance, Lucent Technologies
• "Data Access in an HFC Architecture" with Mark Lauback, Com21

12-1:45 p.m.: Luncheon topic—History of the Internet with Keynote Speaker Dave Clark, MIT.

SCTE

2-5 p.m.: Session B: Data Services Over Cable—Applications. Moderator: Jim Chiddix, Time Warner Cable. In this session, applications which represent a variety of future business opportunities for cable operators will be explored. We will hear about some of the ways in which Internet technology may evolve allowing time-sensitive traffic such as voice and video. We will also hear about the strategies of two major groups of system operators for the roll-out of consumer services. Finally we will gain some insight into the systems integration challenge behind the deployment of high-speed data services. Presentations include:
• "Packet Telephony in Cable Networks" with Marty Glapa, Lucent Technologies
• "The Delivery of Internet Video"
• "Time Warner's Road Runner Service" with Mario Vecchi, The Excalibur Group
• "@Home's Deployment Strategy" with Milo Medin, @Home
• "The Systems Integration Challenge in High-Speed Data Service Deployment" with Terry Wright, Convergence Systems Inc.

6-8 p.m.: Polaris Award reception

Friday, Jan. 10
8-8:30 a.m.: Continental breakfast sponsored by Antec
8:30-10:15 a.m.: Session C: New Science Applied to Current Issues. Moderator: Tony Werner, TCI. As HFC networks rapidly deploy new services, operators are experiencing operational and engineering issues. This session is dedicated to providing quantitative field data relating to these issues as

design of the grating, laser operation in a single longitudinal mode.

Figure 6 shows a simplified comparison of the optical spectra of typical Fabry-Perot (FP) laser and a high-performance distributed feedback 1,550 nm laser. Figure 7 shows an actual spectral measurement of a sample FP laser made by a Hewlett-Packard optical spectrum analyzer and Figure 8 shows the corresponding spectral measurement of a sample DFB laser. Commonly measured optical parameters of FP lasers are total power, mean wavelength (center of mass), sigma (spectral width based on a Gaussian distribution), FWHM (full width half maximum = spectral width at the half power points), peak amplitude and peak wavelength. The key spectral measurements made on DFB lasers are SMSR (side-mode suppression ratio), mode offset, peak wavelength, peak amplitude, stop band, center offset, bandwidth and linewidth. The FWHM of the FP laser is 5.47 nm, which is 992 GHz wide. The bandwidth of this DFB laser is 0.213 nm, which is 26 GHz wide.

Figure 6: Spectra of a typical FP laser and a high-performance DFB laser

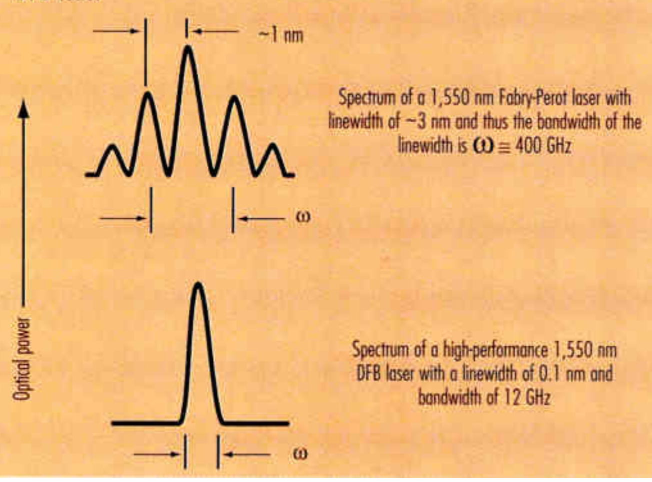
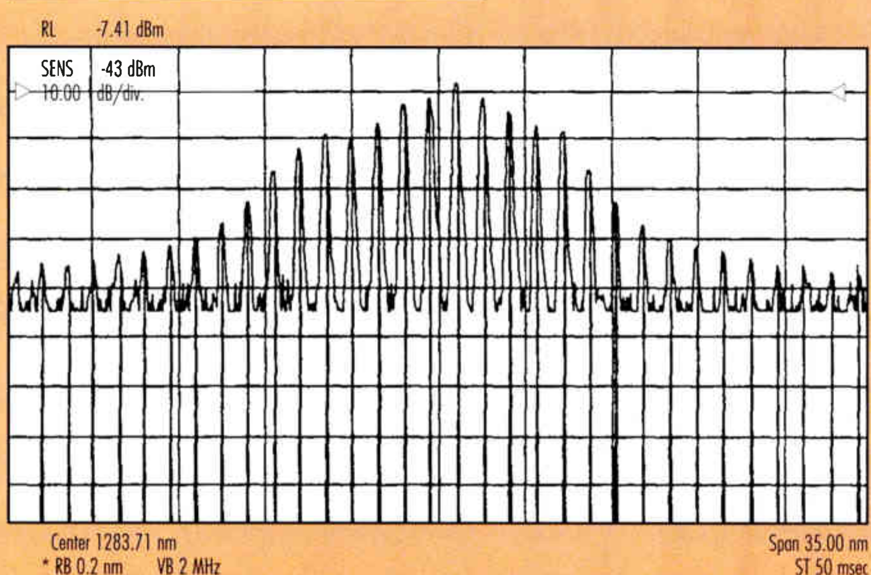


Figure 9 is a photo of an Ortel 1,310 nm DFB laser. Ortel is aiming this particular laser at the return path market. It is considerably less expensive than downstream DFBs according to Larry Stark, vice president of broadband communications at Ortel — in the neighborhood of $1,000 (in quantity). Also important for return path applications, Stark noted that the package contains a thermoelectric cooler and an optical isolator permitting operation over the -40 to 85°C (-40 to 185°F) — significant since return path lasers will not be in the controlled environment of the headend where downstream lasers are usually located.

Figure 7: Measurements of FP laser

Fabry-Perot laser test

Mean wavelength = 1284.12 nm	FWHM = 5.47 nm
Peak wavelength = 1284.41 nm	Peak amp = -6.83 dBm
Mode spacing = 1.06 nm	Total power = -2.08 dBm
Mode spacing = 193.47 GHz	Sigma = 2.32 nm



Fabry-Perot lasers on a CATV system

Distributed feedback lasers are almost universally used today for analog CATV system sources. However in a February 1989 issue of *CED* magazine, Robert Luff, then group vice president of technology for Jones Intercable (now chief technical officer, Broadband Group, Scientific-Atlanta) wrote a comprehensive plan to use Fabry-Perot lasers in a system upgrade for the Broward County, FL, system ("The Broward Cable Area Network Fiber Model"). This proposal was prompted by economics — DFB lasers were much more expensive than Fabry-Perot lasers.

In that plan, due to the limitations of the Fabry-Perot lasers, the bandwidth capacity per laser, and thus per fiber, was calculated to be limited to 12 to 18 TV channels. The second-order intermodulation products are the limitation. By keeping channels on a single FP laser within an octave (i.e., highest frequency = 2 x lowest frequency), the second-order beats can be easily filtered out by a simple RF passive filter placed at each receiver right after conversion from light to RF, but before combining with the other fiber signals.

In a recent phone conversation, Luff said that the system was built as described with 12 channels per laser.

At that time the costs of DFB lasers were much higher than they are today but their price reduction coupled with their much higher channel capacity (110 channels) have led to the near universal use of DFB lasers for analog CATV.

Wavelength division multiplexing

Wavelength division multiplexing (WDM) is the use of two or more wavelengths to carry signals through the same fiber. The advantages of WDM techniques include the ability to support bidirectional flow on a single fiber and the ability to upgrade the capacity of existing fiber systems

Figure 8: Measurements of DFB laser

DFB laser test

Peak wavelength = 1321.33 nm	SMSR = 49.23 dBc
Mode offset = 0.62 nm	Peak amp = -18.42 dBm
Stop band = 2.36 nm	Bandwidth = 0.213 nm
Center offset = 0.56 nm	(at -20.97 dB)

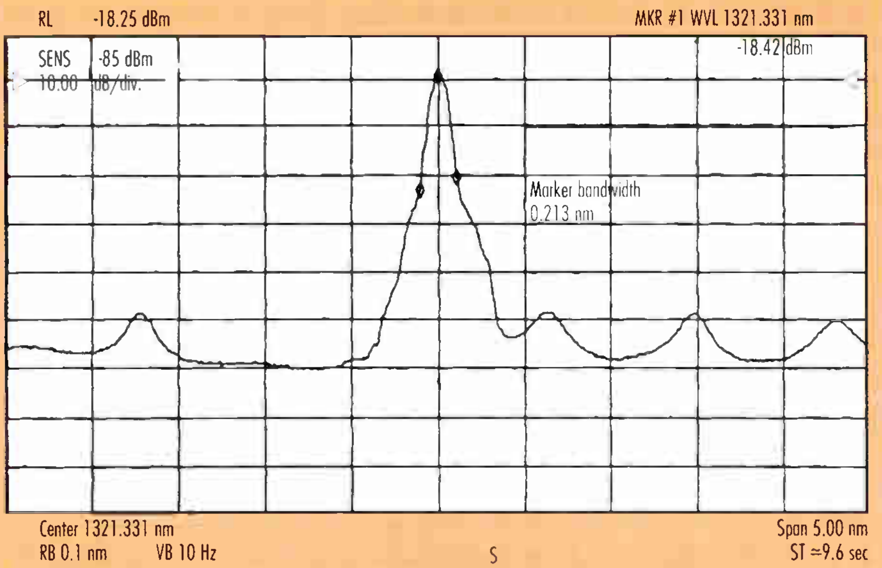
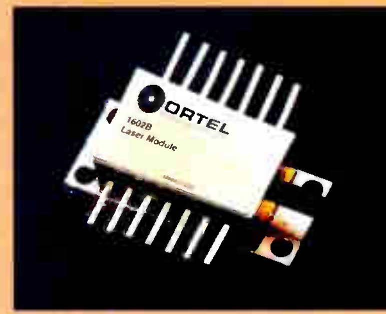


Figure 9: Ortel 1602 1,310 nm DFB laser



(without laying additional fibers). Wavelength division multiplexing of light is the same as frequency division multiplexing (FDM) of RF except WDM is done at the frequencies of light as compared to the lower RF frequencies in FDM.

How much bandwidth is available for WDM? (See Figure 10.) The available bandwidth of a single-mode fiber in the 1.5 to 1.7 µm transmission window, where the fiber loss is less than 0.4 dB/km, is about 24,000 GHz (or 24 THz).

The process of separating out different wavelengths carried on a fiber (demultiplexing) or combining different wavelengths (multiplexing) depends on some fundamental principles in light. The familiar case of a beam of sunlight going through a prism producing a "rainbow" of colors is an example of separating wavelengths. (See Figure 11.) Prisms refract light of different wavelengths at different angles, because the refraction index of glass varies with wavelength. Diffraction gratings scatter light at different angles, depending on its wavelength and the spacing of lines on the grating. Use of a grating in a demultiplexer is shown in Figure 12.

WDM devices such as shown in Figure 12 are based on a reversible structure, hence the multiplexing operation can be performed by the same device, simply exchanging the input and output signal direction.

IBM — Muxmaster

A leading-edge application of use of

Figure 10: Typical loss and available bandwidth of a single-mode fiber

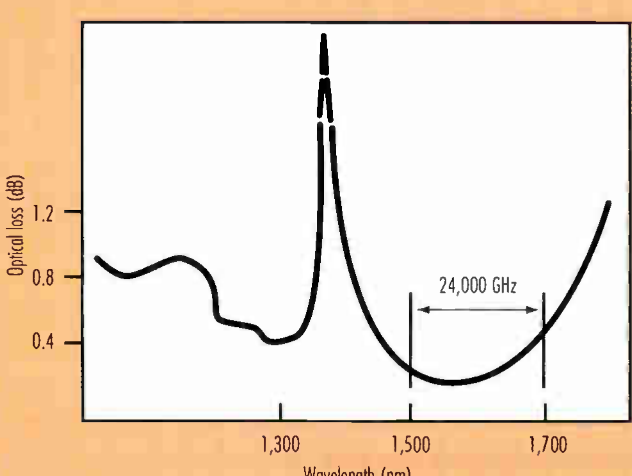


Figure 11: Prisms and diffraction gratings spread out light by wavelength

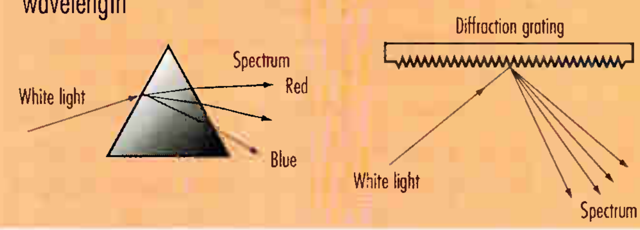


Figure 12: Basic structure of a grating demultiplexer

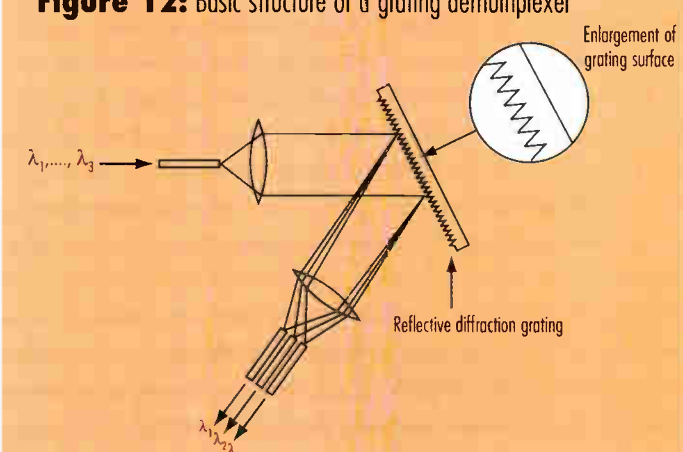
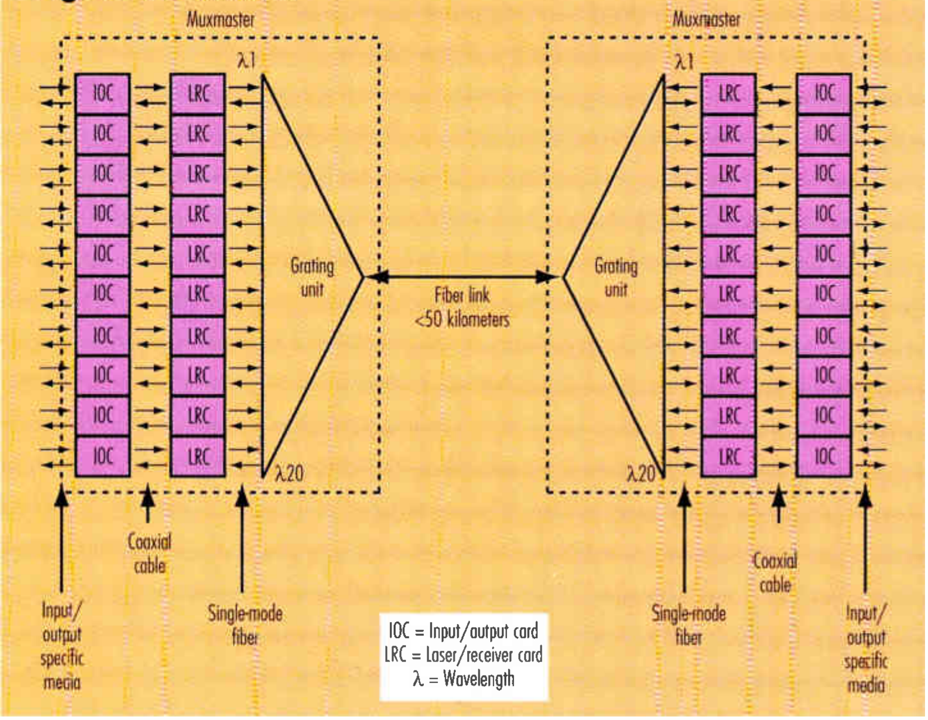


Figure 13: Muxmaster



gratings in WDM was recently announced by IBM called a Muxmaster. In what is termed dense WDM the Muxmaster sends 20 simultaneous data streams over a single optical fiber. Muxmaster transmitters use telecom-grade lasers capable of sending digital data at up to 1 gigabit per second in each data stream. Current applications are using 200 Mb/s (in each data stream) in each direction for up to 75 km (46 mi). (See Figure 13.)

Muxmaster uses 20 separate wavelengths separated by 1 nm in the wavelength window of 1,540-1,559 nm. Ten of these channels are used for transmission in one direction and 10 in the opposite direction on the same fiber. The grating unit on the left in Figure 13 takes the 10 separate wavelengths and multiplexes them onto the fiber link. The same grating unit acts as a demultiplexer and separates out the other 10 separate wavelengths incoming on the fiber and sends them to their separate receivers. And of course the same actions take place on the other end of the fiber link.

Paul Green, manager of optical networking for IBM Research in Yorktown Heights, NY, said that IBM has sold "dozens" of Muxmasters in an extended beta test of the product. He said that the price was dependent on each application, but generally was more than $150,000. Many of the users are banks and Green mentioned three: Morgan Stanley, Republic National Bank and the Bank of Austria in Vienna.

Green also is managing an IBM/Corning team partially funded by the U.S. Defense Department's Advanced Research Projects Agency (ARPA). The main goals of the project are to increase the number of channels and to reduce the price. They have already achieved 32 channels on a single fiber — 16 wavelengths in one direction and 16 wavelengths in the opposite direction. One objective in reducing costs is to reduce the equipment to an "optoelectronic chipset." (See Figure 14 on page 27.)

Underneath the common optical chip at the top of the figure is mated either the multichannel receiver or the multichannel transmitter. For the receiver function, the light from each grating output falls on a separate photo detector. In the case of the transmitter the bottom of the lasers are coated with reflective coatings while the top of the lasers are coated with antireflective coatings and finally the end of the fiber is coated with a reflective coating. Thus the resonant cavity for each laser is from the bottom of the laser up through the grating back to the mirrored end of the fiber. This con-

Name ____________________

Company ____________________

Address ____________________

City ____________ State ______ Zip ______

Phone ____________________

Fax ____________________

PLACE
STAMP
HERE

MHz
MEGA HERTZ

6940 South Holly, Suite 200
Englewood, CO 80112

Name ____________________

Company ____________________

Address ____________________

City ____________ State ______ Zip ______

Phone ____________________

Fax ____________________

PLACE
STAMP
HERE

MHz
MEGA HERTZ

6940 South Holly, Suite 200
Englewood, CO 80112

Name ____________________

Company ____________________

Address ____________________

City ____________ State ______ Zip ______

Phone ____________________

Fax ____________________

PLACE
STAMP
HERE

SPECTRUM

803 Forest Ridge
Suite 108
Bedford, TX 76022

Six ways to maximize your system performance.

Tricorder III
Hand-held instrument functions as signal level meter, leak detector and data logger. Measures signal levels, hum, carrier to noise, and performs 24-hour test. Calibrated leakage optional.

Searcher Plus
The industry standard. Performs calibrated leakage measurements down to 2 microvolts per meter. Comes with mobile mount for quarterly drive-outs, and can be hand carried to pinpoint leak source.

Super Plus
The ideal instrument for detecting signal ingress, Super Plus offers over 4 times the sensitivity of any other leakage detector. Immune to power line interference and ignition noise. Special sub carrier tag ensures that only your leaks are detected. Perfect for overbuilt areas. Uses Searcher Plus mobile mount and antennas.

VF Series Filters/ AM-1000 Preamplifier
VF preselectors extend the range of composite triple beat, cross-modulation and carrier-to-noise measurements by up to 20 dB. AM-1000-20 dB preamplifier boosts set-top converter output to level needed for FCC part 76 testing.

TFC-600 Tunable Frequency Counter
Automatically strips modulation from the video carrier for accurate measurement of video carrier frequency and aural-visual carrier separation.

9580 Return Alignment System
Balances the return path and includes spectral display for measuring ingress and noise. Updates sweep measurements twice per second. Optional switcher allows 8 test connections per heaend unit. Each 9580 headend unit will support up to 6 field units simultaneously.

Make Trilithic your source for CATV test equipment.

Trilithic offers a full line of outstanding CATV test equipment to help you keep your system in top operating condition.

From signal measurement to leakage detection and headend testing, Trilithic products are designed to give technicians reliable, efficient performance under the most demanding field conditions.

For more information on Trilithic's complete line of CATV test equipment, call today or contact your local Trilithic representative.

TRILITHIC
The Best Thing On Cable

9202 E. 33rd Street
Indianapolis, IN 46236
317-895-3600
1-800-344-2412
Fax: 317-895-3613

Reader Service Number 146

LECTRO

Push It

The Lectro ZTT Power Supply Ensures Continuous Power

To The

For Your Digital Or Analog Signals...Zero Transfer Time!

Limit

The Lectro ZTT

60/90 VAC
Field Selectable
NOW AVAILABLE

LECTRO

800-551-3790
Lectro Products, Inc.
420 Athena Drive
Athens, Georgia 30603

Reader Service Number 122

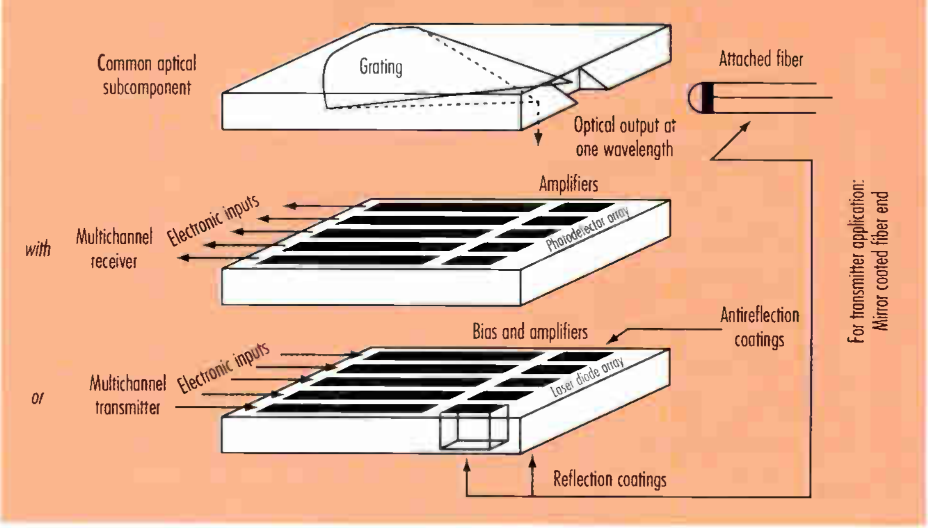
figuration eliminates laser modes in a manner analogous to a DFB.

The project has developed a multichannel receiver in a chipset but is still working on the development of the transmitter chipset. Currently the top chip is about 2″ by 4″ and the receiver is about 1/4″ on a side.

Conclusions

The progress of optical communications from ground zero (nonexistence) to its present state in only a couple of decades has been breathtaking. In 1965, Gordon Moore a co-founder of Intel, and still its chairman, formulated Moore's law — the performance of chip technology, as measured against its price, doubles every 18 months or so— and since then it has held true in the computer world. Now, whether Moore's law can be applied to the field of optical communications remains to be seen but regardless it's a safe bet that the future will be just as exciting as the past. **CT**

Figure 14: Optoelectronic chipset



References

1) *Optical Fiber Telecommunications II*, S. Miller, I. Kaminow, Academic Press, 1988.

2) *Optical-Fiber Transmission*, E. Basch, Editor, Sams & Co., 1987.

3) *Single-Mode Fiber Optics, Principles and Applications*, L. Jeunhomme, Marcel Dekker Inc., 1983.

4) *Optical Communications*, M. Sibley, McGraw-Hill, 1990.

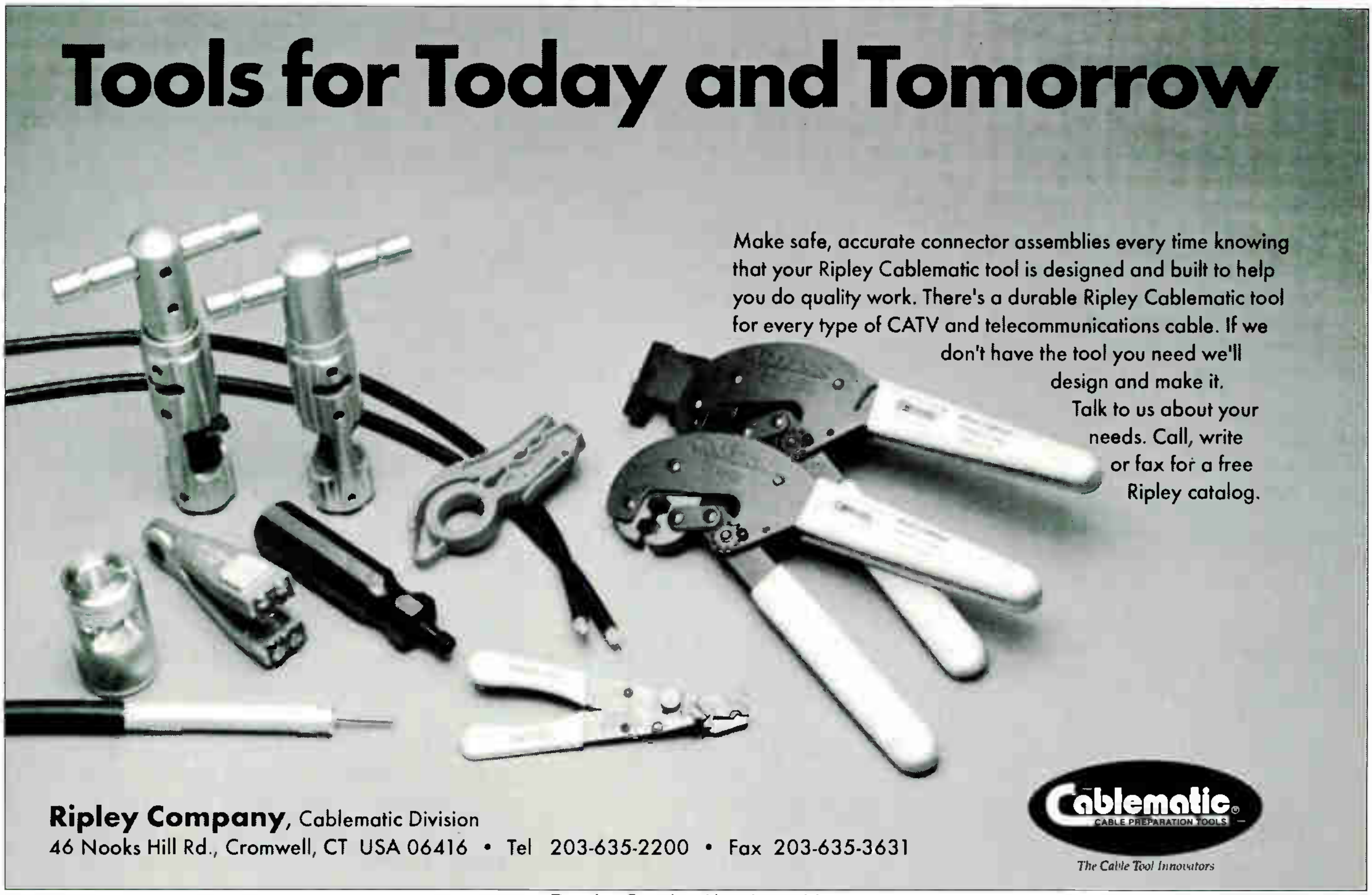
5) *Optical Communication Systems*, J. Gowar, Prentice/Hall, 1984.

6) *Fiber Optics Handbook for Engineers and Scientists*, F. Allard, McGraw-Hill, 1990.

7) *Understanding Lasers*, J. Hecht, Sams & Co., 1988.

8) *Understanding Fiber Optics, Second Edition*, Sams & Co., 1993.

9) "Toward Customer-Useable All-Optical Networks," P. Green Jr., *IEEE Communications* magazine, December 1994.



By Steve Day, President, Telecommunication Programming & Services Corp.

Basics of the multimedia engineering evolution

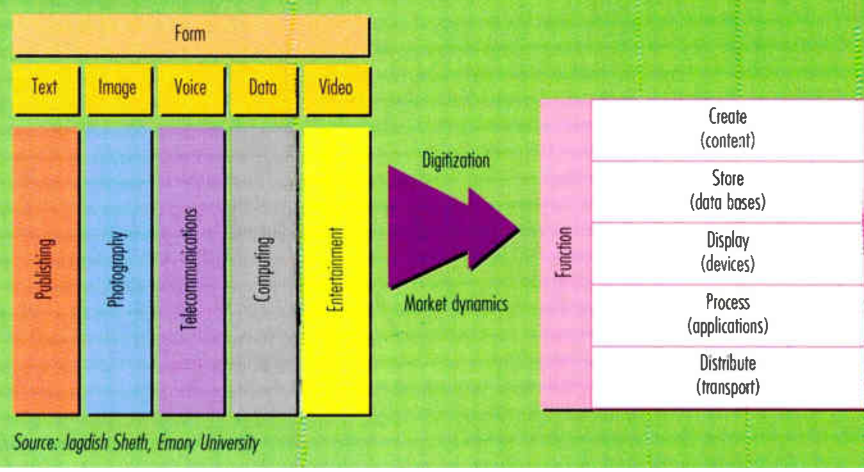
In today's marketplace, there is an uncertainty about what the future holds. Will the revenue justify the expense of a new multimedia network? Will telcos, CATV and direct broadcast satellite (DBS) competitors erode the basic TV subscription business? Will the transactional TV marketplace be driven by content ownership, digital delivery or multitier marketing?

These represent some of the most important questions about defining the engineering future. Yet still today, we have few answers and fewer deployed solutions. I think we are awaiting that "flare in the sky" that says, "It's time, let's get out there and deploy hybrid fiber/coax (HFC) networks with full multimedia."

Vertical empires represented in Figure 1 include telcos, CATV, broadcast, computing, print media and newspapers. These are huge, thriving industries that have all experienced tremendous growth. Yet, each one is threatened in some way by two evolutions.

The first is digitization. The ability to digitize information allows for cost-effective storage, transmission and processing. The information is no longer separated by large gaps in the technology. Secondly, as an entire generation grows up through the communications age, it has become sophisticated and, frankly, demanding. Broadband engineering will drastically change in ways we have yet to realize.

Figure 1: Media's evolution



Source: Jagdish Sheth, Emory University

Impact of digitization

I can remember when working at Sprint in the early 1980s, we began installing digital switches. Massive infrastructure, countless people and other resources had been dedicated to the physical trunking of telephone circuits through large, analog switching facilities. I remember the analog switching facility and hearing the hum of the mechanical switching, the hustle of the central office (CO) technicians, and bays of physical wire and processing equipment running down long corridors the size of football fields. (There's maybe a little exaggeration here.)

After a digital switch was installed, the entire switching center became incredibly quiet, the work of 50 could now be done by two, the digital switch took up a fraction of the space of its analog counterpart and the entire process of switching the massive office could by now controlled from one computer terminal.

Nothing, in my experience, more dramatically illustrates the collapse of a vertical, technical structure than my remembrance of these digital switch cutovers. Digitization represented a complete revolution of these old telephony offices and, eventually, the way telcos conducted business. Furthermore, this digital capability is now being made available in smaller packages including personal computers.

More importantly, what were

Figure 2: The basic multimedia engineer training curriculum

THE BEST JUST GOT BETTER

Better

The GC12V75's improved run time and competitive price make it an exceptional value.

Best

The GC12V100 offers the industry's longest run time and an unprecedented 2-year warranty.

Alpha offers two new choices for improved system reliability: the Dynasty GC12V75 and GC12V100 float-service broadband batteries. These new Dynasty gel/cell® batteries offer the *longest* run time of any battery sold in the industry.

Dynasty broadband gel/cells® are also the only batteries that share the features and reliability found in telecommunication battery designs. There is simply no better battery for reliable cable system performance.

And there's no better or more convenient battery service than the Alpha Advantage℠ program.

- **The Longest Run Time Available**
  These new broadband gel/cells® provide the industry's longest run time.
- **The First 2-Year Warranty**
  The new GC12V100 offers the industry's first full 2-year warranty.
- **The Most Complete Battery Service**
  Fast delivery and complete recycling with the Alpha Advantage℠ program.

The Alpha XM Series CableUPS® and the Johnson Controls Dynasty gel/cell® battery.

▸ *For more information, on the* **Alpha Advantage℠** *battery program call:* **1-800-421-8089**

United States
Alpha Technologies
3767 Alpha Way
Bellingham, WA 98226
Tel: (360) 647-2360
Fax: (360) 671-4936

Canada
Alpha Technologies
5700 Sidley Street
Burnaby, B.C. V5J 5E5
Tel: (604) 430-1476
Fax: (604) 430-8908

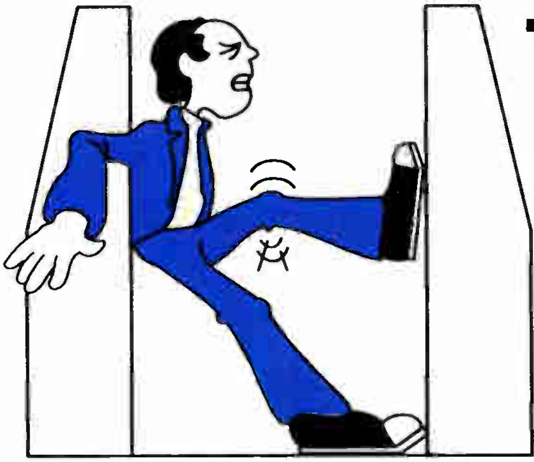
INTERSTATE BATTERIES
Fresh Power. Guaranteed!

DYNASTY®
JOHNSON CONTROLS

ALPHA TECHNOLOGIES

Reader Service Number 27

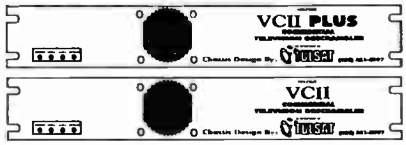
Is your headend cramped for space?



Try our half-sized chassis.

$139.00
HALFSIZE VCII CHASSIS

THERMOSTAT CONTROLLED FAN
SAVES RACK SPACE



SA 6340
MODULATORS
Channel 2 thru 70
Many used less than 2 months

Over 1500 in Stock
SCIENTIFIC ATLANTA
6380 Stereo
6150 Processors
6130 Processors
6330 Modulators
6350 Modulators
6250 De-Modulators

SA 9280
AGILE MODULATOR
Many used less than 2 months

TRAPs

New & Used Traps
Pos, Neg & Tiering

Over A Half Million
IN STOCK
New & Refurbished
Taps & Traps
WE SWEEP ALL TRAPS AND TAPS BEFORE SHIPPING

NEW
CONNECTORS

Large Inventory
Popular &
Hard to Find Sizes

Modulators Processors Receivers Line Gear IRD Cards VCII's

FACT

LESS THAN
$100.00

Average
Repair Charge
Including Parts

1605 E. Iola
Broken Arrow, Ok 74012

TULSAT

800-331-5997

Reader Service Number 46

the reactions of the technical teams charged with making these switches work? Largely, there was uncertainty. Uncertainty associated with how their jobs would change. Uncertainty associated with the digital technology. Uncertainty of how to handle the horizontal job structure where the old rules no longer apply. How does a technician react when Friday there were 50 people performing jobs with a great deal of physical interaction with the equipment and on Monday there were two people in jobs with a computer terminal doing all the work?

This parallels what will happen in tomorrow's broadband environment. We are faced with the same uncertainty. Rapidly, we are going from dealing with analog RF carrier transport of simplistic 6 MHz, AM-VSB video channels to a network carrying all kinds of voice, video and data. We are moving to a network with all kinds of added functionality: switching, status monitoring, digital compression and so on. How do we continue to instill the basic knowledge and abilities into the CATV engineer, headend technician and others that are performing in small, medium and large offices throughout the world? How do we move new service offerings and new technologies from specialists to the mainstream engineering staffs (the guys working in today's typical offices)? This will change the engineering environment as follows:

- As the vertical structures flatten out, it is important to equip the engineer and technician with computing technology that will simplify and automate the work environment.
- As the vertical structure collapses, the engineer must now completely understand the horizontal structure and all facets including content, storage, equipment, applications and transport.
- As the horizontal structures emerge and automation replaces manual labor, it is important to educate the engineer and technician so that they are confident in their understanding, resist their inherent urges to physically intervene and use their newfound capabilities in the proper manner.

Automation

In today's video office, these same types of technological advancements and engineering developments are occurring. Instead of a physical, mechanical office, today's video office is becoming a digital processing office. Like most telephony switching offices of the 1970s and 1980s, the processing of information from providers to customers can now be controlled from one computer terminal.

Education

This automation concept is the first important fundamental. The second is education. There is no better tool than education in dealing with the uncertainty of the future and rapid change in the engineering environment. Successful engineering staffs will be able to understand all horizontal layers. I have never taught a broadband engineering course where the majority of the CATV students understood the video basics. I have never taught a telephony engineering class where the majority of the telephone students fully grasped the voice and data basics. It is amazing that someone can function in a pyramidal or vertical organization by


Now's not the time to be scratching your head with questions.
There is a better way.
HEWLETT PACKARD

Tear out this ad and roll it into a ball.

It will be about the size of the average ulcer you can get from chasing cable faults.

If cable faults are causing you headaches and ulcers, **Riser-Bond Instruments** may have the cure!

Riser-Bond's complete line of time domain reflectometer, cable fault locators, can help you locate cable faults fast. From economical handheld digital TDRs to full function waveform models, Riser-Bond manufactures a TDR for any application and budget.

As cabling systems become more advanced, the need for maintainance becomes more important than ever. Riser-Bond Instruments stays ahead of a changing market by offering the most user-friendly and sophisticated instruments available today while maintaining low cost.

Automatic features greatly simplify the operation of Riser-Bond Instruments' TDRs and help eliminate the confusion and frustration you may have experienced with other test equipment.

Exclusive features like SUPER-STORE waveform storage and WAVE-VIEW software bring you tomorrow's technology today. Using either your TDR or your PC, you can store, recall, and manipulate waveform information like you are still in the field. You can also use your PC and printer for unlimited storage and documentation. To experience the exclusive WAVE-VIEW software program, call for a free demo disk.

NOTICE: All Riser-Bond Instruments' products are available without a prescription!

800-688-8377 402-466-0933 Fax: 402-466-0967

Reader Service Number 103

Riser Bond
INSTRUMENTS

learning his job and routinely repeating the same tasks without fully understanding his functional discipline.

Figure 2 (page 28) represents the basic building of knowledge required for tomorrow's CATV engineer. Beginning with video basics and moving up through ATM technology provides for a solid broadband engineering background.

When viewing the current vertical structures, the analogy of putting fires out with a line of people passing buckets of water from the well to the fire comes to mind. All a person has to master is his particular task. In the analogy, a person passing buckets of water really doesn't even have to see the fire. In the future of digital technology and multimedia market dynamics, this support structure will disappear. In the horizontal domain, the engineer will be forced to handle all functionality of a particular discipline. The video office engineer will have video, voice and data analog, digital and compressed digital one-way broadcast and two-way interactive and circuitized and packetized information. Successful companies in the competitive future will:

1) Replace programmed training with outcome-based training. Companies gearing for the future must do more than ensure that a subject is covered. They must ensure that their engineering and technical staffs emerge with a working knowledge and ability to function in the horizontal marketplace.

2) Develop tomorrow's engineer to be able to understand, engineer and function in a world with voice, video and data comingled.

3) Like the telephony digital office example, develop engineering tools that allow engineering to handle the vast array of new horizontal considerations with simplistic, open architecture concepts.

These subtle, but important changes will occur in the next five years. Fortunately, the deployment of digital technology and the development of the multimedia market will result in a horizontal structure giving each engineer unparalleled autonomy and the ability to make a difference for his or her company like never before. It will be the engineering and technical talent that exists in each system that will make all the difference. The competition that possesses the best of these engineers will win because of one basic principle: The delivery of service with higher quality and for a lower cost will result in a basic competitive advantage.

This is particularly important for CATV companies. Today, the CATV engineering talent, knowledge and innovation has manifested itself in unrivaled growth and development. CATV companies that realize what power of automation, engineering and education basics will most certainly increase the probability of keeping this talent — the core talent that drives the industry and represents its foundation.

The last message is to remember the strength of empowering the local CATV engineers above all else. The tendency with new technology is to centralize its roll-out. Yet these local engineering staffs have historically been the strength of the CATV industry. Realize that these engineers represent each company's future competitiveness and provide them with the necessary training. **CT**

By Larry Stark, Vice President and Business Manager, Broadband Communications Products, Ortel Corp.

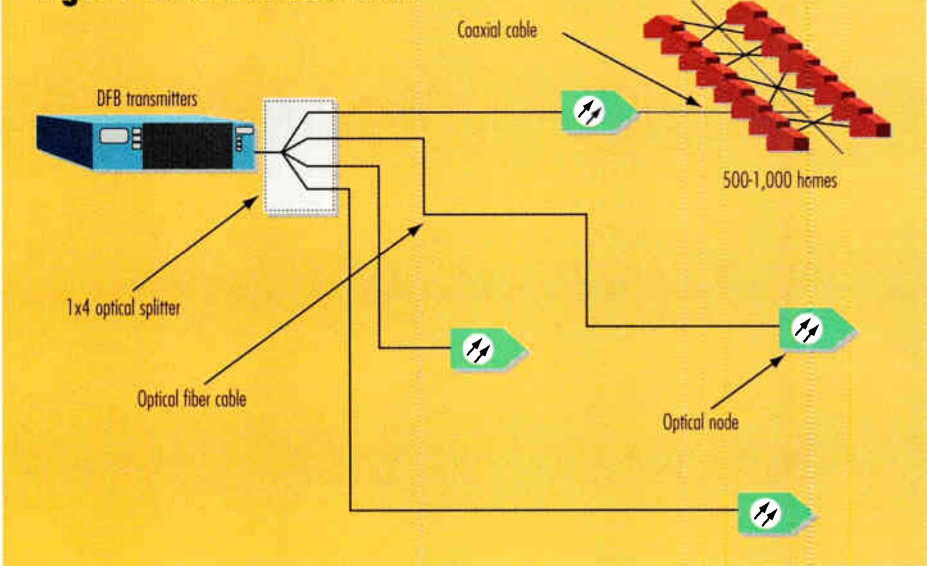
HFC: Interactive and inexpensive

Passing almost every home in the United States is a virtual communications gold mine — broadband coaxial cable. Today, these coaxial cables are being connected to the CATV equivalent of a telephone company remote terminal, the fiber-optic "node," which replicates a full spectrum of headend signals at the output of a fiber-optic cable within 1,000-2,000 feet of the home.

Spurred by these technology advances and by the promise of significant changes in the regulatory environment, local exchange carriers (LECs) and independent telephone companies are planning to install fiber and coaxial cable, and many of them are considering offering not just TV signals, but a wealth of digital services, including interactive multimedia and telephony.

What are the technological changes that have brought these hybrid fiber/coax (HFC) networks into the forefront of telephone network discussions and what can these networks offer to subscribers and network operators? This article reviews the changes in fiber optics that have made these networks possible, and offers some perspectives on the benefits of HFC networks for interactive networks, as well as some of their shortcomings.

Figure 1: Fiber-to-the-feeder network



HFC networks

HFC networks combine the best features of fiber and coaxial cables. The advantages of fiber are well-known. These include very low attenuation, high bandwidth, low cost, light weight and immunity from electromagnetic interference. Nevertheless, fiber-optic technology is sometimes less preferable than metallic cables. In particular, the cost of high dynamic range optoelectronic transmitters and receivers is significantly higher than their electronic counterparts. The costs for passive optical components, such as couplers and connectors also are much greater than their electronic counterparts.

Coaxial cable and RF electronics also have significant advantages. Coaxial cable can distribute signals up to 1 GHz over distances of 1,000-2,000 feet. Of greatest significance are the extremely high dynamic range and low cost of the RF amplifiers and passive components used in coaxial networks. This makes coaxial cable by far the most economical medium for distributing broadband high dynamic range signals within neighborhoods. On the other hand, coax also has limitations. Of greatest importance is the high loss of coax compared to fiber and also the fact that the loss is strongly frequency-dependent. For distances much greater than 1,000 feet, signals in coax networks must be amplified and equalized. Every time the signal is amplified, noise and distortion are added. After a number of amplification steps, the signal quality can become unsatisfactory.

HFC networks take advantage of the best features of each technology. Fiber is used to transmit high-quality signals from a CATV headend or LEC central office into neighborhoods. An optical receiver is then used to convert the optical signal to an electrical (RF) signal. The signal is then distributed within the neighborhood using a "short range" coaxial tree-and-branch design. →

We Stock Canusa and So Much More.

TVC INCORPORATED

Canusa heat shrink tubing is a fast, reliable way to protect connectors and equipment from moisture. Stripes change color when the correct temperature is reached and, if necessary, removal is easy since Canusa strips clean leaving no residue.

Call TVC today for fast delivery of shrink tubing and well over 8,000 other top quality products. Now, with offices around the globe, we reach farther than ever. But TVC is still as close as your phone.

NORTHEAST: HERSHEY, PA
(717) 533-4982 1-800-233-2147

WEST: SAN CLEMENTE, CA
(714) 361-2011 1-800-755-1415

SOUTHWEST: HOUSTON, TX
(713) 956-2984 1-800-346-3759

SOUTHEAST: SARASOTA, FL
(813) 371-3444 1-800-245-4423

EUROPE: SUSSEX, ENGLAND
(0)825 872848

CORPORATE OFFICE:
1746 E. CHOCOLATE AVENUE, HERSHEY, PA 17033

Reader Service Number 66

Figure 2: Digital fiber optics

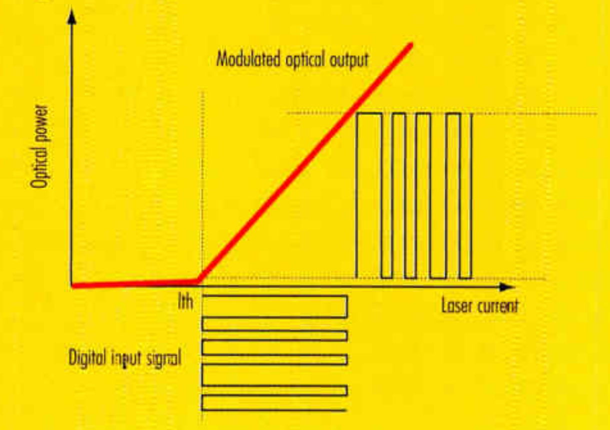
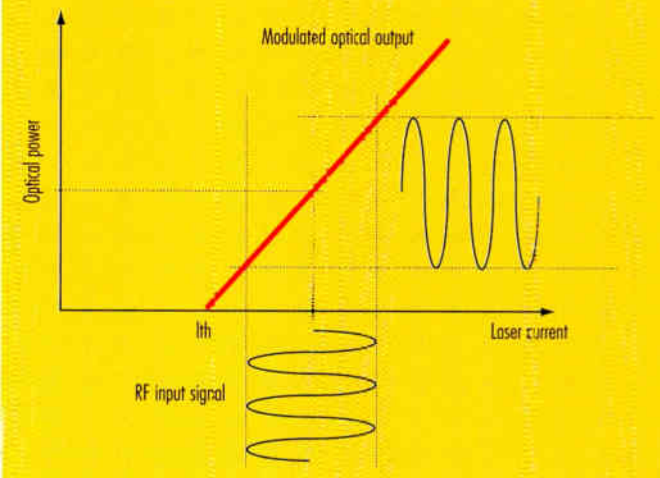


Figure 3: Linear fiber optics



The coaxial network also collects return path signals from the neighborhood that are transmitted back to the headend or central office via a return path optical link. The most common implementation of HFC today is the fiber-to-the-feeder (FTTF) network architecture. A representative FTTF network design is shown in Figure 1 (page 34). Typically the output of a single laser transmitter is split three to four ways to individual optical receivers. Each optical receiver delivers its signal to 500-1,000 homes. The transmitter delivers signals to a few thousand homes.

Linear fiber optics

Linear fiber optics has made an enormous impact on communications systems that use radio frequency signals. Prior to the emergence of this technology, system designers in RF communications systems had no cost-effective way to incorporate the undeniable benefits of fiber in their systems.

All fiber-optic links consist of an optical source, transmitting through an optical fiber to an optical detector. In digital fiber-optic links, the source is turned on and off, producing a binary (on/off) optical beam. The detector responds to the presence or absence of an optical signal at the output of the link, producing a binary current output, as shown in Figure 2. This signal can be "interpreted" correctly in the presence of significant noise and signal distortion, so the optical source does not have to meet stringent performance standards. Digital fiber-optic products were unsuitable for transmitting RF signals, because they did not provide high enough performance, either in output power, signal bandwidth, linearity or low noise.

In linear fiber-optic links, as shown in Figure 3, the RF signal proportionally modulates the output of the transmitter, so that the optical signal is an exact analog of the instantaneous RF signal. Thus the optical detector converts the instantaneous intensity of the received optical beam to a current, which is a replica of the input RF signal. Distortion and noise that is of little consequence in digital links can significantly impair the reception of analog signals, so the performance requirements on the optical source are more stringent.

Research on laser and photodiode technology for high-frequency analog signals began in the early 1980s. By the late 1980s, development efforts for high-performance links had focused on the distributed feedback (DFB) semiconductor laser. The DFB laser is a "quaternary" semiconductor chip, made from InGaAsP. The optical properties of this device are determined by an internal optical grating that acts as an optical filter resulting in a single optical wavelength at the output of the laser. Without such a grating, semiconductor lasers produce a beam that includes several wavelengths. Such lasers, called Fabry-Perot (FP) are generally not well-suited for linear fiber-optic links. This is an important feature of high-performance linear laser sources.

To achieve the performance of today's fiber-optic transmitters, researchers had to find ways to raise the maximum modulation frequency of semiconductor lasers from about 1 GHz to almost 10 GHz. This work resulted in significant improvement in the noise and linearity of lasers, ultimately resulting in the performance of today's products. It also was necessary to increase the power capability of packaged semiconductor lasers from 1-2 mW to today's levels of 10-20 mW. This increase was the result of designing more efficient lasers, increasing the coupling efficiency of the laser chip to the optical fiber and increasing the operating current capability of the laser.

Rising performance, falling costs

The first commercially deployable linear fiber-optic CATV transmitters were marketed for $30,000, carried 40 channels on a single fiber over an optical loss budget of 5 dB, barely sufficient for transmitting 10-12 km. Today's transmitters sell for about a quarter of that cost, and carry 80 channels plus several hundred MPEG digital channels over distances of 20-25 km. This trend toward higher performance and lower cost is not finished. Increasing production volumes of linear DFB lasers are cutting product costs in half every three years. The historical "linear premium" that equipment manufacturers have paid for CATV DFB lasers is rapidly evaporating. Except for differences in testing requirements, there will soon be no significant difference in price between linear and digital DFB lasers that are manufactured with similar packaging requirements. This will have a critical impact on the cost of HFC networks, especially on networks with fiber pushed deeper into the network.

Interactive HFC networks

HFC architectures provide a highly cost-effective way to build a network for today's analog video services that can grow flexibly and provide interactive digital services in the future. The cost penalty of providing analog video with digital signals makes an HFC network virtually mandatory. With approximately 200 million TV sets and 100 million VCRs in the United States, no network operator can realistically consider providing this equipment base with digitized video for "basic services."

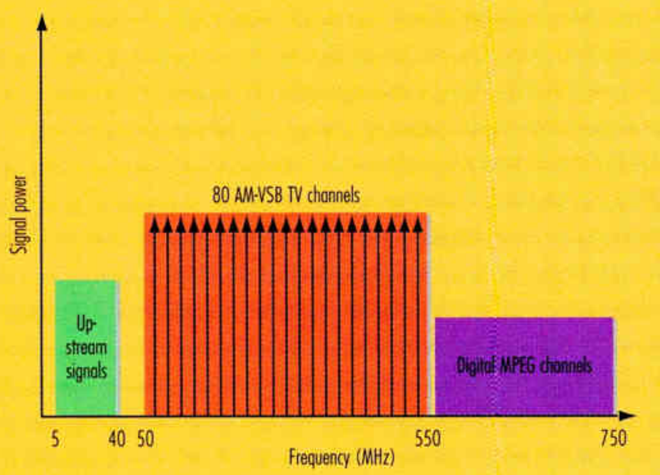
If the digital MPEG decoder costs $300, this installed base of existing RF tuners represents $90 billion that must be paid by any provider of broadcast video services using digital signals. Also, many TV sets are "cable-compatible" and viewers are highly skeptical of services that require them to use a set-top just to view basic tier services. These considerations virtually mandate that prospective analog video service providers plan to use HFC networks.

Once an HFC network has been deployed, it is straightforward to migrate to a full-service two-way communications network. Coaxial cable can carry two-way signals, by separating them into different frequency bands, the downstream and the upstream bands, as shown in Figure 4. The edges of these bands reflect the practical limitations of accommodating TV channels at their traditional broadcast TV frequencies. While some planners have experimented with placing the upstream band in the 850-1,000 MHz frequency range above the downstream frequencies, there are practical difficulties with this approach, and it has not been widely adopted beyond some experimental trials.

Evolution from today's FTTF HFC networks to highly interactive designs

Network type	Downstream bandwidth per sub (50% penetration)	Upstream bandwidth per sub
FTTF	1.5 Mbps	160 kbps
Point-to-point	6 Mbps	160 kbps
Fiber deep	6 Mbps	640 kbps
Frequency stacking +250 home forward	12 Mbps	2,560 kbps

Figure 4: Frequency spectrum of HFC network



Analog video channels are normally transmitted between 50 and 550 MHz, which is enough spectrum to transmit 80 channels of NTSC video. The digital channels are carried in the 550-750 MHz band. Even allowing for a guardband between the analog and digital spectrum, this represents almost 1 Gbps of digitized information using QAM or VSB digital modulation technology, or about 300 MPEG video signals. As demand for analog services falls in the future, the digital band can be extended downwards to 450 MHz, for a capacity of about 500 channels. This is the origin of the famous "500-channel" CATV system that has been widely touted to the public.

Upstream signals from the home are carried to the optical node over coaxial cable, through bidirectional amplifiers. At the node, they are modulated onto an upstream laser and transmitted as fiber-optic signals to the headend (or central office). The upstream frequency band coexists with a number of commercially active RF bands, such as radio amateur bands, CB radios, shortwave broadcast, etc. Even new cable plant can conduct a significant amount of energy radiated by these services into the return band, and threaten to disrupt upstream signals. Also, home appliances often radiate electrical interference in this band, and this energy can be conducted into the return band from within the subscriber's home. These issues will be discussed more fully in the final section of this article.

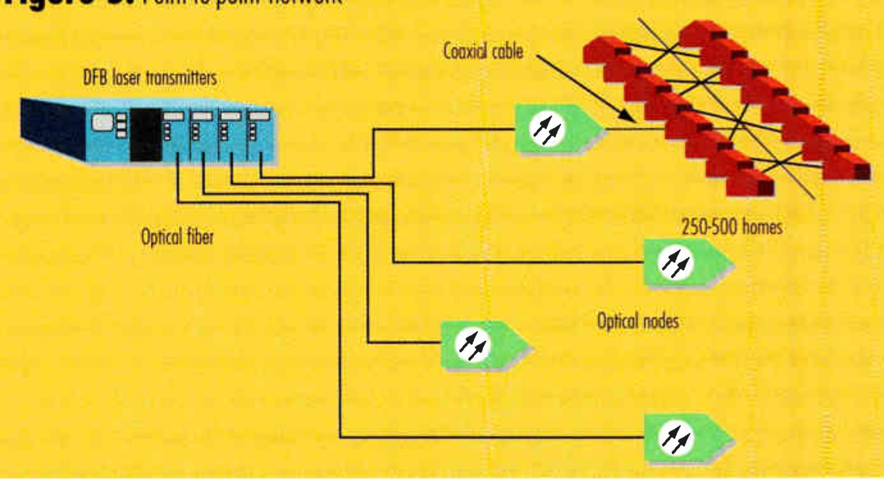
The FTTF plant design shown in Figure 1 (page 34) is capable of providing interactive services as is, but as demand for such services grows, such a plant design would eventually need expanding. This is one of the primary advantages of HFC networks — the ease of adding digital capacity incrementally as demand grows. There are two basic ways to expand such a plant architecture.

A simple expansion approach, shown in Figure 5, is to eliminate the optical splitter at the transmitter site, add additional DFB transmitters, connect each fiber to a unique transmitter, and transmit AM and digital signals to nodes of approximately 500 homes over a single fiber. With 80 channels of AM video and an additional 300 MPEG video channels, network operators can satisfy a significant degree of interactive demand using this network.

A variation of this architecture, shown in Figure 6 (page 40), uses completely separate transmitters for the digitally modulated RF signals, transmitted through separate fibers to separate photodiodes, and combine the digital signals with the analog after the optical receiver.

The advantage of the first approach is that it minimizes the use of optical fibers, uses simpler receivers and does

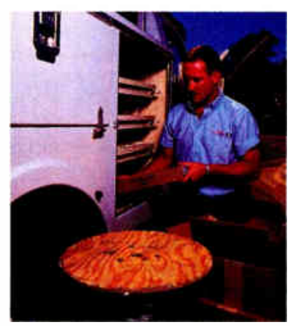
Figure 5: Point-to-point network



Bill Winslow's Up On The Latest Ways To Avoid Downtime

Bill Winslow
Manager
Materials Management Services

In your business, downtime is deadly. It drains productivity and your cash flow. But Bill Winslow can give you materials management solutions to make your techs and installers more productive. You'll get just the right amount of equipment, just when you need it. You'll meet industry service mandates, and your customers will be satisfied. And that's where Bill Winslow and Sprint/North Supply can help.



At Sprint/North Supply, we have years of experience creating a full range of materials management solutions that save time and money. Solutions for building, upgrading or re-building systems. Solutions for drop installation orders to hook up your new customers. And solutions for any type of plant maintenance — including emergency repairs. We take care of your materials needs, so you can focus on productivity and service. We'll manage your materials quickly and accurately — all orders are filled in 24 hours and shipped overnight.

Effective, efficient materials management is easy with our network of 11 distribution centers. We have 30,000 products from 1,200 leading manufacturers. Located throughout the United States, our distribution centers cover 1,067,107 sq. ft. of space. They're linked by computer to deliver the materials and equipment you need to keep your productivity on target and your customer service on track.

With one toll-free call, you'll have instant access to the broadband and telecommunications solutions you need. At Sprint/North Supply, we're your full-line national distributor. Call and let us tell you how to keep your downtime down.

FREE CATV/BROADBAND CATALOG. Call and order your FREE 296-page catalog, featuring thousands of products. NO OBLIGATION.

On Line, On Call, On Time

1-800-639-CATV

Sprint
North Supply

Reader Service Number 77

well as procedural and technological solutions from subject matter experts. Presentations include:

• "Downstream Laser Clipping: Field Measurements and Operational Recommendations" with Rex Bullinger, Hewlett-Packard

• "A Cost-Effective Approach to Return Path Monitoring" with John Mattson, Arris Interactive

• "Return Path Testing Methods and Performance Comparisons" with Oleh Sniezko, TCI Communications

• "Composite Power and Its Effect on Reverse Path Laser Clipping" with Lamar West, Scientific-Atlanta

• "Network Management Tools and Processes for HFC Networks" with Serge Rochette, Rogers Cablesystems

10:30-12 p.m.: Session D: Empirical Data and Field Experiences. Moderator: Pete Smith, Rifkin and Associates. After all the research and product development is completed a network application is launched. In this session you will hear about real life deployments of data networks including work at home applications, technical requirements of the network, business requirements, and security issues of a widely dispersed network. Presentations include:

• "Network Operations and Field Experience" with Tom Staniec, The Excalibur Group

• "Business Experience in a Residential Data Network" with Frank Cotter, Rogers WAVE

• "Work at Home—Integrated Data and Voice" with Doug Wolfe, West End Systems

• "Security Issues in Wide Area Networks"

12-1:45 p.m.: Luncheon topic—History of New Business Technology Development with Robert Lucky, Bellcore

2-4 p.m.: Session E: Over the Horizon. Moderator: Earl Langenberg, Consultant. Requirements for the mass storage, retrieval and distribution of data is growing exponentially. This panel of industry experts explore over the horizon technologies that may well be used to create the super servers and fiber-optic transport components that are so vital to the success of our telecommunications industry. Presentations include:

• "Super Servers—Meeting Tomorrow's Mass Storage and Retrieval Requirements" with John Mashey, SGI

• "Optical Fiber Gratings for Dense Wave Division Multiplexing and Long Reach Telecommunications" with Tino Alavie, ElectroPhonotics

• "Micro Replicated Polymers—On the Way to Low Cost Optical Splitters and Combiners"

• "Sampled Grating Distributed Bragg Reflectors: Crafting High Yield Coherent Optical Transmitters"

• "Fluoride Fiber—A Way to Improve the Performance of Optical Amplifiers"

"(ET '97) is of vital interest to engineers, managers, manufacturers and consultants involved in broadband telecommunications."

Opryland

A recently completed expansion of the Opryland Hotel Convention Center makes it one of the largest convention center hotels in the world. Located near some of Tennessee's prime attractions, the hotel offers many conveniences for visitors including 22 retail shops, over 15 restaurants and lounges, and the hotel's 18-hole championship Springhouse Golf Club. The impressive surroundings include waterfalls and fountains, three indoor gardens totaling over eight acres and four Mississippi flatboats riding the river that winds through the hotel.

Nearby, you can enjoy some of Opryland's finest country music entertainment at the internationally-famous Grand Ole Opry, ride the world's largest showboat, the General Jackson, be part of a live studio audience at a Nashville Network taping and visit historic Ryman Auditorium, the original location of the Grand Ole Opry.

Miss something?

If you're reading this after Jan. 10, and didn't have a chance to take advantage of ET '97, remember that a proceedings manual and tapes are available from the conference. Contact: SCTE national headquarters, 140 Philips Road, Exton, PA 19341-1318: Phone: (610) 363-6888; or World Wide Web: http://www.scte.org.

Expo '97

Don't forget about the SCTE's Cable-Tec Expo '97, the premier techology conference in the cable telecommunications industry, which is taking place in Orlando, FL, from June 4-7. Information and registration packs are availabe from SCTE national headquarters. **CT**

Figure 6: Digital overlay network

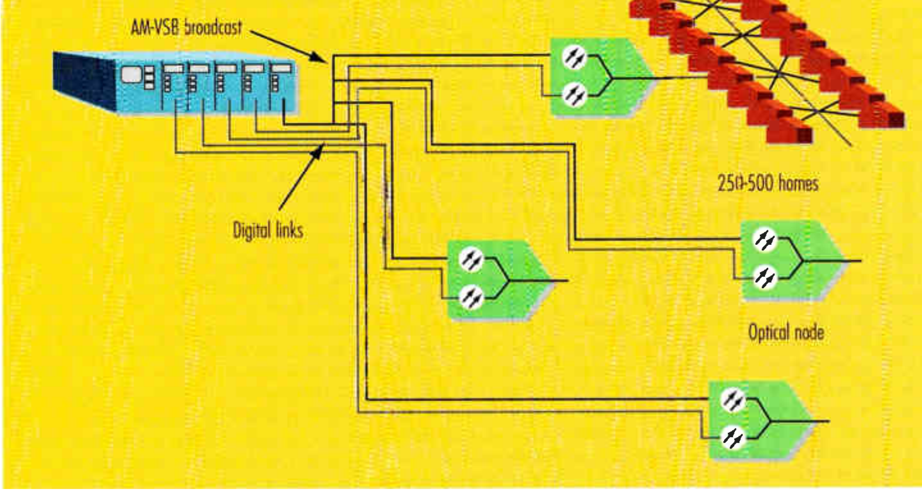
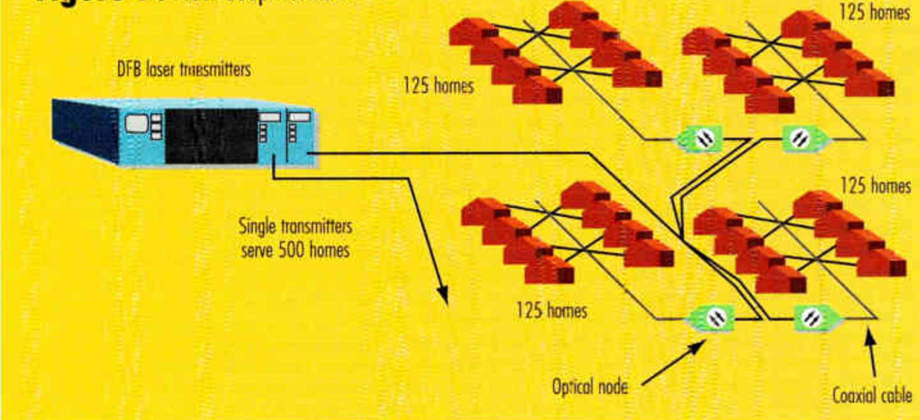


Figure 7: Fiber deep network



not require any additional network reconfiguring when the frequency plan changes. The advantage of the second is that the additional transmitters are less expensive because they are only required to transmit QAM or VSB digital signals. Most equipment manufacturers are now developing transmitter products for both approaches.

Designing for the return path

What is the capacity for upstream communications with HFC networks? How much bandwidth is really available and what problems will be encountered trying to use this bandwidth?

Traditionally, CATV networks were one-way. The low-frequency portion of the spectrum was available for upstream signaling, but was basically not utilized for two reasons, both of which have been substantially alleviated with linear fiber optics. First, before the development of HFC networks, all subscribers in a region ultimately funneled through the same 25 MHz of bandwidth back to the headend. With 50,000 to 100,000 subscribers on a single trunk cable, the available bandwidth was not sufficient to serve all the potential users. Second, the 5-40 MHz frequency band available is susceptible to ingress. The "upstream funneling" effect of the tree-and-branch network meant that all the ingress from individual "branches" of the network added together, resulting in an extremely poor communications channel back at the headend.

The HFC network architecture substantially overcomes both these limitations. HFC architectures segment the network into groups of a few hundred subscribers. Each subscriber's share of the 25 to 35 MHz of bandwidth is quite high. Also, studies show what common sense suggests. The ingress into the return band is easier to manage with HFC networks, which have fewer homes connected to the fiber-optic trunk. Each node can be treated as if it were a separate "mini" system. While there are still troublesome frequency bands, the availability of the return channel for 500-home nodes is nearly 100%. Advanced modulation techniques will further reduce the effects of ingress. Published studies show that smaller node sizes will enable the use of QPSK and even 16-QAM formats.

It is quite practical to reduce the size of the nodes below 500 homes. An approach proposed by Time Warner Cable is shown in Figure 7. Here, the fiber is split four ways in the field to individual nodes serving 125 homes each. This quadruples the available upstream bandwidth while maintaining the same downstream bandwidth. As demand for interactive services grows further, HFC networks will push fiber deeper still into the network. Forward path transmission to 250 homes is envisioned, and "frequency stacking" node designs can quadruple the upstream capacity again, providing in excess of 1.5 Mbps dedicated upstream bandwidth for every home passed. The trend toward more easily managed ingress as node sizes drop will further improve the return path capacity, and it is clear that HFC networks can indeed provide extremely high upstream bandwidth.

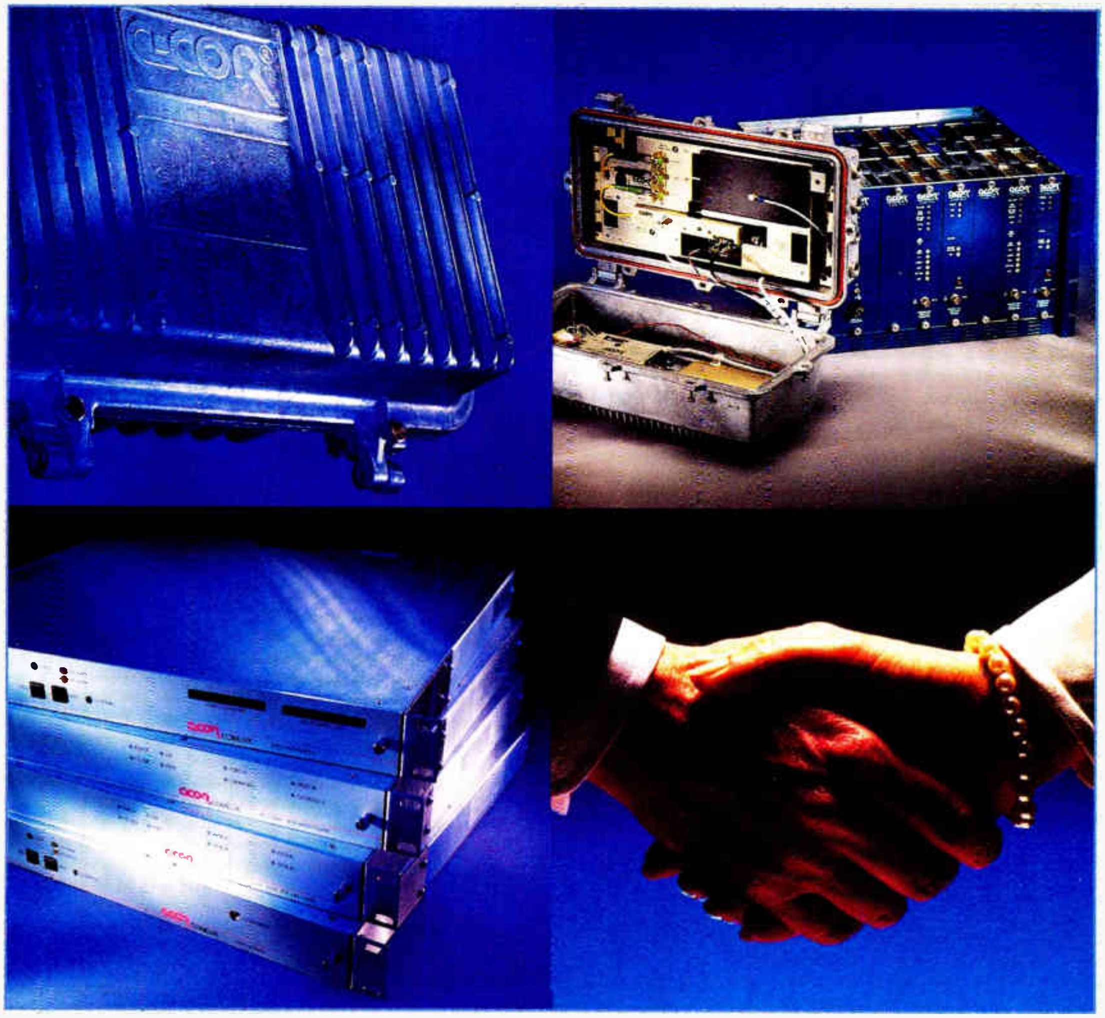
The accompanying table (page 38) shows how the transition from FTTF to fiber deep networks and eventually frequency stacking networks results in a steady increase in interactive bandwidth, both in the forward and reverse directions. The table entries are calculated in the case of 50% service penetration. Given the "bursty" nature of communications traffic, the instantaneous bandwidth to individual users will be quite high. When analog TV services drop back to a basic tier, the downstream capacity could be doubled again as most of the 750 MHz forward spectrum is converted to digital signals.

Summary

HFC networks were made possible by the development of "linear" fiber-optic products that transmit RF signals through standard single-mode optical fiber. By eliminating the need for a digital decoder, HFC networks enormously reduce the cost of supplying TV signals for today's broadcast analog video services compared to digital network designs. For future digital interactive services, including telephony, HFC networks can evolve to fully interactive networks with high-capacity downstream and upstream signal paths. **CT**

SystemSelect™

FOR INTELLIGENT SOLUTIONS



Call now, **800-233-2267**, for more information about SystemSelect™.

SystemSelect™, *C-COR's platform for a full range of network solutions for the cable television, telephone, and broadcast industries.*

C-COR's fiber optic and RF products offer advanced networking capabilities for today's hybrid fiber/coax architectures.

POWERFUL...LinkNet™ AM fiber optic equipment offers 750 MHz capability on single or dual fibers; redundant optical backup; a flexible, modular, upgradable platform; and the network management option.

FLEXIBLE...FlexNet™ RF amplifiers offer cost-effective, flexible capability from basic service to interactive multimedia. FlexNet™ 750 MHz amplifiers come in a 1 GHz housing and are backed by C-COR's extended warranty.

RELIABLE...Multi and single channel uncompressed digital video fiber optic systems provide highly-reliable, cost-effective delivery of video, audio, and data over long distances with no signal degradation.

Network analysis, design, installation and maintenance assistance, repair, training, and a 24-hour technical support hotline are also part of SystemSelect™.

For Intelligent Solutions!

ISO 9001 REGISTERED

C-COR ELECTRONICS INC
The Network Company

60 Decibel Road
State College, PA 16801
814-238-2461
800-233-2267
Fax 814-238-4065

CALIFORNIA OFFICE
47323 Warm Springs Boulevard
Fremont, CA 94539-7462
510-440-0330
Fax 510-440-0218

DENVER OFFICE
12742 East Caley Ave. / Suite A
Englewood, CO 80111
303-799-1100
Fax 303-643-1743

INTERNATIONAL OFFICE
P.O. Box 10.265, 1301 AG Almere
The Netherlands
31-36-536 4199
Fax 31-36-536 4255

CANADIAN OFFICE
377 MacKenzie Avenue, Unit 5
Ajax, Ontario L1S 2G2, Canada
905-427-0366 / 800-427-2559
Fax 905-428-0927

Reader Service Number 64

By Andy Paff, Executive Vice President, Strategic Planning and Technology, Antec Corp.

HFC evolution, integration with the public network

The late 1980s and early 1990s saw a revolution in the use of fiber-optic technology in the cable TV industry. Since then, the hybrid fiber/coax (HFC) cable network has emerged as the preferred platform for delivering an array of video entertainment channels to consumers. Today, the HFC platform is more frequently cited as a key transport mechanism in the delivery of video, voice, data and multimedia services to consumers.

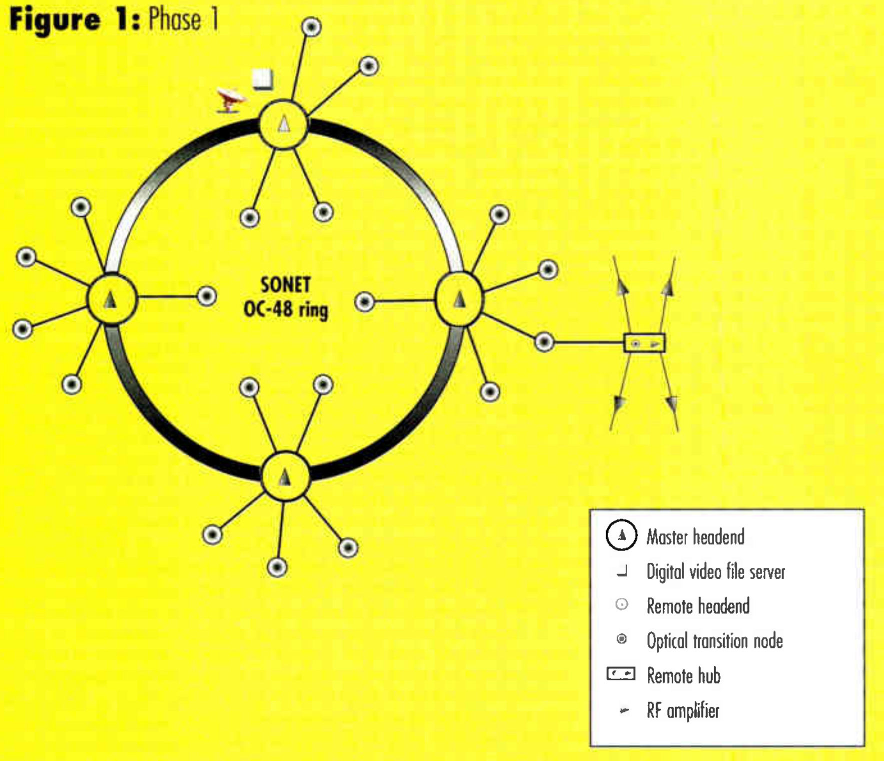
The HFC network offers an advantage from its initial installation. HFC provides a scalable and easily migratory path that can deliver greater bandwidth capacity with a lower capital investment than other technologies. The cable industry increased initial HFC deployments as increased channel capacity and new revenue streams demanded greater reliability and improved signal quality. Since HFC also delivers digital signals in any type of digital modulation format, the platform provides broadband operators with the ability to gracefully migrate to the all-digital transport network in the future. This has prompted telephone companies to take a much harder look at HFC's capabilities to the home.

"The HFC network offers an advantage from its initial installation."

Today, most state-of-the-art HFC systems are positioned at 750 MHz and deliver up to 80 analog video channels in the 50 to 550 MHz frequency range. The additional 200 MHz is being reserved for digital services. Nonactive components, including broadband taps, splitters and connectors now offer total bandpass of up to 1 GHz. Traditional return path lies in the 5 to 40 MHz spectrum, though additional return spectrum can be utilized between 750 MHz and 1 GHz if RF amplifiers (which cause degradation to return signals) are eliminated from the network.

For the HFC network to be fully positioned for interactive capabilities, the size of the areas served by fiber remains a critical factor. Interactive services such as broadband telephony and data communications rapidly chew into the return path capacity, which is currently limited to about 25 MHz of the 5-40 MHz range. With just 25 MHz available until the coaxial portion of the HFC network becomes fully passive (by eliminating all RF amplifiers), HFC systems that size their optical nodes to 2,000 homes will only allow about 25% of users in that node to simultaneously use their telephones, for example, before the HFC network would run out of capacity. At optical nodes sized to 500 homes, penetration can increase to 96% simultaneous use before the network would be overextended.

Figure 1: Phase 1



Most advanced HFC designs are sizing their service areas to 500-home nodes in anticipation of this type of capacity need, especially in the return path. Many forward thinking cable operators also are pre-provisioning each 500-home node with additional fiber to eventually segment these serving areas down to less than 100-home "passive" nodes that eliminate the remaining active devices. Then the high-

end return capacity (750 MHz to 1 GHz) can be used for additional return information.

Considerable progress has been made in HFC network evolution, but much remains to be done to tie that residential platform to the wider global communications infrastructure. What follows is a description of a three-phased approach to HFC network growth that cable operators might want to consider to integrate the residential platform with global communications network.

Phase 1: Regional integration

Regional interconnections of existing headends (Figure 1 on page 42) provide several key benefits for the core application, analog video delivery. The Phase 1 drivers include:

- Achieving operational economies by consolidating operations at a single site.
- Enhancing the network's advertising business.
- Delivering enhanced pay-per-view (analog near-video-on-demand — NVOD).

Regionalization of existing HFC networks achieves operational economies by eliminating many business locations that typically serve small groups of subscribers (e.g., 60,000 homes). By centralizing equipment and personnel resources, one "master" site may serve 200,000+ home geographic areas far more efficiently than headends spread over that geographic area. Once interconnected, previous headend locations would now act as remote signal processing hubs.

A double star network design provides an ideal residential foundation. Optical transition node (OTN) sites initially can start as optical repeater sites deep in the residential plant. OTNs are optimally sized to serve no more than 20,000 homes and initially receive, split and process broadcast HFC signals to feed no more than 40 optical nodes of 500 homes each. Since this first phase involves forward-only broadcast video, fiber counts to the OTN are reduced to cut costs in the residential plant. OTNs also spread headend processing equipment costs, such as RF modulators, over a much larger subscriber base.

Operational economies are achieved by managing one network rather than several. The master regional headend would acquire all the signals and process them to the remote hubs (formerly headends), which then feed the OTNs. This helps to boost the HFC advertising business by providing an integrated processing and distribution center for delivering commercials to consumers. New digital advertising insertion systems offer advertisers the ability to specifically target their messages to certain demographic groups — and operators to sell more ad times. Digital ad insertion could start by targeting one ad per region (200,000+ homes), and move to targeting ads to each remote hub (60,000 homes), to one ad per OTN (20,000 homes), to one ad per optical node (500 or fewer homes). Much like the HFC network itself, advertising insertion can grow in a scalable, easily upgraded fashion as new revenue streams from advertising are built.

Trafficking video through the region may initially involve proprietary digital technologies, though ultimately, synchronous optical networks (SONET) will become critical to the regional network in moving voice, data and digital video applications and internal telecommunications traffic around the region. Full SONET integration at the regional level has the added benefit of allowing the transfer of information to and from the public network, a critical component in delivering interactive and transactional services. Also during this phase, HFC is connected to the long distance providers to offer access globally.

MPEG-2, the standard used to digitize and compress entertainment video signals, may prove the impetus for SONET deployment. MPEG-2 cells will map directly into the SONET STS-n frame or be converted to asynchronous transfer mode (ATM) cells if further processing is needed. At remote headends, entertainment video may be decoded or, when possible, transmitted in compressed form through the HFC network for decoding at the consumer's set-top device.

It's important to note the assumed compatibility between SONET, ATM and MPEG-2 standards. None of these issues have been worked out yet but various forums and committees understand the importance of interoperability.

Phase 2: Digital migration

Phase 2's digital applications that will require "dedicated" bandwidth to and from the home include: VOD for both advertising insertion and MPEG-2 delivery to the home set-top; data and multimedia communications, such as on-line service connectivity and teleconferencing; and broadband telephony.

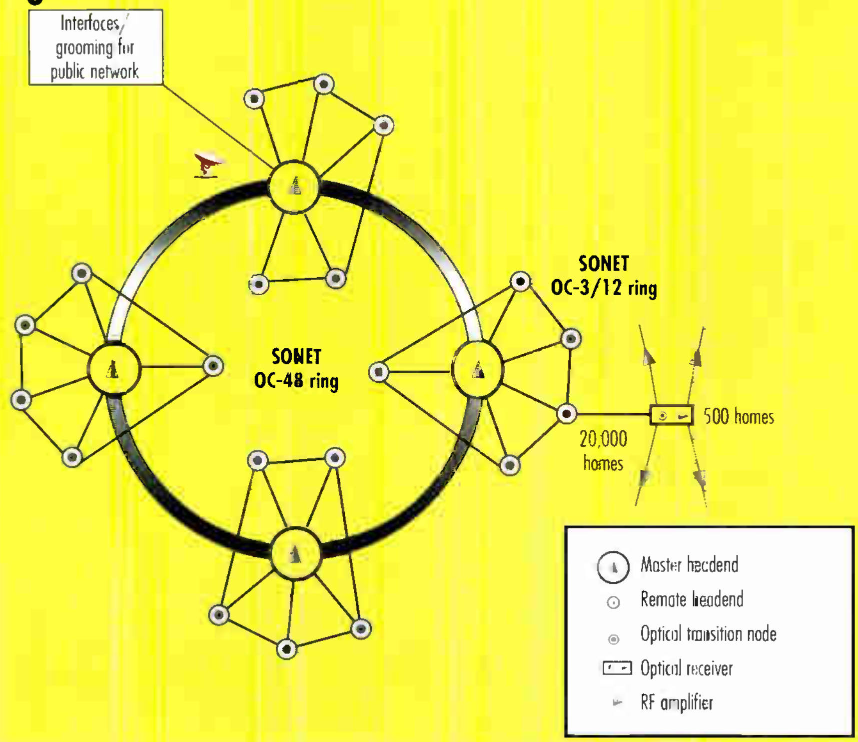
One of the most important elements during Phase 2 will be implementation of a common transport standard to optimize use of the network. For example, ATM modulated in the 64-QAM format could be used for downstream traffic (headend-to-home); ATM modulated in the QPSK format with some multiple access protocol (such as time-division multiple access — TDMA) could provide the upstream (home-to-headend) support.

The reality, particularly in the initial part of Phase 2, will be more complex. A variety of formats and protocols will probably prove practical to transport a particular group of applications and manage the limited return path. While one strength of the HFC platform is its ability to handle many different formats through discrete frequency assignment, as much commonality as possible will drive the industry toward a standardized digital transport format.

As networks move into Phase 2, dedicated lasers serving each node are phased in to segment the OTN's 20,000 homes into individual nodes. (See Figure 2 on page 46.) This provides the ability to "narrowcasting" services — to deliver a specific application only to a given node. Lower powered lasers (3 to 5 milliwatts) will cut capital costs in establishing this narrowcasting where a single laser feeds a single optical receiver. Optical receivers, too, will be retrofit with return lasers (or installed with them). Initially, upstream frequency block converters at each OTN could be used to "stack" the incoming 5-40 MHz return information from each node (Node A = 5-40 MHz, Node B = 52-88 MHz, etc.) for transport via a dedicated upstream fiber back through the regional network for processing.

During this phase, the OTN begins receiving signals bidirectionally. Since interactive applications, including telephony and data communications, will involve the public network, the SONET backbone network becomes the logical choice for linking the OTNs. Compressed digital video applications, whether in native MPEG-2 or

Figure 2: Phase 2



ATM cell format, can be delivered to OTNs through SONET OC-3 or OC-12 rings. The master headend and remote hubs could be linked via an OC-48 regional ring.

Video file servers also move to the OTNs. Storage and processing for advertising insertion, analog NVOD and VOD (broadcast), VOD (real-time, dedicated channel), catalog shopping, games, etc., moves closer to the customer. OTNs also are likely to house some routing functions, including an ATM switch. Demand for bandwidth between the SONET and HFC platforms will dictate where in the network the storage and switching elements reside.

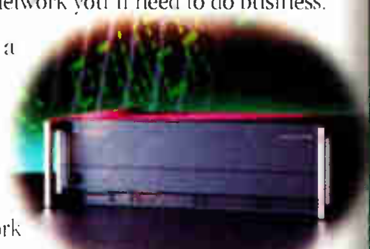
With the Phase 2 requirements for digital modulators, dedicated lasers, SONET equipment, video file servers, routers and ATM switches, the OTN grows into something larger than an environmentally controlled roadside cabinet. Since additional space and local regulatory approvals may be required, initial OTN placement with future plans in mind is essential.

At the remote headend, broadcast modulators are likely to remain. The real change will be in digital grooming and network management. With digital video requirements alone, the SONET backbone network will expand rapidly. Each OC-1 (STS-1) frame will carry approximately seven NTSC video channels, perhaps 10 given the dynamic compres-

Because the Infobahn is a 2-Way Street

Return path traffic ahead.

The superhighway is coming head-on. And Harmonic Lightwaves' complete optical return path system gives you the reliable two-way network you'll need to do business. ■ There's a digital return path for our network management



system and expanded bandwidth options to handle digital and analog services. Everything goes through our receivers...onto the superhighway...and right back to our headend transceivers. ■ Return path is critical-path to expanding your revenues. To learn more, contact Harmonic Lightwaves at 3005 Bunker Hill Lane, Santa Clara, CA 95054 USA, fax 408-970-8543 or call 408-970-9880 or **800-788-1330**.

Harmonic *Lightwaves*

See your network in a new light

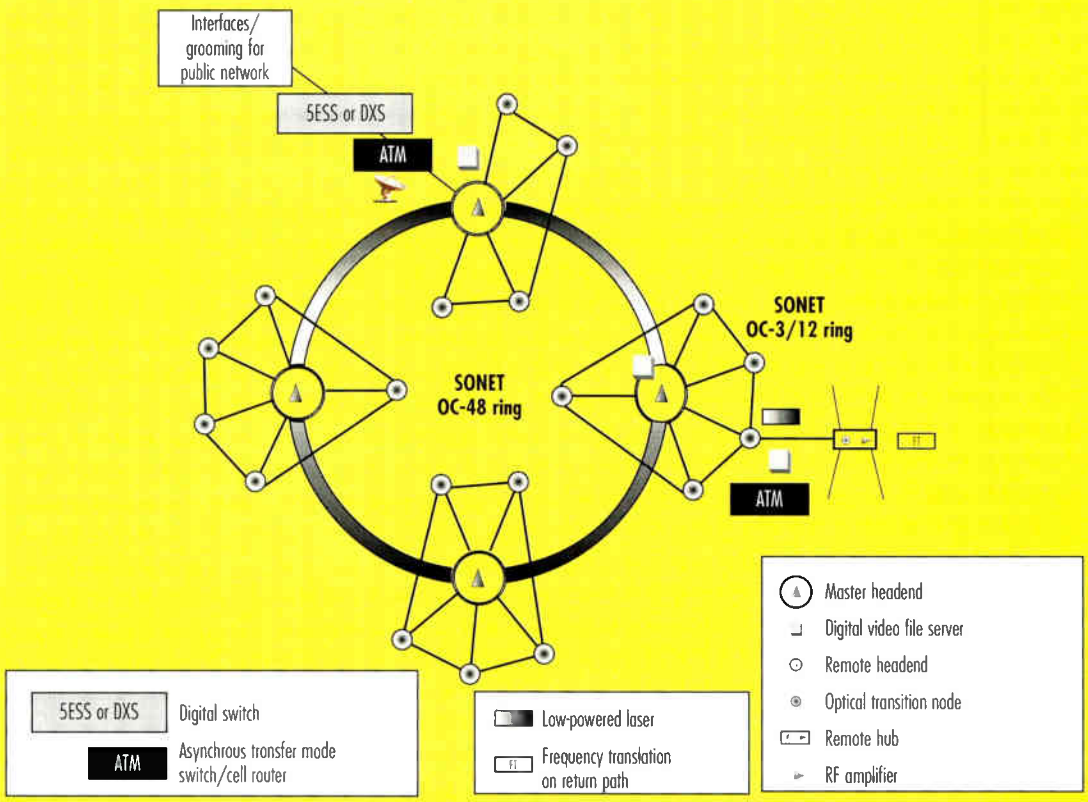
Reader Service Number 62

sion capabilities of MPEG-2.

However efficient MPEG-2 becomes, routing dedicated video material to individual OTNs will consume a great deal of SONET bandwidth on both the backbone OC-48 network and OC-3/OC-12 OTN rings. Crossconnects and/or ATM routers may eventually be located at the remote headend for optimization of the SONET bandwidth.

Remote headends also begin to serve as the primary point for the HFC "element manager." While the HFC element manager remains largely undefined to date, it will need to monitor and

Figure 3: Phase 3



A Bright New Light in the Headend Universe

PULSAR

BARCO introduces PULSAR, a revolutionary modulator for CATV headend applications requiring high quality RF signal and automatic provisioning. PULSAR offers remote monitoring and control of all modulator functions. An intelligent "white limiter" and video AGC prevent overmodulation and automatically optimize video input signal levels.

Remote or Local Control

Easy-to-use front panel keys allow direct control of video and audio RF levels, modulation depth, frequency deviation, and input switching. An RS-485 interface allows remote control of the unit.

Maximum Flexibility

PULSAR operates with 110 Vac or -48 Vdc, making it compatible with both conventional CATV or Telco powering schemes. The modulators feature IF substitution and are compatible with all major scrambling techniques.

Find Out More!

PULSAR gives CATV operators and Telcos an entirely new dimension in signal and service delivery. To find out why PULSAR will transform the future of headend modulators, call 770/590-7900.

- High RF Output Over the Entire Frequency Range
- White Limiter and Video AGC
- Auto Set-Up, Auto Alignment
- Complete Software Control for Monitoring and Backup
- Fixed Frequency and Tunable Versions
- 110 VAC and -48 VDC Powering
- Unique In-Channel Tilt Control

PULSAR BARCO THE ULTIMATE MODULATOR

BARCO

1000 Cobb Place Boulevard
Kennesaw, GA 30144
Tel: 770/590-7900
Fax: 770/590-8836

Reader Service Number 127

"HFC's primary benefit remains its scalability."

control elements such as modulators, lasers, receivers, power supplies and all active devices past the optical node. This information would be fed back to the remote headend and provide input to the overall network management system located at the master site. A second remote headend is likely to be configured as a backup to the master location, providing an ability to receive and process appropriate satellite and terrestrial information in the event of a critical failure at the key master location.

Phase 3: Global network integration

Once information is transported to and from the home in digital form, the need for additional digital bandwidth becomes more critical. Analog broadcast modulators disappear and digital modulation becomes typical. During this phase (Figure 3 on page 48), the OTN begins housing all RF modulators, assuming equipment cost reductions follow volume increases and size is reduced.

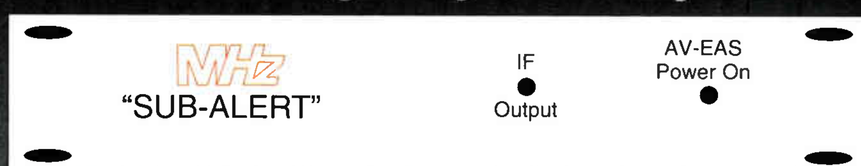
In the all-digital world, the conventional subsplit configuration (5-40 MHz and 750 MHz to 1 GHz for return path and 50 MHz to 750 MHz for forward path) can be addressed. Upstream/downstream signal requirements can be more readily balanced given node-level demand. Fiber moves even closer to the home and the coaxial bus becomes passive as all remaining RF amplifiers are eliminated from the HFC network. The high-end spectrum (750 MHz to 1 GHz) can now be effectively used for return information without the conventional problems caused by the RF amplifiers.

SONET bandwidth in both the backbone and OTN networks will remain an issue. Distributed switching, routing and grooming at remote headends need to be economically compared to deploying this equipment at the OTN to increase SONET bandwidth. Once OC-96 products are available, the trade-off between ring capacity and the location of processing equipment will need to be balanced.

Summary

Technology is moving quickly. Expectations are high. For HFC to continue evolving and integrating with the global telecommunications network, new applications, particularly those that require interactivity and high bandwidth, will continue to drive HFC deployment.

HFC's primary benefit remains its scalability. Since each broadband network provider can migrate the residential network toward a passive coaxial bus system and regional SONET infrastructure only when customers demand new services and as operational needs and revenue streams warrant, HFC can easily grow over time. By initiating the three-phase approach outlined here, broadband networks can ultimately be transformed from today's electronic islands delivering forward-only video services into the integrated, interactive platform needed to tie consumers to the overall global communications infrastructure. **CT**



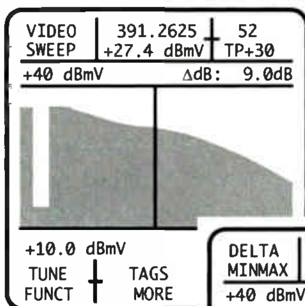
The WindowLite PLUS Enhancement That's SWEEPING the Industry!

ComSonics introduces...

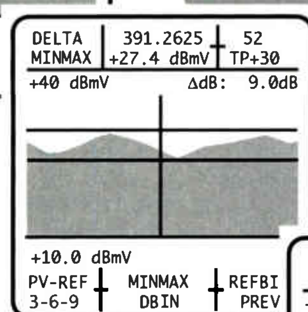
WindowLite PLUS™ Delta

The New User-Friendly Virtual Sweep Analyzer

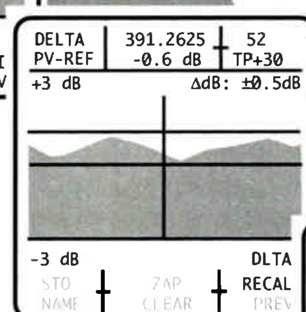
Read it...



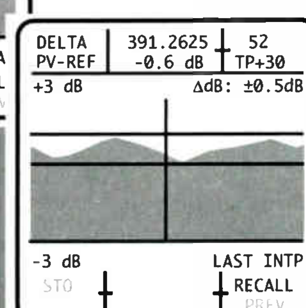
Compare it...



Store it...



Recall it!



Delta is the newest enhancement to the WindowLite PLUS™. Together with the DSR memory module installed in a line amplifier, your technicians can store, recall, and compare live and historical data both in the field and at the home office.

ComSonics, Inc.® *An Employee Owned Corporation*

We set the standards.

1350 Port Republic Road - P.O. Box 1106
Harrisonburg, VA 22801 USA
Toll free: (800) 336-9681
Phone: (540) 434-5965
Fax: (540) 432-9794

By Syd Fluck, CATV Senior Engineer, HP CaLan

PM: Tool for total quality

Over the years, there have been many papers, procedures and lectures presented on the subject of preventive maintenance for broadband networks. Many of the do's and don'ts still apply. We can see performance requirements have been increasing and that there is a demand for significantly higher reliability. How do we relate preventive maintenance with the demand for increased performance plus five nines of reliability (99.999%)?

First of all, performance and reliability are elements in determining total quality. That is, higher performance and higher reliability yields higher quality. Right? Yes, but remember to define quality from the perspective of the customer.

Quality management

Quality is conventionally looked at as goodness, but you can't manage quality with goodness as your definition. Since quality must be defined through the eyes of the customer, we could say quality then is the conformance to carefully conceived requirements. So a total quality program begins with the selection and installation of the system components designed to meet the customers' requirements, the quality is free because it is already built in, and the balance of the program is quality management or prevention.

Within the concept of quality management, the objective of a preventive maintenance program will be to find small potential problems and fix them before they reach the point of interfering with or degrading the service expected by the customers. Again, the success of such a program must be measured from the perspective of the customer. It doesn't matter if we think we are doing a good job if the customer thinks otherwise. Establish performance requirements with zero deviation as the standard. Communicate with your employees (and customers where appropriate) what is to be expected, see that it is done consistently, monitor the results and take corrective action when degradation is noted. Tom Peters, author of *In Search Of Excellence*, said, "If it isn't broke you didn't look close enough."

In one respect we have a head start. Because of the Federal Communications Commission regulations, performance requirements have been established in terms of signal (level, distortions, leakage, etc.) as well as recommended practices to measure performance.

How well do you understand your responsibility to assure compliance? The network is required to meet all performance parameters at all locations all the time, not just at specific test points at specific times of the year.

Quality management of a broadband network is analogous to the quality management of a manufacturing production line using process control. Material comes in from various sources (over-the-air, video feed, satellite, tape, etc.), it is processed to various degrees, stored in some cases, further processed and ultimately delivered to customers.

Quality management for broadband networks for the levels of performance and reliability being established must be met. The equipment is capable. The process and practice are known. The application is not just to meet an FCC requirement but to delight your customer.

Quality management will be the key to meeting this challenge. It will mean doing what you already know how to do, but do it more often and do it more effectively by controlling your process.

Get the big picture

- What measurements should be made and how often?
- What records need to be kept and where should they be located?
- How do you create a status or overview for the network's performance and trends?
- How do you use the information gathered to maintain/improve the performance and reliability of the network? →

About the only thing it doesn't deliver is pizza.

Encrypted data communications
from addressable controller to subscriber.

Extensive on-screen display
with display and graphics capability.

Multiple program guides
Interactive Electronic Program Guide with grid-type presentation.

Near-video-on-demand
field-proven technology with display schedule and enhanced pause, resume and review instructions.

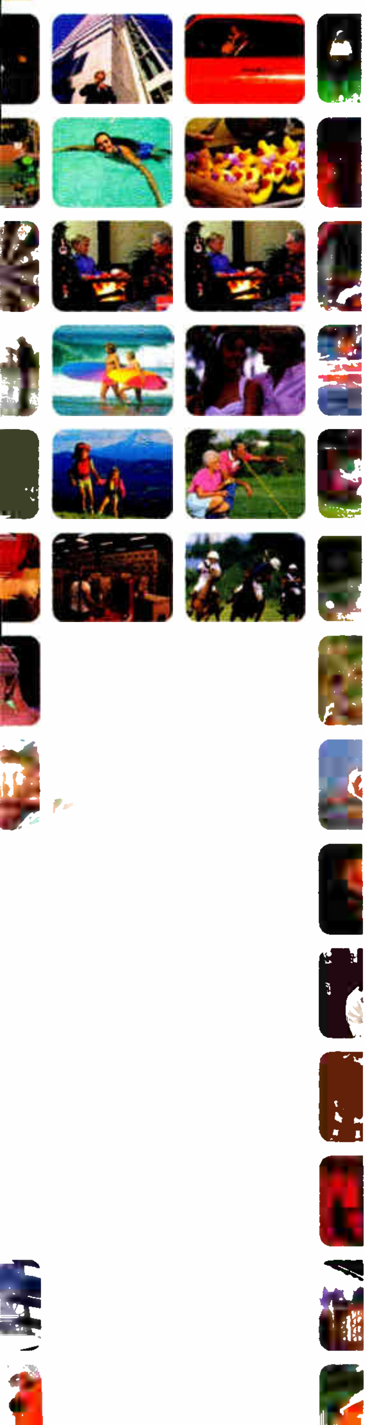
Dynamic picture shift encoding
for the ultimate in enhanced signal security.

Virtual data channels
for additional revenue generation.

As you can see, the BA-V1000 Command Station comes with the works. From its on-screen display capabilities to the security of dynamic picture shift encoding, the Command Station delivers great cable service. It's this kind of vision that keeps your customers happy. And hungry for more. When you're ready to order, just call your Pioneer regional sales manager.

PIONEER®
Pioneer New Media Technologies, Inc.

Northeast, 201-236-4186; Southeast, 614-777-7260; Mid-Atlantic, 614-777-7258; Central, 614-777-7257; West, 310-952-3063.



How many headend channels are enough?

Perhaps 80 or 100 channels still sound impressive. Until you realize GI's next-generation COMMANDER® 6 Modulators and Upconverters use 1 GHz bandwidth to push the head-end performance envelope to 161 channels (much greater with digitally compressed services). It's the new standard for giving subscribers more programming, entertainment, and information services.

What's more, GI's COMMANDER 6 Modulators and Upconverters offer you all the benefits of frequency agility without sacrificing high performance.

What about digital?

If it seems far off, think again. GI's frequency-agile upconverters handle both analog and digital signals right now. So, you won't have to replace them when you implement our industry-leading DigiCipher® and DigiCable™ technology. Now that's smart.

What about space?

GI engineers solve physical space problems at your headend or central office, too. As an example, our new COMMANDER upconverters handle two standard channels instead of one.

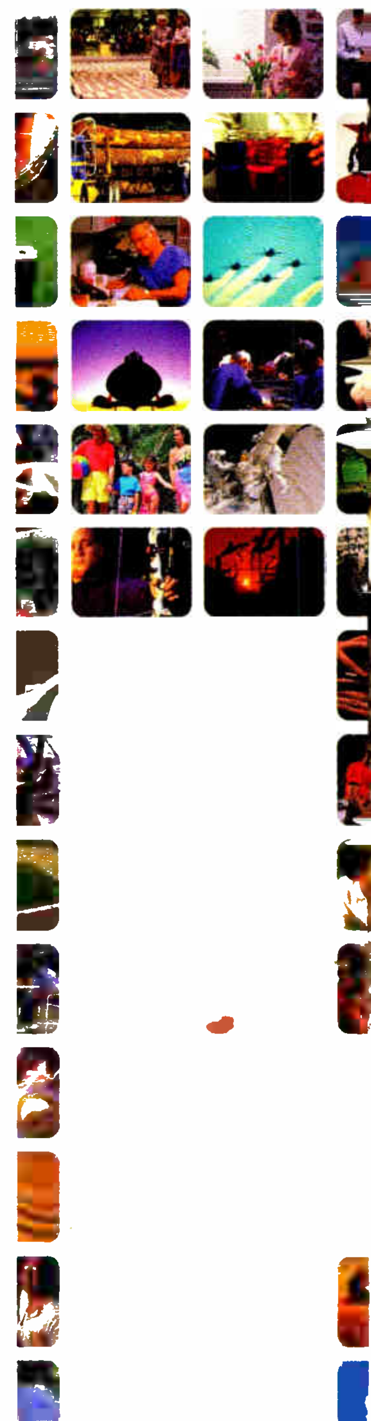
That means you can effectively double the number of channels you offer in the same physical space.

What about services?

GI provides the full range of signal origination, reception and processing products for the emerging technologies—analog and digital video broadcast, digital audio, games, data, and other interactive services. Consider our headend prepackaging service—GI's total system solution, custom-designed, assembled, tested, and delivered using GI expertise.

So, if you're looking for headend solutions with a future, look to General Instrument—the worldwide leader in end-to-end analog and digital communications systems. Call to learn more about GI's next-generation headend systems—advanced enough to be their own replacement.

New GI COMMANDER 6 Upconverter



General Instrument

(215) 674-4800 (worldwide) • (800) 523-6678 (toll-free in U.S.) • (215) 956-6497 (fax worldwide)

Reader Service Number 15

Start with asset management. That is, knowing what and where your equipment is deployed. Log serial numbers, pad and equalizer values for amplifier stations. At hubs, end-of-lines and all other appropriate locations include levels, distortion parameters, temperature, along with the date and time when maintenance was last performed.

Compare the data you get from your test equipment with the history of previous activity. Use remote monitoring and control elements to provide systemwide snapshots of status and performance, then analyze and act on this information. Be proactive. Fix the small stuff.

Make plans of daily, weekly, monthly, semiannual and annual inspections and procedures that are to be performed. Establish check lists or integrate your plans into a network monitoring software program. Review or process the data, look for trends and schedule corrective action.

Don't forget the obvious

Check routinely on standby power batteries, fuel for motor generators, pole hardware, grounding connections, heat and air-conditioning for the headend, lights, safety equipment, manuals and test procedures, loose antenna elements, tower guide lines, paint, etc. This done diligently, contributes to the quality management and an overall sense of purpose.

What about our people resource? We just do not have enough skilled technologists and the gap is growing. Smarter instruments, remote monitoring and network management tools will help to fill this gap but training our people resource also must be a priority.

Expanding on the value of quality management beyond increased performance and reliability, let's take a look at remote performance monitoring and network management from the perspective of return on investment. This includes:

• *An FCC proof-of-performance testing without rolling a truck.* Let's assume: A 50,000-subscriber network; FCC proof time for 13 test points being approximately 240 hours per year; fully loaded technician at $50 per hour. The savings is $ 12,000 per year

• *Reduced maintenance costs.* Reduced truck rolls. Problem identification prior to rolling a truck. Scheduled maintenance vs. fire drills. Let's assume: average revenue of $30 per sub per month, $18 million per year total; maintenance costs are 10% of revenue or $1.8 million per year; monitoring saves 15% of maintenance cost. Therefore, net savings are $270,000 per year.

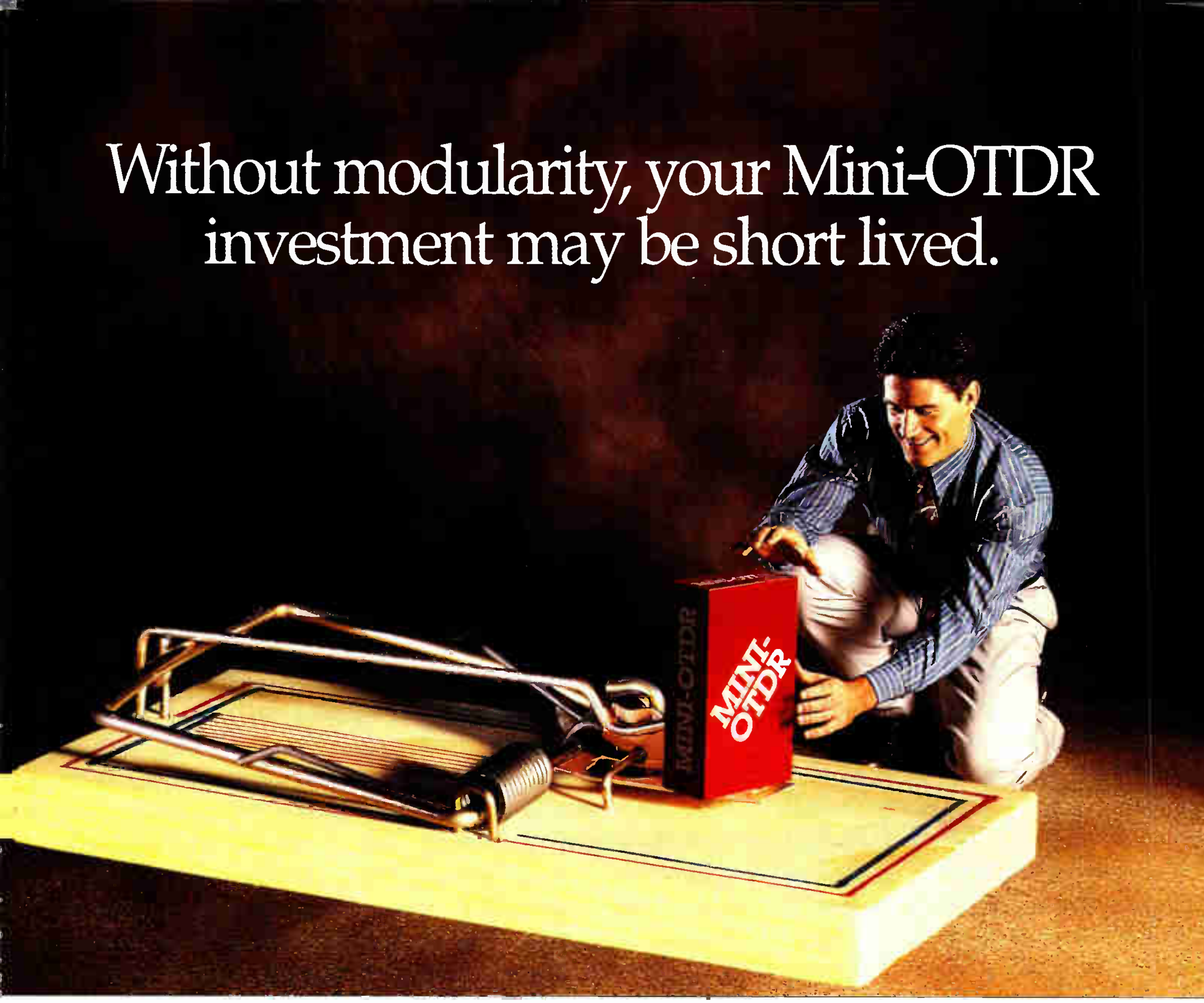
• *Increased customer satisfaction.* Lower customer turnover. More services ordered. Greater market share. Let's assume: higher system quality generates $1 per subscriber per month additional revenue. The result is $50,000 per month, $600,000 per year.

To sum up the total annual return: $12,000 on FCC proof testing; $270,000 on reduced maintenance costs; $600,000 on increased customer satisfaction. That's a net return of $882,000 (amortized deployment expense ± incremental support expense).

Summary

While the value assumptions may be challenged, the necessity to develop a total quality perspective for preventive maintenance should clearly present a bridge to a more proactive maintained network. The program starts with the customers requirements and expectations and will be successful if we learn to commit ourselves to total quality management for continuous improvement. **CT**

Without modularity, your Mini-OTDR investment may be short lived.



Anritsu's MW9070 Modular Mini-OTDR. It answers your needs today...and tomorrow.

Don't fall into the trap of buying a Mini-OTDR with no future. There's only one Modular Mini-OTDR that won't let new technology pass you or your equipment by—and that's the MW9070. Modularity keeps you current with OTDR advancements in dead zone, dynamic range, etc. The mainframe and user interface are also a powerful platform, able to support other measurement applications you come up against down the road.

Maximum Modularity.

Only our MW9070 gives you the platform for the future with field-changeable components:

- Optical modules
- Battery modules
  - NiCd (rechargeable)
  - Dry Cell (alkaline)
- Visual light source— 635 nm
- Optical connectors

Upgrade in the field.

Hardware reconfigurations and software upgrades can easily be completed in minutes, so craftspeople will spend valuable field time *using* the MW9070.

Anritsu's MW9070 Mini-OTDR. The end of absolescence is just a phone call away.

For detailed literature or a hands-on demonstration, contact us at 1-800-230-AWSC (2972).

Reader Service Number 50

Anritsu Wiltron

- **U.S.A.** (800) 230-AWSC
- **U.K.** (0582) 418853
- **Italy** 06-502-26-66
- **Canada** (905) 890-7799
- **Germany** (0211) 679760
- **Japan** 03 3446-1111
- **Brazil** (021) 286-9141
- **France** (1) 64-46-65-46
- **Asia-Pacific** 81 (3) 3440-2770

By **Anthony Black,** Service Center Manager, Cox Cable Louisiana, **Dean Kinzel,** Technical Trainer, Cox Cable Louisiana,
Ron Zimmerman, Plant Maintenance Supervisor, Cox Cable Ocala/Formerly with Cox Louisiana, **A.J. Finnin,** Vice President of Marketing, IDK Technologies Inc.

Premature failure of batteries: A case study

Cox Cable of Louisiana serves over 235,000 subscribers in New Orleans and the surrounding communities. Battery backed-up power is supplied to the cable distribution system by a mixture of power supplies. This backup capability is taking on increased importance with the installation of fiber-optic cable. There are over 1,200 power supplies in the system, each equipped with two or three 90 amp/hour absorbed glass mat (AGM), valve-regulated lead acid (VRLA) batteries. At Cox we have determined that by far the major cause of standby power failure was due to failure of the system's batteries.

Cox, like all cable companies, is very concerned about the quality and reliability of the service we provide to our subscribers. We are of course also interested in providing this service at the lowest possible cost so we are always looking for ways to improve service and reduce cost.

In the middle of 1994, after completing an upgrade of many of our power supplies, we decided on a program to monitor the life of the batteries used in the power supplies. This program was initiated when we realized how many of the batteries that had been in service in the old power supplies had an average in service life of 2.5 years or less. According to the manufacturer, the battery we use is designed and rated with an operating life of 10 years. Why, then, are we having to replace them every two to three years? How much money could we save if we could extend the life of these batteries one or two life cycles?

"System reliability will improve and emergency service calls will decrease."

What is the failure mode of the batteries? Have we misapplied the batteries? Is there a problem with our power supplies? Is our power supply maintenance program adequate? Is it possible/recommended to perform preventive maintenance on so-called "maintenance-free" batteries? If so, what maintenance should be performed and at what interval? How are we going to find an answer to these questions?

We contracted with a local company, IDK Technologies Inc., to establish a program for:

- Testing all batteries removed from service to determine their failure mode.
- Reporting periodically on the results of this testing.
- "Rejuvenating" and returning batteries that are sulfated but restorable.
- Investigating the cause(s) of the battery failures.
- Developing strategies to reduce or eliminate the failures.
- Designing a preventive mainte-

I TAKE A GOOD LOOK AT OUR NEW POLYETHYLENE ENCLOSURES.

Channell Commercial's high quality ABS plastic enclosures are well known in the industry and are used extensively throughout the world. Now, we've added a new series of enclosures to meet the needs of our economy-minded customers: The Economy Pedestal Housing (EPH™) Series of high production, injection-molded polyethylene enclosures for housing taps and splitters. They're engineered and manufactured to our usual high standards in our own facilities, but designed for applications where security is not a major concern.

EPH Series enclosures feature constant wall thicknesses and include many of the other features found on our most popular Signature Series (SPH™) enclosures. These cost-competitive polyethylene enclosures have the highest possible UV protection, yet are far superior in design to any existing polyethylene enclosures found in the industry today.

When economy is a factor and security is not a major concern, take a good look at Channell's EPH Series of polyethylene enclosures. Call toll-free today for complete information.

Trap Mounting Bracket

Universal Locking Plate


Optional Trap Holder


Temporary Drop Entrance


Optional Wire Organizer

U.S.A. 800/423-1863 • 909/694-9160 • FAX: 909/694-9170
CANADA 800/387-8332 • 905/567-6751 • FAX: 905/567-6756
U.K. +1 44 171 589 3304 • FAX: +1 44 171 589 1021
ISRAEL 972 4 341329 • FAX: 972 4 341387

CHANNELL
COMMERCIAL CORPORATION

Reader Service Number 125

nance program to implement these strategies.

In the remainder of this article we will discuss our progress to date on this project.

Testing the batteries

In order to collect data on batteries removed from service in a consistent manner, a multiple step testing and data recording procedure was developed for the AGM batteries. Some of the more significant steps are as follows.

Inspect the battery for obvious signs of physical damage such as punctures of the case and bent or broken terminals. Inspect for signs of overcharging, overheating, venting or explosion such as concave or convex case sides and vertical splitting of the case along cell boundaries. Reject any batteries that do not pass visual inspection.

Measure the open circuit voltage (OCV) of the battery using a digital voltmeter and the load voltage (LV) using a 50 amp load tester for 10 seconds. Reject the battery if the OCV is less than 11 volts or if the LV is less than 9 volts.

Charge the battery with a conventional 20 amp automatic cutoff DC charger until the charger cuts off. Disconnect the battery from the charger.

Measure and record the open circuit voltage and load voltage on a battery data sheet. Discharge the battery to a terminal voltage of 10.5 volts under load using a fixed 25 amp timed discharger. Record the time to discharge to 10.5 volts on the battery data sheet. Disconnect the battery from the discharger.

These tests allowed the state of health of each battery to be determined in an objective manner and to divide them into categories for tracking. A summary of the data collected on batteries processed during the first six months of the program is provided in the next section.

Reporting of battery data

A data collection and reporting system was developed that included the generation of a spreadsheet-based data base that contains a tracking number for each battery processed along with the battery's age and test data. This data base along with a set of reports is compiled on a quarterly basis. The accompanying table is an example of one of the reports and summarizes the status of the batteries processed during one reporting period.

A quick analysis of this data reveals that over 50% of the batteries suffered catastrophic damage while in use. Analysis indicates that the batteries with signs of overcharging and/or overheating were the result of high float voltages in the power supplies in combination with high ambient temperature conditions.

Code	Description	Total	Percentage
1	Suitable for cable use	150	25%
2	Suitable for other use	11	2%
3	Failed discharge test	10	2%
4	Failed OCV or LV test	88	15%
5	Physically damaged	13	2%
6	Overcharged or overheated	212	35%
9	In process	78	13%
10	Non-AGM battery	40	7%
	Total	*602*	*100%*

"Rejuvenating" batteries

The batteries that were deemed "suitable for cable use" were "rejuvenated" by IDK using its pulse amplitude charger conditioner (the Rejuvenator) and retested to ensure their reserve capacity was adequate to be returned to service. A description of unveiled a fiber-optic transceiver designed to provide bidirectional single fiber, single wavelength transmission capability for high-speed data LAN or Internet service. The CyberFiber product is a direct response to the recent announcement from 15 of the top cable operators regarding plans to create cyber schools with high-speed links to the Internet.

The CyberFiber1000 Series is completely compatible with all RF data modems that operate in the 15 to 550 MHz frequency range. The CyberFiber products also provide additional capacity that can be used to deliver FM-modulated video and audio simultaneously with the bidirectional data service. This combined service package is said to provide cable companies with an extremely cost-effective approach for establishing a high-performance interactive presence in their communities.

The CyberFiber design allows the installation of interactive high-speed data using one fiber strand operating only in the 1,310 nm fiber window. The single wavelength, bidirectional service allows the 1,550 nm window to be reserved across the network for other needs of service upgrades. Model CF1015 can transmit over a 15 dB 1,310 nm optical budget with symmetrical full-motion video, audio and high-speed data. CF1015 transceivers are available in quantities for under $1,250 per unit.

Reader service #306

Flex clips

The single flex clips from Telecrafter Products are now in full production and ready to ship. The new clips are said to provide long-lasting, damage-free holding power.

Manufactured of a durable, UV-stabilized polyethylene, the flexible clip wraps around the cable, adjusts to size, and holds securely with no compression of, or crimping to the cable. The material is strong but pliable and can adapt to most sizes of single coax. The clip accommodates an additional wire so it can be used to install a messengered cable or coax with a ground wire.

Because the pliable material will not crimp, pinch, compress, cut into or damage the cable in any way, signal integrity is not compromised. This is increasingly important as more and more operators go to digital signal technology and upgrade for increased bandwidth.

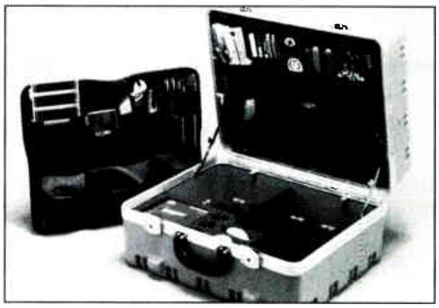
An installation feature is that each pre-inserted screw clip will fit a Phillips-head, slotted-head, or hex-head screwdriver.

Reader service #305

Digital SLMs

Sadelco announced that all of its Minimax signal level meters (SLMs) can now read digital channels. This new feature provides accurate reading of the average power of all digital channels. A single keystroke tells the Minimax that the tuned channel is digital. The Minimax then automatically makes the corrections and displays the average power of the digital signal.

Reader service #304



Fiber kit

The JTK-4000 fiber-optic termination fit from Jensen Tools is now offered with an enhancement package that is said to give all the facility of a complete fiber workbench in the field.

The product contains a standard selection of 38 basic tools that the client is invited to supplement with the fiber termination tools and accessories of their choice. The kit is housed in a super tough case with plenty of room for additional tools and test equipment. Basic components include a cable tie tool, ties and labels, coax cutter, tape dispenser, fiber scribe, hook blade knife, micro fork and reamer, penlight, pliers, polishing film and plate, fiber-optic scissors, spudgers, adjustable wrench, wire the steps in the process follows:

1) Rejuvenate the battery until the LED "float condition" indicator shows that the battery will not accept additional energy.

2) Measure and record the OCV and LV on the battery data sheet.

3) Discharge the battery using a fixed 25 amp load discharger. Record the time to discharge on the battery data sheet. Disconnect the battery from the discharger.

4) Repeat Steps 1 and 2.

5) If OCV is ≥12.6 volts and LV ≥11.8 volts and discharge time measured in Step 3 equals the rated reserve capacity of the battery, then the process has been successful, so go to Step 6. If the previous criteria have not been met, go to Step 7.

6) Return battery to service after the serial numbered rejuvenation date tag has been placed on battery.

7) Install rejection label and move it to the recycling collection area for disposition.

Corrective action

A large percentage (over one-third) of the batteries processed during the first six months of this project could not be recycled because they were overcharged or experienced overheating. It was decided to focus the investigation on the cause of this problem due to the magnitude of the number of failures due to overcharging.

Overcharging is usually caused by batteries being left in float application for extended periods of time with an excessive float voltage applied to the battery. This problem can be compounded by high battery temperatures. The higher the temperature, the lower the float voltage has to be to maintain the battery at full charge.

We held meetings with our field service technicians to discuss these problems and to learn what procedures they were using to identify "weak" batteries, what their criteria was for replacement of these batteries and what the replacement policy was (e.g., replace the weak battery only or replace the entire set.)

It was learned that the batteries that were processed had been used in several different types of power supplies and that the technicians periodically test the batteries at each power supply and record the measurements on a form in a nonstandard format. There seemed to be differences from technician to technician in the procedure each followed to test the batteries, record data, the type of test equipment employed and battery replacement criteria and policy.

The next step was to inspect a sample of the three types of power supplies that are in widespread use in the system. Tests of these units indicate that the "two-battery" model is maintaining the batteries at a float voltage of 13.2 volts per battery. The "three-battery" models are typically floating each battery at over 14 volts per battery. A float voltage of 13.2 is ideal so no changes are necessary for these units. The 14 volts is much too high in the other power supplies and must be corrected.

Armed with this information, a set of recommendations were developed that will rectify the causes of battery overcharging and improve the preventive maintenance program so "weak" batteries can be identified before they fail and while they can still be saved.

The recommendations are as follows:

• Use the new preventive mainte-

Introducing Zenith MultiMedia. Power your way to new cable revenues. Today.

Zenith Network Systems has developed the first real-time, two-way interactive analog system that offers you nearly every revenue-generating service associated with digital.

And, since it's analog, you can install it at a fraction of the cost.

What's more, it's technology that's here, technology you understand, technology that's ready to install. Today.

The MM2500™ Set-Top

Our MM2500 set-top is an addressable, broadband, stereo-compatible unit that offers you two distinct advantages.

It is the only fully-downloadable, software-driven set-top, so you get full, diverse control from the headend.

And the MM2500 set-top is the only analog unit that supports revenue-generating real-time, two-way interactive services...the unregulated sources of revenue so essential to your growth and survival in today's competitive environment.

The ScreenPlay™ Authoring Tool

The ScreenPlay Authoring Tool is an easy-to-learn, easy-to-use Windows™ based system that lets you creatively customize on-screen displays downloaded to the MM2500 set-top.

It comes with a wide variety of characters and other graphic devices built-in, while allowing you to scan in virtually any graphic you might choose.

Real Revenues Today. And Tomorrow.

While getting ready for the digital future, the MM2500 set-top can begin to generate new sources of real revenues today.

- Expanded promotion of PPV
- Interactive program guides
- Bulletin boards and messaging
- Interactive shopping and games
- New advertising options
- Near video-on-demand

Equally important, the MM2500 set-top can be a pathway for you — and your customers — to the digital future.

Plug In To The Power.™

New technologies make way for new ways of making profits. And leading the way in technological advancements is, of course, something Zenith has been doing for over 75 years — another reason to plug in to the power of Zenith.

To learn more and to receive our free information kit, just call us today at 1-800-239-0900.

ZENITH
WATCH US.

Reader Service Number 188

C9517-

nance procedure that includes battery preventive maintenance steps.

- Perform preventive maintenance on all the batteries in the system at least twice and preferably three times a year.
- Identify and replace "weak" batteries before they fail in accordance with a policy that calls for processing all batteries after two years of service using the pulse amplitude chargers.
- Begin a program to recalibrate the battery charger modules in the "three-battery" models of the power supplies.

In order to facilitate the implementation of these recommendations we have developed a detailed implementation plan and schedule consisting of the following steps:

1) IDK personnel will work with Cox technical personnel to review and finalize the new preventive maintenance procedure referenced before.

2) Training classes for Cox technicians on battery preventive maintenance will be conducted.

3) Cox Cable will make arrangements for the recalibration of the charger modules in the "three-battery" power supplies.

4) IDK will develop a tracking and reporting system to monitor the progress on the implementation of the plan.

Preventive maintenance program

The following is a preliminary version of the preventive maintenance procedure for power supply batteries used by Cox Cable of Louisiana. This procedure will be used as the basis of the preventive maintenance training class as well, so it includes a section on battery theory to provide a foundation of understanding on which the class and procedure will be built.

Battery theory

The chemical reaction in all lead acid batteries produces a terminal voltage of 2.2 volts per cell. The greater the surface area of the plates, the higher the current the battery is capable of producing. The thicker the plates, the longer the battery can supply its rated current. The discharge time at 25 amps is a measure of the battery's capacity usually stated in amp/hours.

Since the nominal cell voltage of a fully charged battery is 2.2 volts, the voltage of a so-called 12 volt battery (which has six cells) will be 13.2 volts. This is defined as the float voltage of the battery. When the battery voltage reaches a level above the recommended float voltage, overcharging will occur.

Sulfation is a process that occurs naturally in a battery as part of the charge/discharge cycle. During discharge, lead sulfate is deposited on the negative plates of the battery. As the battery is charged, most of the sulfate is returned to solution in the electrolyte. Repeated charge/discharge cycles increase the amount of sulfation as does undercharging and allows a battery to stand in a discharged state for extended periods of time. As the sulfation increases, the capacity of the battery is diminished, and the voltage necessary to fully charge the battery increases. This is a result of the increased internal resistance of the battery.

Multiple batteries installed in a series configuration such as a cable TV power supply will not charge equally if each has a different internal resistance. This condition can be determined by measuring the voltage across each battery while in circuit with the power supply on.

Periodic rejuvenation of batteries restores their capacity, reduces their internal resistance, and makes it easier to match them for service.

Procedure

Check the voltages on each individual battery while in float. This will tell you which battery is starting to increase its internal resistance (sulfating). Check overall voltage across all batteries while in float. This will tell you what the total output of the charging unit is. This should be adjusted to 39.3 volts (26.2 volts for 2 battery systems).

Check load voltage on each battery. To check load voltage you first have to remove the surface charge. To do this you load the battery with a 50 amp load for several seconds several times or until the OCV reaches the same point after load is removed (usually 12.4 to 12.6 volts). At this point you apply a 50 amp load to the batteries for 15 seconds. Batteries with a load voltage below 11.6 volts needs to be removed from service, tested and rejuvenated.

If batteries are above 11.6 volts (under 50 amp load), check date code. Batteries that have been in service two or more years should be pulled from service. These batteries are probably stressed.

After all batteries have been brought up to good condition, it is necessary to pull and cycle batteries on a two-year basis (or when load voltage is at or below 11.6). Complying with these steps ensures the successful recycling of the battery and will achieve a greatly extended service life.

Conclusion

Although this is a project that is far from complete, some important lessons have already been learned. In order to maximize the useful life of batteries in cable TV power supply applications, it is necessary to perform preventive maintenance on the power supplies and the batteries installed in them.

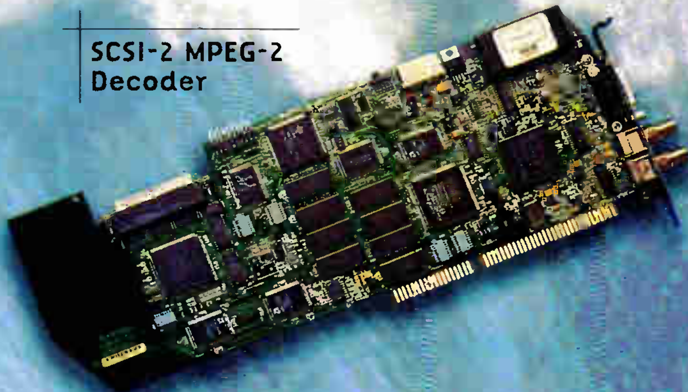
A preventive maintenance program tailored to the types of power supplies and batteries in your system will make it easier for your technicians to identify and correct potential problems before they cause a system outage. As well, system reliability will improve and emergency service calls will decrease. **CT**

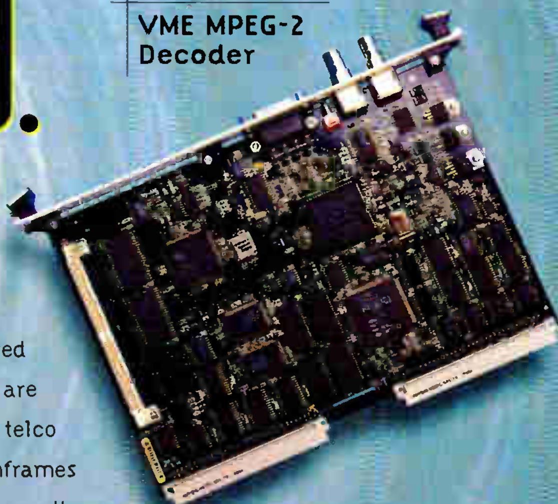
Although not mentioned in this article, it is important to note the specific models of batteries and power supplies involved since the results achieved by Cox and IDK may be related to them.

The batteries referred to in the paper are Johnson Controls Dynasty Model UPS 12-275. The "two-battery" power supplies are Lectro Model ZTT. The "three-battery" supplies are a mixture of Lectro Super Sentry II and Unimax models.

If you have any questions about this article you can contact the authors at Cox Cable Louisiana, 2120 Canal St., New Orleans, LA 70112, (504) 734-7345; or IDK Technologies Inc., 2301 Poydras Center, 650 Poydras St., New Orleans, LA 70130, (504) 524-3532.

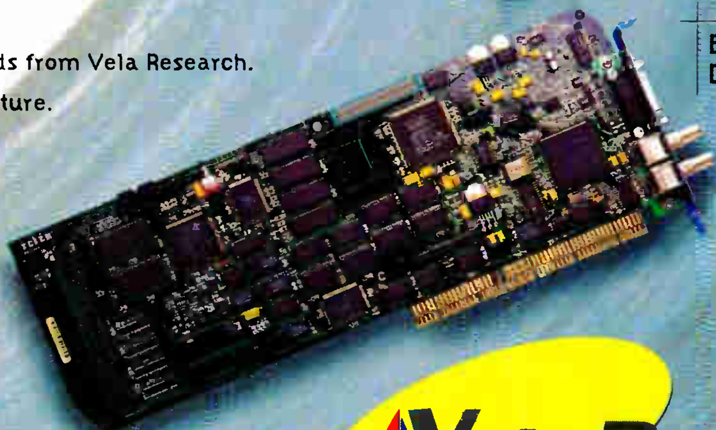
It's Only A Good Wave... If You're Using The Right Board.


SCSI-2 MPEG-2 Decoder


VME MPEG-2 Decoder

In a sea of video technology, you could sink or swim based on the choices you make. Our engineers and scientists know the right equipment makes a big difference when it comes to performance. In a business where speed and efficiency mean money, you'll appreciate how we've revolutionized the MPEG-2 decoder environment. Our single board, audio/video decoders are designed for a wide range of television entertainment, broadcast, cable, telco and video production applications. Computer platforms from Mac's to mainframes can now become multimedia servers...with products from Vela that address the PCI, EISA, VME and SCSI architectures.

Versatile, flexible MPEG-2 decoder boards from Vela Research.
The right boards...for the wave of the future.


EISA MPEG-2 Decoder


The Wave Of The Future.™

Vela Research™
The Wave Of The Future.™

1•813•572•1230

To get all the facts, call Rick Chile, Director of Sales.
2501 118th Avenue North • St. Petersburg, Florida 33716
See us at COMDEX, booth M6506

Reader Service Number 96

By **Mike Blankinship**, Field Engineer, Magnavox CATV Systems U.K. Ltd.

Simple trunk and feeder PM

Keeping your CATV system in top condition requires a preventive maintenance (PM) program that includes the following steps: 1) Keep accurate records; 2) Set up a maintenance schedule that fits into the work flow; 3) Make consistent checks on signal levels, voltage, distortions and picture quality.

The first step is to keep records for each amplifier with which you can compare current measurements to those in the past. Significant changes in the readings can indicate problems.

Second, you need to set up weekly maintenance. For example, take the number of last amplifiers in the system and divide by the number of work weeks per year you can do some maintenance (about 40). This is the number of amplifiers you should check per week. Then divide this number by the number of techs available. This is the number of amplifiers each tech should check per week. Then, organize your last amplifiers by geographical area so you can assign techs to amplifiers in the same area, saving drive time. Keep in mind that you should check every last amplifier at least once a year, you should check different amplifiers in the same geographic area at least once a quarter, and you can expect to spend about 10-30 minutes at each amplifier (unless you uncover a problem).

At every last amplifier you'll need to measure and record signal level at all channels, voltages, carrier-to-noise ratio (C/N), composite triple beat (CTB) and composite second order (CSO). For these tests you'll need, at minimum, a signal level meter (SLM), graph paper (or use an SLM with memory and a printer) and a voltmeter. For more accurate measurements, consider using a spectrum analyzer with a printer and a tunable bandpass filter instead of the SLM.

Once you've finished each test, record your results and compare them with your records for that amplifier. If you uncover changes that could cause problems for your subs, backtrack and find the source. To pinpoint a problem, try the "binary" method of troubleshooting. Determine which amplifier is halfway between your location and where the cascade begins. For example, if you're at Amplifier 16, check Amplifier 8. Continue to halve the distance until you find the amplifier you need to repair.

Levels of all channels

Make a sweep trace using an SLM to measure the level at each channel and graph paper to record measurements. A broadband sweep system is best for evaluating the full spectrum because an SLM won't show what's going on between carriers. Although you can expect small changes, significant ones can indicate one of these problems: suck-outs, low signal levels, high signal levels, incorrect tilt in the signal, cracked cables or bad connectors. When recording the measurements, note the outside temperature to see how it affects signal levels.

Measure the voltage

Although you need a true RMS voltmeter for an accurate voltage reading, you can use a standard voltmeter for these maintenance tests because you are only looking for changes. But, you must use the *same* standard voltmeter whenever you test that amplifier. Even small changes in voltage should be checked. Voltage changes indicate cracked cable, corroded connectors or a line power supply in need of repair.

Check the C/N

To measure the C/N, you need a reference signal that is at least +20 dBmV and an SLM. Follow the manual's instructions or try this method. Tune the SLM to a channel that has no lower adjacent channels and is not next to the bandsplit; record the carrier level. Setting the SLM to the space where there is no channel, tune back and forth for the lowest reading you can find. Reducing the attenuation, tune back and forth again, until you get a constant reading; this is the noise floor. The difference between the carrier level and the noise floor, minus a correction factor, is the C/N value. For best results, subtract the correction factor published in the meter's manual. A tunable bandpass filter probably will be necessary to avoid overloading the SLM when measuring noise.

A bad C/N reading indicates you have a low input to one or more amplifiers in the cascade. Low input to an amplifier can have several sources, including water in the cable, water in the splitter, a corroded connector or an improperly set or defective amplifier.

Check the CTB

With the same reference signal you used for the C/N measurement, tune the SLM to a vacant channel, where you would find the carrier frequency. The signal you find there is the CTB.

A low CTB ratio indicates you have too high of an output from one or more amplifiers, which can be caused by an AGC error in the amplifier or an improperly set or defective amplifier. A tunable bandpass filter probably will be necessary when measuring the CTB.

Check the CSO

Using the same reference signal, tune the SLM 0.75 or 1.25 MHz from the vacant carrier. (CSO is found ±0.75 and ±1.25 MHz from the video carrier.) This is second order. If you subtract this reading from the video carrier reading at the adjacent channel, you have a good indication of the CSO. A poor CSO measurement often indicates a defective or improperly set amplifier or problems with a fiber link. You can perform these distortion tests with a spectrum analyzer, but you need a tunable bandpass filter set to a vacant channel. When using a spectrum analyzer, remember you are working with active video. You need to take measurements when sync is high. Use a slow sweep and wider resolution bandwidth setting to see when sync is high, and you may want set the spectrum analyzer in "max hold" mode. Record the levels and keep your records.

Picture quality

Finally, check picture quality. Use a quality portable TV set and a converter to tune channels. (This will minimize direct pickup.) Make sure the signal levels at the input to the converter do not exceed +5 to +10 dBmV. Record comments about the picture quality along with measurement results from your other tests. **CT**

From source to subscriber, only Tektronix helps you maximize signal quality. And customer satisfaction.

The all-new VM100 Video Measurement Set combines automated one-button testing, VITS signal ID, remote control capability, and Tektronix measurement accuracy in a highly affordable instrument.

The rugged RFM150 SignalScout™ signal level meter automatically performs a wide range of advanced measurements with unmatched simplicity.

In today's increasingly competitive cable TV industry, the key to keeping your customers happy — the key to keeping your customers period! — is better signal quality and more reliable service.

Fortunately you can turn to Tektronix for all of your testing needs. From installing and maintaining the cable plant, to monitoring and verifying the video/audio signal itself. Literally everything, from the headend to the home.

Today, Tektronix remains the industry standard to which all others are compared, from RF and digital transmission testing to the very latest in broadband and digital compression technologies. Tektronix is the name the television industry turns to. To win customers. And keep them.

For information on Tektronix communications test solutions, just call 800-426-2200. (When prompted, press "3" and ask for program 441.) Or, find us on the Web at http://www.tek.com/mbd/w441

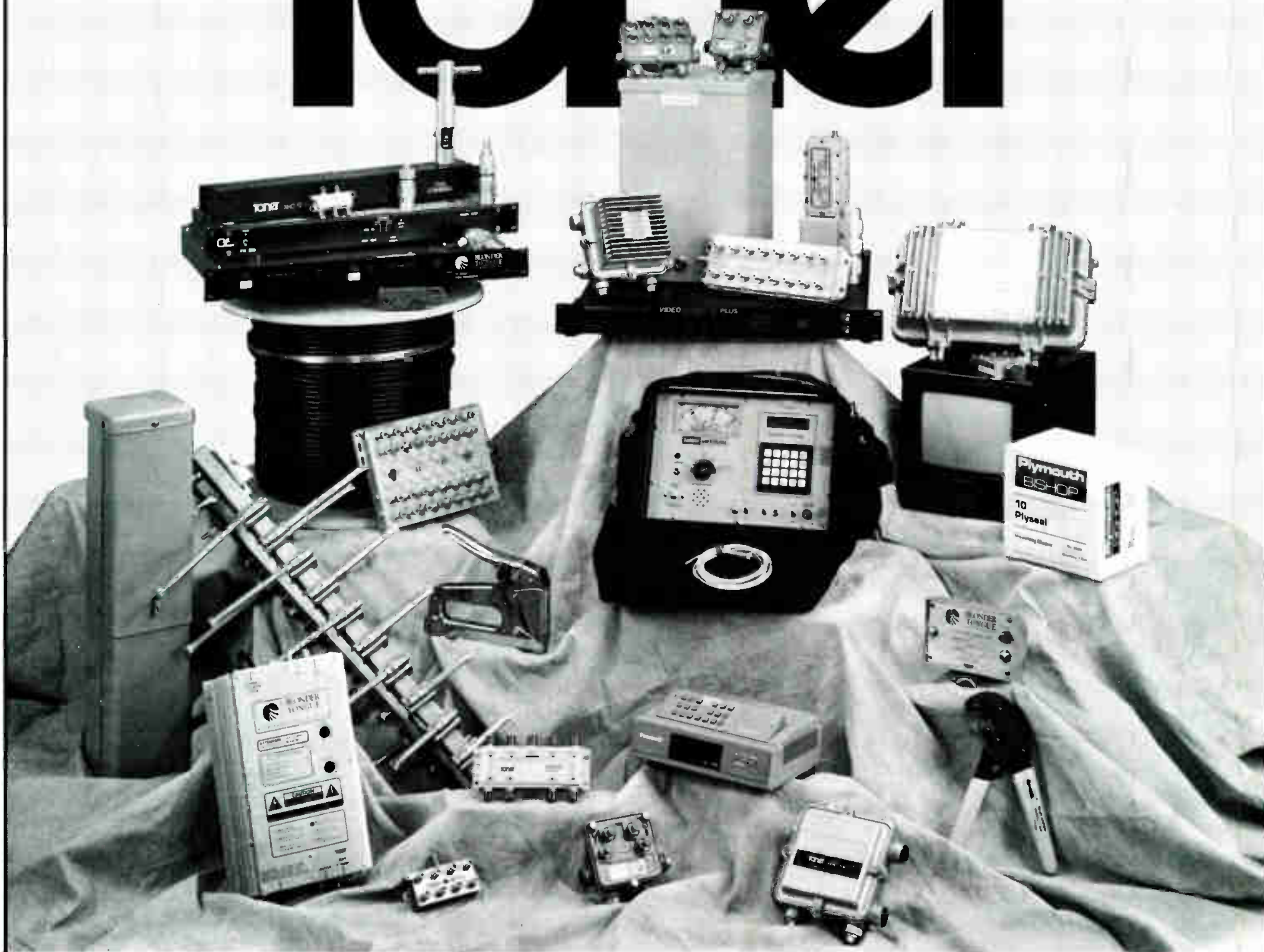
TESTING THE CHANGING WORLD OF COMMUNICATIONS

Tektronix

Reader Service Number 185

just a few of over 2,000 cable-tv products available from

Toner



Successfully serving the cable-tv and telecommunication industries for over 23 years.

Call for your FREE copy of the best catalog in the industry

Toner

cable equipment, inc.

969 Horsham Road • Horsham, Pennsylvania 19044 • USA

USA NATIONWIDE: 800-523-5947 • FAX: 215-675-7543 • WORLDWIDE: 1-215-675-2053

Reader Service Number 101

By Randy Goehler, Senior RF Technician, Cox Cable San Diego

Measuring optical return loss

Reflections in optical links from fiber, connectors, components and splices can decrease system performance by increasing the noise. Many of today's CATV headends utilize 1,310 nm distributed feedback (DFB) lasers with narrow linewidths and single-mode fiber to transport AM-VSB carriers. Although lasers are isolated from the fiber link, reflected power can be coupled into the laser cavity depending on the quality of the laser's isolator and the magnitude of the reflected signal. In extreme cases, power reflected back into the laser can create intensity fluctuation and spectral broadening in the laser output. This power reflected back to the source from the fiber and discrete reflections can be measured as optical return loss (ORL).

Reflected power occurs from the effects of both Rayleigh scattering and Fresnel reflections. Rayleigh scattering is created by microscopic impurities in the fiber. It occurs when light is scattered in all directions by the fiber. Fresnel reflections develop when light travels between two materials with different refractive indices (such as an air gap that occurs between mated connectors). In these cases, light is reflected back to the source.

Two terms should be understood when examining reflections in an optical link: reflectance (R) and optical return loss (ORL).

Reflectance, expressed in negative decibels (dB), is the ratio of the reflected power P_{rfl} to the incident power P_{inc} at a reflection point or component.

$$R\ (dB) = 10\log(P_{rfl}/P_{inc})$$

Where:
R = Reflectance given in negative decibels
P_{rfl} = Reflected power
P_{inc} = Incident power

ORL is the ratio of total reflected power from discrete reflections and fiber backscatter to the incident power in an optical link.

$$ORL\ (dB) = 10\log(P_{rfl}/P_{inc})$$

Where:
ORL = Optical return loss given in positive decibels
P_{rfl} = Reflected power
P_{inc} = Incident power

Often in manufacturer literature the term reflectance is replaced with ORL or just return loss (RL). Therefore, we will call measured discrete and combined reflections in an optical link ORL.

The goal of the technician is to keep reflections to a minimum so they do not impact link performance. For example, the ORL for 10 km of fiber is 34 dB, but each mechanical splice and connector in the link will add some level of reflectance that will degrade the link ORL figure. There is little contribution to the carrier-to-noise in the optical link when connector and splice ORL values are kept ≥55 dB.

ORL values for connectors have decreased over the years with improved polishing techniques. Return loss values for today's connectors approach the fiber backscatter level, which is 69 dB ORL for 1 meter of fiber. For some types of connectors, ORL values approach 55 dB for super physical contact (SPC) and 70 dB for angled physical contact (APC). Mechanical splices can achieve ORL values of >55 dB. Fusion splices reflect very little light because there is no air gap between the fibers. Technicians can quantify how reflective an optical device or link is by measuring the ORL.

Measuring methods

There are two common methods to measure ORL:

1) Performing procedures outlined in Electronic Industries Association FOTP-107 using a 2x2 coupler, stable light source and optical power meter, and

2) Using an optical time domain reflectometer (OTDR).

A modified version of FOTP-107 is given as follows:

- Step 1: Connect optical power source to Port A, power meter to Port C and terminate Ports B and D. Record power at Port C as P_O. See Figure 1.
- Step 2: Connect optical power source to Port A and power meter to Port B. Terminate Port C and D. Record parasitic power P_P at port B. See Figure 2.
- Step 3: Attach device under test (DUT) to Port C with the optical power source and power meter connected to Ports A and B, respectively. Record power at Port B as P_B with

Figure 1: Reference power

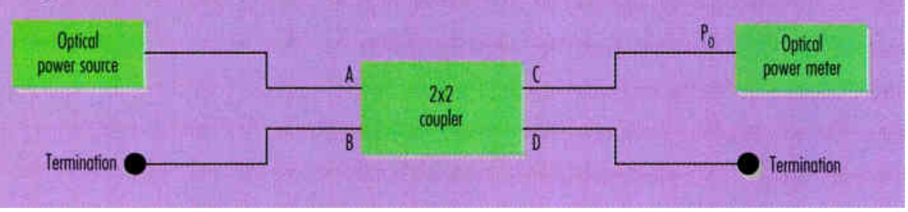
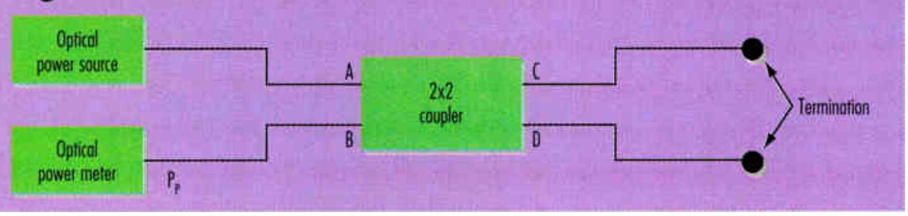
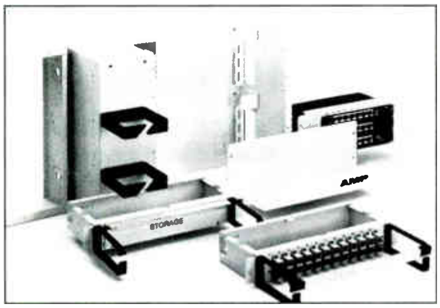


Figure 2: Parasitic reflection



strippers, tweezers and more. Now the optional package also provides a complete Fiber-Vue microscope kit, a curing oven, an AMP crimping tool, plus two fiber cable test instruments from Darkstar Technologies.
Reader service #303



Cable management

AMP Inc. introduced its wideband integrated management system (WIMS) that offers flexible, modular cable management regardless of application, cable type, storage location or future modifications.

It features a compact management module that accommodates fiber, UTP, coax and active electronic components. It also supports passive branching devices, splicing and cable storage. Each module mounts individually in a three-mount module high wall frame, or in a six-module high chassis, which provides integral vertical and horizontal cable management with front and rear accessibility.

According to the company, WIMS offers consistent form factor and cable management. This modular uniformity standardizes design, installation and craft practice, resulting in a flexible, easy system. Expansions and modifications simply involve screw-in of new system modules.
Reader service #302

Ingress monitoring

Introduced by SAT was its new SAT 330-CTMS21 for monitoring ingress on multiple nodes, 24 hours/day, seven days/week. The system is designed for use at the headend on the return path of hybrid fiber/coax (HFC) systems.

It is a completely automated system that uses SAT software to provide powerful monitoring capabilities to capture interfering signals in the presence of desired signals. Users can select multiple alarm actions to alert and report when ingress has been detected. Actions include storing spectral traces, calling a pager and writing to an alarm log. Fast processing of data results in monitoring four nodes/second.

The SAT software runs on an IBM-compatible PC under Microsoft Windows. The systems use a Hewlett-Packard spectrum analyzer for superior RF performance and an Electroline programmable RF switch for fast switching speed and optimal price/performance trade-off. Users can suspend automated monitoring and manually control the spectrum analyzer, and switch from the computer for troubleshooting ingress on a specific node.
Reader service #301 →

Figure 3: Device under test

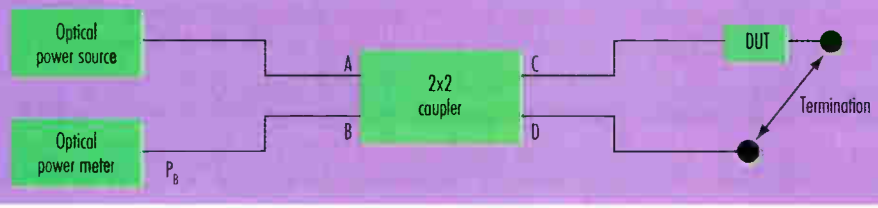
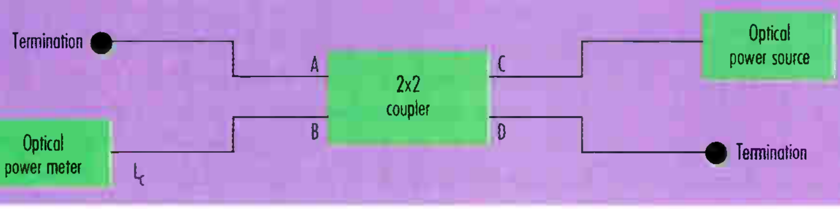


Figure 4: Coupler insertion loss



Port D and the fiber after the DUT terminated. See Figure 3.

- Step 4: Connect optical power source to Port C and power meter to Port B. Record the coupler insertion loss L_C (in dB) at Port B with Ports A and D properly terminated. See Figure 4.

The ORL of the device under test can be determined with the values recorded in Steps 1 through 4 using the following equation:

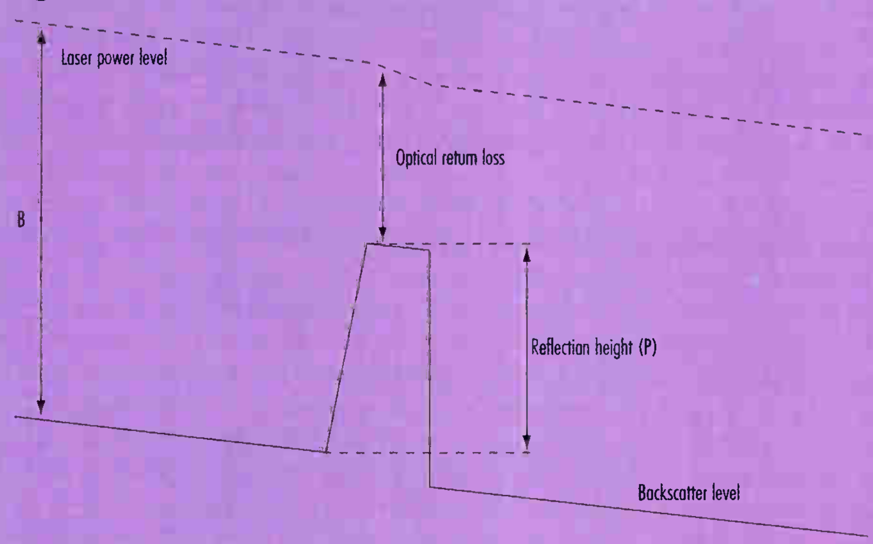
$$ORL = 10\log[(P_B - P_P)/P_O] - L_C$$

When measuring the ORL using FOTP-107, follow the guidelines listed to perform accurate measurements:

- Terminate unused port by using index-matching gel or by mandreling the fiber around a 5 mm diameter until it does not affect the measurement.
- Make sure the optical power source is stable with a constant power output.
- Make sure the power meter is linear through the dynamic range of measurements.
- Ensure that the optical power source output and power meter sensitivity have the dynamic range to measure high-value ORL.
- Keep the length of the coupler's fiber feeding the DUT <1 meter.

This measurement also can be performed by using a high-quality three-port coupler in place of the four-port coupler. FOTP-107 does not specify a coupler value. There are several manufacturers who make ORL test sets. These units contain a light source, power meter and precision coupler that can be used for quick, accurate and re-

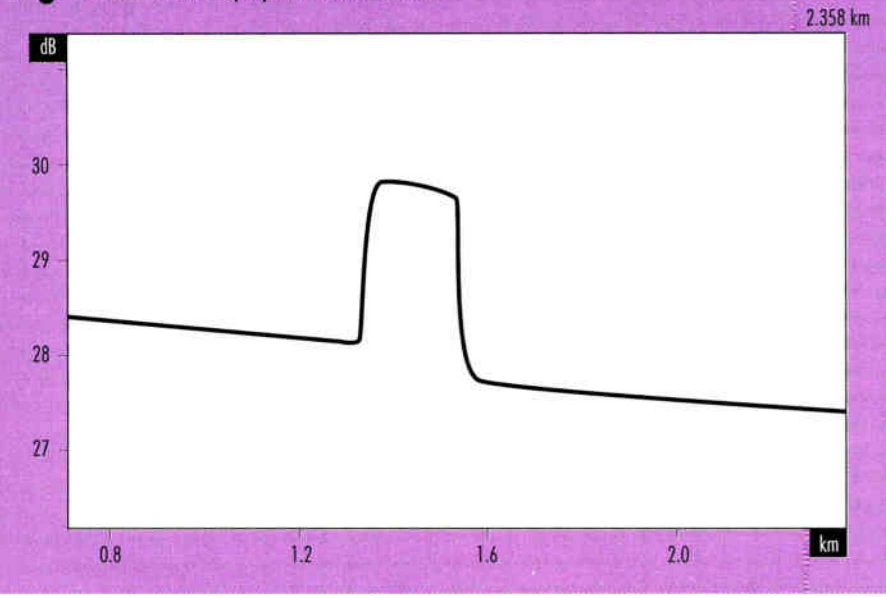
Figure 5: Relation of Fresnel reflection and ORL



AD INDEX

It's so simple! To obtain additional information from any of the display advertisers appearing in this issue of ***Communications Technology***, please use one of the **Reader Service Cards** on the facing page (pass the others along). The ad index below has been expanded to include not only the page number of each advertiser, but also each corresponding reader service number to be circled on the **Reader Service Card**.

Figure 6: OTDR display of Fresnel reflection



peatable ORL measurements.

An OTDR can be used to determine ORL of a discrete Fresnel reflection. Measuring the ORL with an OTDR allows you to determine both the magnitude and location of a reflection. The reflection will appear on the screen as a rise in the displayed backscatter. Figure 5 on page 71 displays the relationship between the height of a Fresnel reflection and the ORL. Simply stated, the larger the height of the reflection above the backscatter level, the lower (worse) the ORL. The optical return loss can be calculated by using the equation given below:

$$ORL = B - 10\log[(10^{P/5} - 1)D]$$

B = Fiber backscatter level (in dB) below the incident power level
P = Reflection height (in dB) above the backscatter level
D = Pulse duration in nanoseconds (ns)

Figure 6 is an OTDR display of a Fresnel reflection. With a fiber backscatter level of 79 dB, a reflection height of 1.7 dB, and a pulse duration of 2,000 ns, the ORL is 45.2 dB, determined by the previous equation.

To perform accurate measurements using an OTDR:

- Ensure the Fresnel reflection protrudes from the noise floor far enough to accurately measure its amplitude.
- Do not allow the reflection to saturate the receiver in the OTDR.

Many of today's newer OTDRs have the software capability to calculate and display the ORL of discrete reflections. Some also have the capability to calculate the link return loss, which is the combination of both Fresnel reflections and fiber backscatter.

Reflected power in an optical link also can be re-reflected. This is known as double Rayleigh backscatter and double reflection. Double Rayleigh backscatter occurs when light reflected from the fiber to the source is re-reflected by the fiber toward the detector. Double reflections occur between two reflective components forming cavities re-reflecting signals toward the detector. These re-reflected signals combine with the incident signal and increase the noise floor. The fiber sets the threshold for double Rayleigh backscatter and each discrete reflection in the link will contribute an additional re-reflected signal. Double reflections cannot be measured with the same methods used to measure ORL. However, by keeping reflected signals to a minimum you also will minimize re-reflected signals.

ORL measurements on fiber-optic networks should be performed and recorded prior to network activation. Manufacturer's ORL specifications also can be verified with either method presented. A telltale sign of highly reflective components in an optical link is a large increase in noise with a small decrease in optical power at the receiver. Optimum system performance depends on keeping connector and splice ORL values high. Clean connectors and optical barrels before every mating. Follow the manufacturer's procedures regarding proper handling, installation and maintenance of connectors and splices. If ORL is in doubt, measure the performance of the device or link in question. **CT**

References

1) Kapron, F.P., Adams, B.P., Thomas, E.A., Peters, J.W., "Fiber-Optic Reflection Measurements Using OCWR and OTDR Techniques," *IEEE Journal of Lightwave Technology*, Volume LT-7, Number 8, pages 1,234-1,241, 1989.
2) Electronic Industries Association, "FOTP-107 Return Loss for Fiber Optic Components," 1989.
3) Allard, F.C., *Fiber Optics Handbook For Engineers and Scientists,* McGraw Hill, 1990.
4) Hewlett-Packard, "Measuring the Return Loss of Fiber-Optic Components," *Hewlett-Packard Product Note*, 1991.
5) Schiestle, J., "OTDR Return Loss Measurements" *Siecor Application Note*, 1993.
6) Birrell, B.L., Refi, J.J., "Determining the Impact of Different System Configurations on System Performance for Analog and High Speed Digital Systems," *NFOEC '94 Proceedings*, Volume 2, pages 443-457, 1994.

It's a promise kept.

More than a trap,

an Eagle is a trap that arrives on time, as promised.

Last year, Eagle delivered on schedule 98.5% of the time. And we're working to improve, with more than 750,000 traps in stock and the largest trap production capacity in the world.

For traps on time, call
1-800-448-7474,
Sales Extension 12.

EAGLE
COMTRONICS INC.
P. O. Box 2457 • Syracuse, NY 13220 USA
800-448-7474 • (315) 622-3402 • Fax (315) 622-3800

Reader Service Number 74

Fiber-optic connectors

Diamond introduced a line of angled physical contact fiber-optic connectors for high-performance applications where back reflections and forward losses must be kept to a minimum.

The connectors feature a precise 8° angle-polished ferrule end face for ultra-low back reflection (<-70 dB) maintained over a wide range of temperatures and conditions, and termination via the company's active core alignment process for unparalleled repeatability and consistently low insertion loss (0.2 dB typical/0.4 dB maximum).

Like all the company's connectors, these units incorporate a two-component ferrule consisting of a hard outer casing and an insert of Cu-Ni alloy, resulting in consistent core-to-core contact and better stability under vibration conditions and extreme temperature. The units are available in four styles: FC, SC, DIN and CECC-LSH (E-2000).
Reader service #312

Fiber aerial tools

Jameson Corp. introduced a line of aerial cable placement tools for fiber-optic and coaxial cable placement. The high tech line consists of stringing blocks, corner blocks and setup brackets. The tools are said to increase efficiency and require minimal setup time. According to the company, when the tools are used, job site productivity is maximized.
Reader service #305

Fiber-optic transmitter

Broadband Networks introduced a new fiber-optic transmission product that provides the capability to deliver video, voice and data services via one single-mode fiber. The TR1000 series product, often called by customers the "video brick," allows baseband video and audio inputs to be delivered up to 25 miles with broadcast-quality performance. In addition, the unit has the capability to deliver data ranging from fax service to 10 Mb/s Ethernet networking.

The key benefit of the product is said to be the capability to deliver both video and data in an extremely cost-effective manner. It is currently being used by cable TV companies and telcos for distance learning and videoconferencing applications.
Reader service #308

Clip gun

Newly developed by Telecrafter Products is its RB-4 clip gun system. It is said to ensure damage-free installations and uncompromised signal integrity while fastening dual and messengered cable quickly and securely to any wooden surface.

The dual cable clips are made of high-density polyethylene that cradles and protects sensitive dual cable. Two galvanized nails are driven into the wood on either side of the cable, providing long-lasting holding power. These round shanked nails will not kink or bend even when driven into extremely hard surfaces. That means a perfect fit of the dual clip housing and the strength of galvanized nails to provide a secure, error-free installation. There are no staple nicks, no compression of the coax, and no undetected cable damage that can compromise signal quality.

The gun holds a strip of 25 clips and loads as easily as a staple gun. The body is made from a high-impact reinforced nylon that is lightweight yet strong. All interior moving parts are manufactured from hardened steel. **Reader service #309**

Multimedia wiring kit

US Tec unveiled a series of tecLAN kits. They are in-home multimedia wiring network products that use a higher bandwidth capacity wire developed to accommodate the growing digital communication needs of the U.S. home.

Consisting of a patented wall plate, a central electronic server, coax and Category 5 twisted-pair telephone wire, the system allows homeowners access to satellite and cable TV, telephone and electricity from a single convenient wall source installed in multiple locations throughout the home.

This structured wiring solution to "the last 100 feet" of the information superhighway is uniquely packaged in kit form, including all components necessary to wire a home. Four kits are being offered: configurations of four, eight, 14 and 20 wall plates. The kit is said to simplify order processing, job costing, installation, material handling and inventory control and ensures the integrity of the home electronics network.
Reader service #307

Stereo modulator

The new SVM-1 from Leaming is a stereo audio/video modulator that provides CATV, SMATV, private and wireless cable systems with an affordable, BTSC stereo audio/video modulator in one-third of a rack space. The unit accepts video, left and right baseband audio signals and generates a TV channel output.

Built-in features include BTSC stereo encoder, SAW filter and agile output from 50 to 450 MHz. Each unit fits in a 1.75-inch (height) by 19-inch (width) rack space.
Reader service #311

Traps

Eagle Comtronics announced split-tuned negative traps that attenuate both video and audio, for use with addressable descramblers that normally permit audio to come through. Appropriate in low-volume situations, they can be installed indoors or outdoors. For high-volume situations, the company's positive trap systems — discrete jamming carriers or sideband interdiction systems — can scramble the audio on the same channel with an addressable system.

Also, the company's tier traps are available at 1 GHz for maximum compatibility with the company's 1 GHz single-channel traps.
Reader service #306

CABLE TRIVIA

By Rex Porter, CATV Consultant

Our historical guru (aka Rex Porter) has provided us with these trivia questions on the cable industry. Answers to the last installment's questions appear first. ("Cable Trivia" ran on page 92 of the August issue.) Look for answers to this month's questions in next month's issue (along with a new set of 10 questions). The person supplying the most correct answers (see additional requirements below) will be awarded an industry-related novelty prize (e.g., cap, water bottle, T-shirt).

Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 1900 Grant St., Suite 450, Denver, CO 80203; fax: (303) 839-1564; e-mail: CTmagazine@aol.com. To be in the running for a prize, your answers need to be postmarked, faxed or e-mailed to us by the 20th of the month of the issue date that the specific trivia test appears in. The first person who sends in the most correct answers will be the award winner. Good luck!

Trivia test #2 answers

1) Robert "Bob" L'Heareux
2) Carter Mountain
3) Jerrold
4) Ameco
5) Denver
6) New Orleans
7) Las Vegas, NV
8) Waco
9) Viking
10) Monty Rifkin

Trivia test #3

1) In January 1981, Warner Amex Cable launched the first information retrieval service in Columbus, OH, with the ________ system.

2) In the 1970s, the National Cable Television Association began awarding the Robert H. Beisswenger award to honor excellence in sales and marketing management. The first award went to every sales staff in the industry. The first individual to win the award was________.

3) During the '50s and '60s, Taco and Scala were the leading manufacturers of CATV________ .

4) A division of Alcoa, ________ Cable Co., supplied both drop and aluminum sheathed cable in the early days.

5) Originally know as *Horizons* magazine, *TV & Communications* was published in ________ before moving to Denver.

6) In the 1960s, some TV repair shops and dealers teamed up with powerful home antenna manufacturers to stop the growth of CATV. Their organization was known as________.

7) Before Magnavox, if you called Manlius, NY, and ordered products for cable TV, you were likely calling a company known as ________ Electronics Inc.

8) The most popular field strength meter in the early years was manufactured by Jerrold and was known by its part number, ________ .

9) Because of the weight and cost of the Jerrold field strength meter, installers and field techs most likely would be issued an FS-2, more commonly known by the name of its manufacturer, ________ .

10) In 1958, ________ formed a company that by 1965 had handled the sale of more than 80% of cable systems across the nation. His "team" consisted of himself, Alan Harmon, Monty Rifkin and Ross MacGregor.

And the winner is ...

The Trivia Judge here at *Communications Technology* announced that David E. Fousse, design manager at Intermedia Partners, won the July 1995 "Cable Trivia" test #1 with 4-1/2 questions correct. Congratulations David!


WAVETRACKER
COLLECTING DATA
157
CLT

The following is a listing of some of the videotapes currently available by mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

☛ *Developing a Technical Training Program*—Roger Keith discusses the design and development of a system-level CATV technical training program. (1 hr.) Order # T-1065, 35.

☛ *High Definition Television*—Walt Ciciora, Ph.D., Wayne Luplow and Norman Hurst briefly review the basics of high definition TV (HDTV), going on to discuss intermediate technologies such as advanced TV (ATV) and ACTV. Delivery of these signals by cable, as well as competitive technologies, also are discussed. This program provides an understanding of how HDTV can affect your systems in the years to come. (1-1/2 hrs.) Order #T-1066, $45.

☛ *Fiber-Optic Technology*—Jim Chiddix and Scott Esty review the basics of fiber-optic communications including how it works, how fiber is constructed and some of the design parameters for using fiber technology in your system. This program also examines, from an operator's point of view, what fiber will mean to the cable industry in the future. (1 hr., 5 min.) Order #T-1069,$45.

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

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, 140 Philips Rd., Exton, PA 19341-1318 or fax with credit card information to (610) 363-5898.

Reader Service Number 59

CDS CAD DRAFTING SERVICES, INC.

Charles Wright
(815) 698-2564
Rt. 116 & I-57, Central Plaza
Ashkum, IL 60911

- Base Mapping
- Strand Mapping
- Digitizing Services
- As-Built Mapping
- System Design
- System Walkout

Specializing in high volume precision drafting.

"Quality service for all your cable drafting and design needs."

Call for literature.

---

130 SPECIALIZED TRUCKS IN STOCK 1100

(10) Telsta-Versilift 1 Ton Buckets In Stock
(10) Digger Derricks Etc.
(50) 28 To 75 Ft Bucket Trucks In Stock

Call For Price List: (215) 721-4444 Fax: (215) 721-4350

Opdyke Inc.
Truck & Equipment Sales
3123 Bethlehem Pike
Hatfield, PA 19440 USA

We Buy Surplus Trucks

COMMERCIAL ELECTRONICS, INC.
CATV ENGINEERING SERVICES

Your complete source of electronic components also specializing in

EQUIPMENT REPAIRS ◆ **METER CALIBRATIONS** ◆ **FCC PROOF OF PEFORMANCE** ◆

FREE PICKUP IN 18 STATES

800-247-5883

Professional Installation & Technical Services, *Since 1986*

An Engineering Services Company dedicated to:

- Sweep - Balance - Proof
- CALAN Equipped - 1GHz
- Computerized Reporting
- Electronic Upgrades - Resplice
- Splicing & Activation
- System Maintenance and Repair
- 750 MHz Sweep Experience

Cincinnati, Ohio
Fax: 513-583-1140

800-457-4569

TKR REPAIR CENTER — *Quality Repair at Competitive Pricing*

REPAIRS & SALES

- *In Warranty Repair*
- *Jerrold Addressable Repair Specialist*
- *DP5, DP7 & DPV7 / Panasonic 1402, 1403*
- *Remote Repair (URC 450, 550)*

Free delivery & pickup in certain areas

For more inforamtion contact:
TKR Repair Center
Tel: (908) 583-2026 • Fax: (908) 290-1677
25 Industrial Drive • Cliffwood Beach, NJ 07735

TCI AFFIL.

MIDWEST CABLE SERVICES

- NATIONWIDE BUYERS -
CATV SCRAP CABLE AND USED LINE GEAR

P.O. Box 96, Argos, IN 46501
Phone: (219) 892-5537 • FAX: (219) 892-5624
(800) 852-6276

John Caulfield
Fiber Optic Services Inc

* FIBER EMERGENCY RESTORATION KITS
* SYSTEM TRAINING ON EMERGENCY RESTORATION
* FIBER CONSTRUCTION AND SPLICING
* FIBER ENGINEERING AND DESIGN

Call: 1-800-651-7960

FCC COMPLIANCE
CALL 800-652-1082
PROOF-OF-PERFORMANCE

- *COMPLETE FCC POP, RF, VIDEO & COLOR*
- *HEADEND DESIGN, SET UP, OPTIMIZING, PROOF*
- *CLI RIDE OUT WITH FCC 320 FORMS COMPLETED*
- *THE MOST AFFORDABLE WAY TO COMPLY WITH FCC RULES*
- *TEST RESULTS REPORT IMMEDIATELY AT END OF TESTS*
- *INDEPENDENT AND UNBIASED REPORTING*
- *RESULTS GUARANTEED TO BE READY FOR THE FCC & CITY*

RELIABLE CABLE TV SYSTEM SERVICE INC.
4849 GRENADIER DR. SW
GRAND RAPIDS, MI 49509

GRANT PEARCE
SCTE BCTE-000098
616-538-1437

VISION SPECIALTIES

Parts Distributor for *Scientific Atlanta* *Panasonic*

Call for Catalog
(800) 233-8431
Rancho Cucamonga, CA

Cosmetic Replacement Parts
SA Cases, Jerrold Bezels/Cases
Overlays, Keysets, AC Cords
Electronic Components
Capacitors, ICs, Transistors
Diodes, VRs, Jerrold "A" PROM
New Panasonic Converters

Specialty Tools: Bits, TORX
Pioneer, Avsafe
New Remote Controls
Transformers, Batteries
Hardware
Screws/Washers,
Connectors, Rivets

White Sands

Jumper Cables
CUSTOM MADE CABLE ASSEMBLIES INCLUDING:
F to F, N to N, BNC, RCA, F-81

Gilbert AHS	RG-56	Belden
LRC	RG-59	Times
Off Shore	RG-11	Comm/Scope
Amphenol	RG-213	Intercomp
	RG-214	

We will make any cable assembly. Quick delivery on all colors and lengths.
Fax: (602) 582-2915, PH: (602) 581-0331
335 W. Melinda Drive, Phoenix, AZ. 85027 USA

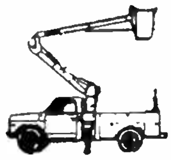
FREE 44pg Catalog & 80 Audio/Video Applic.
250 PRODUCTS
PWR SUPP, EQ, PHONO, MIC, TRANS, ACN, TAPE, VIDEO, LINE, OSC
PRESS BOXES
SVHS-D.A. VIDEO-D.A.
1-in/8-out Video/Audio
1-in/16-out Video/Audio
2-in/24-out Audio Only
1-in/32-out Video/Audio
Video & Audio Dist Ampls.
RGB-Sync Dist. Ampls.
Routing Switchers
OPAMP LABS INC (213) 934-3566
1033 N Sycamore Av LOS ANGELES CA, 90038

The Business Directory features:

• Products • Services
• Career Opportunities • Training • Catalogs
Call 1-800-325-0156 To Place Your Ad!

AERIAL BUCKET TRUCKS

Large selection geared for CATV
STANDARD TRUCK & EQUIPMENT CO., INC.
1155 Hill St. S.E.
Atlanta, GA 30315
Ph: 1-800-241-9357
Fax: (404) 622-4462
USA



BUCKET TRUCKS

JONESURPLUS

WE BUY AND SELL QUALITY CATV EQUIPMENT

LINE AMPLIFIERS, TAPS, CONNECTORS
CONVERTERS - ALL TYPES AND MAKES
HEADEND EQUIPMENT

USA • (619) 757-3008 • Fax (619) 757-4048

WE BUY AND SELL SURPLUS NEW & USED

Connectors, Taps, Headend, Line Gear, misc.

TM BROKERS

5402 Highway 95
Cocolalla, ID 83813 USA
Phone: (208) 683-2797
(208) 683-2019
Fax: (208) 683-2374

TEST EQUIPMENT

Reconditioned Wavetek, HP, Tektronix and more. Signal Level Meters, Sweep Systems, TDR's, Power Meters, Spectrum Analyzers, Frequency Counters and Fiber Test Equipment. Guaranteed to meet/exceed manufacturers specs. 90 day warranty standard.

SATELLITE ANTENNAS

Used Scientific Atlanta, Andrews, Vertex, RSI and others. 7 meter and up.

PTL Cable Services Inc. USA • Phone (407) 747-3647 • Fax (407) 575-4635
BUY-SELL-TRADE

Industry Service Since 1966

ROCKY MOUNTAIN JUMPER CABLES

P.O. Box 9707 • Helena, MT. 59604

Custom Made Jumper Assemblies
All Brands Fittings/Cable

- F Male
- F Female
- BNC
- PL
- RG - 59
- RG - 56
- RG - 11
- Other

Our jumpers never leave our plant during construction, insuring inspection of each phase of construction. Our quality control insures you of the lowest RF leakage possibe.
Call for pricing and free sample. (406) 458-6563

BOUGHT / SOLD / SERVICED

IN STOCK

G. I. VideoCipher II	- $299	Standard 24 PC	- $225
Mag. 5-330 Trunk	- $299	SA 330 Trunk	- $199
Jerrold SJ Trunk 301	- $199	Syl/Tex 2000 Trunk	- $199
Jerrold SJ Trunk 400	- $299	Jerrold JLE-400	- $ 85
Magnavox 5LE330	- $ 85	Jerrold SJ 450 Trunk	- $435
SA Slimline 450 Trunk	- $435	Jerrold SLE/SLR	- $ 19
SA 8525 w/ Remote	- $ 25	Hamiln CRX	- $ 12
Pioneer BC-2002/2	- $1.99	Tocom 5503-A	- $ 40
Assorted Taps	- $1.50	C-Cor 450 LE NEW	- $175

MINIMUM QUANTITIES APPLY - CALL FOR COMPLETE INVENTORY LIST

WE SERVICE WHAT WE SELL! SINCE 1982

ARENA SERVICES, INC.

ALL TYPES OF EQUIPMENT NEEDED - FAX LIST
(610) 279-8000 • 800-WT ARENA • FAX 279-5805

dB-tronics

Cable Television Equipment Sales & Service Center

S-A SPECIALS !

Check Us Out For
Scientific Atlanta
Parts & Services

- ✓ Genuine S-A Parts In Stock
- ✓ Factory Trained Repair
- ✓ Sales of New & RMF Equipment
- ✓ Purchase of Wreck-Out & Excess Equipment
- ✓ 450 & 750 MHz Equalizers

CALL OR FAX US FIRST

Telephone: 803-574-0155
USA Toll Free: 800-356-2730
Fax: 803-574-0383

GENUINE Scientific-Atlanta PARTS

dB-tronics, Inc.
145 Tradd Street
Spartanburg, SC 29301
USA

VISA *get converted !* MasterCard

LEE ENTERPRISE

A Division of Diamond W Investments, Inc.
623 4th STREET • P.O. BOX 590 • DESHLER, NEBRASKA 68340

DOWNSIZE VCII CHASSIS KIT ... $ 99.50
VCII REPAIR OR EXCHANGE ... $ 80.00 TO 135.00*
"ALL PARTS & RETURN SHIPPING INCLUDED ON VCII'S"
VCRS UPGRADE OR EXCHANGE ... $ 379.50*
VCII WHITE LABEL FOR SALE ... $ 225.00*

MODULATOR REPAIR ... $68.50*
PROCESSOR REPAIR ... $68.50*
RECEIVER REPAIR ... $68.50*

Female Business Enterprise • **Complete Cable Equipment Repair**

1-800-551-0096 1-800-551-0096 1-800-551-0096

* Return shipping and minor parts included in price

David Sylvestre
203-953-9240

EDJ
COMMUNICATIONS INC.

WIRELESS SERVICE

Area Evals
Data Base Information
Wireless Installs/Roof & Trees
MDU Prewire/Postwire
65' Tower Trucks for Site Surveys

CATV FILTERS *FOR EVERY SYSTEM NEED*

- Channel BPF • Bandsplitters
- Lowpass/Highpass • Deletion/Reuse
- Security Traps & Filters

- *We love:* *EMERGENCIES* *SPECIAL NEEDS* *GIVING ADVICE*

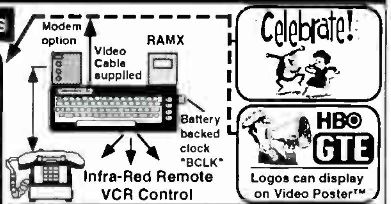
FAX OR CALL FOR OUR CATALOG

COMMUNICATIONS & ENERGY CORPORATION
Telephone 800-882-1587 Fax 315-452-0732 USA

"Video Poster"™ Page Generator & Controller

MAC & IBM Modem Access

Local Weather
Temp:85 F Humidity 35%
Wind from SW @ 5 MPH
Baro Pressure 29.3 HG.
Graphics, Logos, Low cost ads
Update remotely via any computer!
Scrolling messages...
12:24:30 THURSDAY 3:21:94



Basic system: $529.90 inc RAMX & C64
VHS instructional video, cable & manuals

*Hi-Res fonts, Video Page & Character Generator *Store more than 600 pages Logos & pictures on RAMX cartridge *16 colors, variable fonts, Crawl, Flash, Special effects *Two (240 ltr.) crawls per page *Accurate real time clock & date * Restores & displays pages, time & date even if power fails!* Low cost C64 computer (NTSC + Ch. 3/4 RF out) *100 Time & date control commands *Infra-red controls up to 8 VCR's * Program Video Poster™, using IBM or MAC via modem *Control external relays * Video Poster™ Instructions on VHS tape * *Ask about MAC & IBM Video Poster™ page design program "MACP" $179.95*

Model	Price	Description of "Video Poster" ™ Options: *Call for Demo tape*
RAMX	$349.95	Video Poster™; 600 page Battery backed RAM-disk, cables & manual
C64	$179.95	Refurbished computer, with power supply (1 year warranty all products)
Modem	$ 89.95	1200 baud Hayes modem for remote page transfer
BCLK	$ 69.95	Battery clock (with RAM) restores time & date if power fails
PK8	$179.95	Controls 8 relays + DVM2; "WX1 & WSDM "+ IR inputs
WX1	$189.95	Temp.+Humidity ; WX1B $249.95 inc. barometric pres.
WSDM	$279.95	Anamometor Wind speed and direction; (Req. PK8)
RAIN	$249.95	Rain gauge daily, yearly total s in .01" increments
1541	$189.95	Disk drive; unlimited back up for RAMX
TSP1	$379.95	Text-to-speech computer voice message each screen.
DVM2	$379.95	Page controlled Digital audio;10 messages, 2 min.
UPS1	$279.95	Uninterruptible power with 5 hour batteries

NEW Apple™ Macintosh MAC Video Poster™ photographs & Graphics

√Multiple Graphics & Hi res photos display on all pages
√Create flash, crawl text with photo graphics display pages
√Remote control and page insertion via Macintosh
√Works with all new A/V Macs or NTSC display adapters
√Features all MAC fonts and 256 NTSC color resolution
Model "MACP" Video Poster™ for Macintosh $495.00

Engineering Consulting Tel: 714-671-2009 Fax: 714-255-9984
583 Candlewood St. Brea, Ca. 92621*Mastercard*Visa*Discover*Amex*PO*COD

RCH CABLE

301 Route 130 South / Cinnaminson, NJ 08077
609-786-1701 / Fax 609-786-0121

- Door to Door Sales
- System Audits
- Converter Placement Campaigns

Serving the industry since 1977

COAST CATV SUPPLY

IN STOCK
NEW & REFURBISHED
Amps, LE's, Taps, Splitters
Connectors & Headends
ALL BRANDS 270 TO 550 MHz
Call for updated price list

We Buy - Wanted: ALL BRANDS
YOUR USED OR EXCESS EQUIPMENT
Fax your used/excess list
(USA) 909-272-2360 Fax: 909-272-3032

CABLE ID PRODUCTS

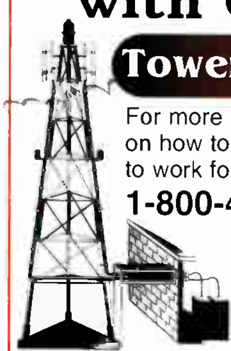
FIBER OPTIC CABLE — Grabber™ Markers. *Identify cable above ground or below ground.*	CAUTION FIBER OPTIC CABLE — Hefty-Poly™ Markers. *Economical identification of cable. Available in orange or yellow.*
Write-On Coverall™ Tags. *Custom info. is written in the field then sealed down with a clear flap. Very durable!*	Reflective #'s and Letters. *Use on pedestals, transformers and equipment.*
WARNING — *Warning stakes and decals, marking flags, buried line tape, pedestal decals, ground wire tags.*	WARNING FIBER OPTIC CABLE — Fiber Optic Labels. *Use on innerduct, conduit or fiber optic cable.*

Call for Free Samples and Catalog
1-800-950-4921
VIP™ Products
THE MOUNTAIN CORPORATION
Houston, Tx USA

IF YOUR LIGHT IS OUT, YOU COULD BE FINED!

Avoid Costly FCC Fines with CFT's

TowerSentry™



For more information on how to put TowerSentry™ to work for you, call...
1-800-448-8099

Tower Light and Transmitter Monitoring Specialists

Emergency Alert Systems By

IdEA/ONICS

Up to 90 Channels
14 day delivery
Compatible with all headends
Affordable
Video units also available
(701) 786-3904
Fax: (701) 786-4294

ASK ABOUT COMPLETE SYSTEMS TO MEET THE NEW FCC MANDATE

DIGITEL
NETWORK SERVICES, INC

the nation's fastest growing HFC network design contractor, is presently accepting applications for the following positions:

- BROADBANDS/RF DESRS.
- CADD DRAFTERS
- DATA ENTRY PERSONNEL
- SYSTEM PROOF/SWEEP & BALANCE TECHNICIANS
- FIBER SPLICERS
- FIELD ENGINEERS
- FIELD MAPPERS

Excellent Compensation & Benefits

Mail Resume to:
DIGITEL NETWORK SERVICES
470 N. Clayton Street NW. Atlanta, GA 30245
or fax to: (404)682-4500

Are You Ready For 1996?

January:
Emerging Technologies
February:
OFC & Texas Show
March:
CAB

Reserve Your Advertising Space Before The End Of The Year!

EDS

For more than 30 years, Electronic Data Systems has helped customers improve their business performance through the application of information technology. EDS has more than 80,000 employees worldwide and serves more than 8,000 customers. In 1994, EDS posted revenues of $10.05 billion. EDS serves all major industries, from communications and insurance to manufacturing and finance. Customers range from small businesses to the world's largest corporations and governments.

Communications Engineer

This challenging position includes all phases of fiber optic system design and project management. Successful candidates will have 2+ years experience in fiber optics design and/or implementation and strong communication and PC skills. Experience in AutoCAD a plus.

Communications Administrator

In this challenging position you will be responsible for certification and trouble-shooting broadband systems in a manufacturing environment. Successful candidates will have 2+ years experience as well as knowledge of cable TV system design and equipment operation. Strong communication and PC skills are also required.

For consideration, please mail or fax your resume and salary requirements to:

EDS
c/o David Bollinger
Mail Stop 512
300 E. Big Beaver Rd.
Troy, Michigan 48083
Fax (810) 524-6147

EDS is a registered mark of Electronic Data Systems Corporation. EDS is an equal opportunity employer, m/f/v/d.

Continental Cablevision, a leading provider of quality cable services, is currently seeking qualified candidates to join our Technical Operations Management Team.

TECHNICAL OPERATIONS MANAGER

Will provide hands-on, enthusiastic leadership for a team of technical operations supervisors for two systems (130K+ subscribers). The successful candidate will possess 2 years technical supervisory experience; 5 years progressive experience as a CATV service technician; extensive working knowledge of CATV system design and operations and exceptional employee development/management skills and experience. Candidates must also possess excellent communication, interpersonal customer relations skills. A Bachelor's degree in a related area is a strong plus.

TECHNICAL OPERATIONS SUPERVISOR

Will lead a team of installers and service technicians in the delivery of service to ensure optimal customer satisfaction. The successful candidate will possess 5+ years progressive experience as a CATV service technician; extensive working knowledge of CATV system design and operations and exceptional employee development/management skills and experience. Candidates must also possess excellent communication, interpersonal customer relations skills. A Bachelor's degree in a related area is a strong plus.

Continental Cablevision offers competitive compensation and excellent benefits. Qualified candidates should submit an application or resume (indicating desired position) with salary requirements to:

Continental Cablevision

Att: Human Resources Department
1520 West Main Street • Suite 201
Richmond, VA 23220

Continental Cablevision is an Equal Opportunity Employer/M/F/V/D

Need to hire technical people?

Call Rebekah Markheim at 1-800-325-0156 for Business Directory information!

Since 1975 we have served professionals in the CABLE-TV industry by matching talent with opportunity. Below is a sampling of the talents we are seeking to match with the many opportunities that are currently available.

- Sweep Technicians
- Designers
- Line Technicians
- Broadcast/L.O. Techs
- Chief Engineers
- Chief Technicians
- Service Technicians
- Lead Technicians
- Headend Techs
- Plant Managers

JIM YOUNG & ASSOCIATES
One Young Plaza • 1235 Ranger Highway - Weatherford, Texas 76086
Phone (817) 599-7623 or Fax (817) 599-4483

US WEST International, Inc.

Director - Engineering Projects

Ideal candidate will have:

• 5 years experience, to include extensive background in the technical basis of various network technologies, plus a technical degree.

• Experience with Cable Engineering - all aspects and constructions, to include CATV Hybrid Fiber Coax Construction and technical resource (consultants/contractors) management, must.

• Experience with modeling tools, analysis techniques and telecommunications engineering; and, must be knowledgeable in strategic planning, contract negotiations and financial management.

• Engineering management experience.

• Experience in international and domestic business development, desirable.

50% or more International Travel required

Candidate will be initially Denver-based. After a period of 12 months to within 18 months must be willing to relocate overseas to support a US WEST International joint venture.

For consideration, please send resume to:

US WEST International
ATTN: L. Harris
P.O. Box 6540
Englewood, CO 80155-6540

Equal Opportunity Employer

US WEST International, Inc.

Director - Construction Engineering

Ideal candidate will have:

• 5 years experience plus a technical degree.

• Experience background in the technical basis of various network OSP technologies, and to include experience in modeling tools, analysis techniques and telecommunications engineering.

• Experience with Hybrid Fiber Coax Construction techniques.

• Must be knowledgeable in strategic planning, contract negotiations, financial management.

• Strong Interpersonal and Management Skills.

• Outstanding Communications Skills.

50% or more International Travel required

Candidate will be initially Denver-based. After a period of 12 months to within 18 months must be willing to relocate overseas to support a US WEST International joint venture.

For consideration, please send resume to:

US WEST International
ATTN: L. Harris
P.O. Box 6540
Englewood, CO 80155-6540

Equal Opportunity Employer

Wanted!

Experienced long term help for Southeast rebuilds/upgrades

Aerial Crews
Underground Crews
Splicers
Installers
Field Engineers

CABLE MAN, INC.
Call (601) 374-5832
Fax: (601) 374-2198

CATV CONSTRUCTION

Experienced personnel needed for long term projects at various locations in the Eastern U.S.

COAX SPLICERS
FIBER SPLICERS
AERIAL CREWS
UNDERGROUND CREWS
SUPERVISORS

Positions available for employees and sub-contractors.

CALL 1-800-693-4237

TESINC

t•e•s•i•n•c
A Dycom Company

6523 N. Black Canyon Highway
Suite 200
Phoenix, Arizona 85015
(602) 242-8110 FAX (602) 242-8227

EXPERIENCED CATV POSITIONS AVAILABLE NATIONWIDE

Fiber/Coax Splicers
CATV Make Ready Engineers
Strand Mappers *Project Managers*
CATV Designers *As-Builters*
Installers *CAD Drafters*

An Equal Opportunity Employer

Send Resumes and Call: 1-800-800-7886

Peter Froehlich & Co. executive search

SCTE Sustaining Member

P.O. Box 339 Weatherford, TX 76086
(800) 742-4947 FAX (817) 594-1337

All levels of Technical Positions - Corporate to Hourly. Operators and Manufacturers
Call or Write. Fees Paid.

THE TOTAL PACKAGE

EARTH STATION RECEIVER

Renowned Drake quality is built into the ESR1260 IRD, as is the VideoCipher®RS module. This high performance integrated receiver descrambler (IRD) is made with the same craftsmanship found in all Drake commercial headend products. While the compact height saves the operator rack space, front panel accessibility to the VideoCipher®RS module provides convenience. Major operating functions are selected via the front panel, and programming is simplified by liquid crystal display of operating parameters.

- Synthesized frequency tuning of IF and audio subcarrier frequencies.
- Compact design – 1.75" H x 19" W x 19.75" D.
- Removable front panel allows module access without removing receiver from the rack.
- Front panel liquid-crystal readout of all operating parameters.
- Dual input tuner, 950–1450 MHz.
- Two IF bandwidth filters, 27 and 22 MHz, can be used with or without threshold extension.
- Compatible operation on C and Ku Band.
- Simple and straightforward programming and operation.
- AFC, IF bandwidth and threshold extension, audio frequency, and VC on-screen display on/off are all selectable by the operator.
- Adjustable audio and video level.
- Static threshold less than 7 dB C/N.
- Superb audio and video quality.
- Made in the U.S.A.

VideoCipher®RS is a registered trademark of General Instrument Corporation.

R.L. Drake Company
P.O. Box 3006
Miamisburg, OH 45343
U.S.A.

Sales Office: 513-866-2421
Fax: 513-866-0806
Service & Parts: 513-746-6990
In Canada: 705-742-3122

Made in America by Drake...A trusted, world leader in communications equipment since 1943.

DRAKE MADE IN AMERICA

DRAKE

Reader Service Number 89

The following is a listing of some of the videotapes currently available by mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Non-members must add 20% when ordering.

☛ *CLI Ninjas* — Have some fun! Here's a chance for you to review the FCC's Form 320 for CLI. The "CLI Ninjas," Brian James and the FCC's John Wong wrap up signal leakage issues and focus on questions and problems encountered with the form. (1-1/4 hrs.) Order #T-1086, $45.

☛ *Fiber-Optic Testing* — Mark Connor and Louis Williamson discuss fiber-optic test equipment and its use during installation and maintenance of a CATV system. (1 hr.) Order #T-1087, $35.

☛ *Painless Technical Writing* — Bill Cologie and Rikki Lee address the issue of overcoming the fear of writing and putting ideas on paper. They also discuss preparing memos, reports and technical articles in a CATV-specific environment. (1-1/4 hrs.) Order #T-1089, $45.

☛ *Signal Leakage Equipment Calibration* — Don Runzo and Steve Windle focus on different aspects of signal leakage equipment calibration, including receiver measurement accuracy, setting up a calibrated leak and calibrating the vehicle-mounted leakage test system. Internal and external calibration and wave propagation are covered. (1 hr.) Order #T-1090, $35.

☛ *Video and Audio Measurements* — Ron Hranac and Steve Johnson demonstrate headend video and audio measurements, covering video level, video depth of modulation, audio level and audio deviation measurements with actual test equipment. (1-1/4 hrs.) Order #T-1091, $45.

☛ *Fiber for Management* — Continental Cablevision and Paragon Cable present real-life case histories that examine the "dollars and sense" of fiber usage in cable TV transmission systems and rebuilds. (3 hrs.) Order #T-1093, $75.

☛ *Fiber Project Management* — Representatives from AT&T Bell Labs, Cable Constructors and CommScope speak respectively on lightguide cable construction guidelines, fiber construction and fiber cable placement. (3 hrs.) Order #T-1094, $75.

☛ *Fiber for Engineers: Performance Issues* — Representatives from Jerrold Communications, Scientific-Atlanta, Engineering Technology Group, Cencom Cable Associates, Continental Cablevision and NewChannels Corp. discuss fiber from an engineer's viewpoint, focusing on such issues as upgrades, "star" architectures, fiber deployment, plant upgrade, rebuild, extension and design. (3 hrs.) Order #T-1095, $75.

☛ *New Developments in Fiber* — A series of exciting, groundbreaking new fiber products, concepts and plans are presented by Sumitomo Electric, AT&T Bell Labs, C-COR, Scientific-Atlanta, Synchronous Communications and ATC. (3 hrs.) Order #T-1096, $75.

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

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 (610) 363-5898.


Virtual Phone/Fax...Interactive Voice Response...Call Answering...Voice/Fax Mail...Universal Messaging...Fax Overflow...IN Services...Audiotex...Fax-On-Demand...

Broadband Training

A comprehensive, broadband technology seminar

Seattle, Washington	February 19-21, 1997
Concord, California (Vendor's Day)	March 5-7, 1997
Orange, California	**March 12-14, 1997**
Phoenix, Arizona	March 19-21, 1997
Dallas, Texas	April 2-4, 1997
Denver, Colorado	April 9-11, 1997
Indianapolis, Indiana	April 16-18, 1997
Toronto, Ontario, Canada	April 30-May 2, 1997
Ottawa, Ontario, Canada	May 7-9, 1997
Montreal, Quebec, Canada	May 14-16, 1997

Includes hands-on training in Philip's mobile classroom, simulating a complete hybrid fiber coax (HFC) system.

For Information/registration, call:
1.800.448.5171
In NY State: 1.800.522.7464
Philips Broadband Networks, Inc.
100 Fairgrounds Dr., Manlius, NY 13104

Let's make things better.

PHILIPS

NMI Management & Training Services
30 Kingwood Rd.
Oakland, CA 94619

SAVE $$$ ON UNNECESSARY PLANT RELOCATION COSTS!

RIGHT OF WAY TRAINING

The most comprehensive and cost effective right of way training available.

You will learn:

- Why easements are necessary
- How to write and interpret easements
- To read and understand legal descriptions of real property
- Basic real property law
- To **negotiate** with property owners and governmental agencies
- How to read and comprehend tax assessar's maps and ownership information
- How to comprehend franchise rights and obligations
- The best way to handle **trespass complaints** (when your company is the trespasser)
- The pitfalls of verbal permission to occupy private property

The 1984 Cable Act provides a great deal of protection; however, your **company needs more than the act provides.** Our class is four and one half days in length and **is only $975 per student.** Call for a complete brochure and schedule. **Classes taught nationwide. References and client list available.**

FREE 44pg Catalog & 80 Audio/Video Applic.

OPAMP LABS INC (213) 934-3566
1033 N Sycamore Av LOS ANGELES CA, 90038
http://www.opamplabs.com

FIBER OPTIC | RF

Our service department can troubleshoot, repair, and calibrate all your electronic processors, modulators, etc From the headend to the home

Call for a quotation

SADELCO™ R&D
Santa Barbara, CA 93105 TEL/FAX 805 682-3341
1990 1996

INSPECT • PAINT • REPAIR • RE-GUY • LIGHTING • ERECT • ANTENNA • FEEDLINES • ANALYSIS • DISMANTLE

HERMAN J. JOHNSTON
PRESIDENT

Nationwide Tower Company

RADIO, TELEVISION, C.A.T.V. AND MICROWAVE TOWERS
P.O. BOX 130 • POOLE, KENTUCKY 42444 • (502) 533-6600
MOBILE (502) 831-4573 FAX (502) 533-0044

JONES BROADBAND INTERNATIONAL

WE BUY AND SELL QUALITY CATV EQUIPMENT

LINE AMPLIFIERS, TAPS, CONNECTORS
CONVERTERS - ALL TYPES AND MAKES
HEADEND EQUIPMENT
USA • (619) 631-2324 • Fax (619) 631-1184

Industry Service Since 1966

ROCKY MOUNTAIN JUMPER CABLES
P.O. Box 9707 • Helena, MT. 59604

Custom Made Jumper Assemblies
All Brands Fittings/Cable

- F Male
- F Female
- BNC
- PL
- RG - 59
- RG - 56
- RG - 11
- Other

Our jumpers never leave our plant during construction, insuring inspection of each phase of construction. Our quality control insures you of the lowest RF leakage possibe.
Call for pricing and free sample. (406) 458-6563

FREE WAVETEK Meter

with your repair or sales orders
We Buy, Sell & Repair
CATV EQUIPMENT
Call for Details

RMT ENGINEERING
800-228-0633
E-mail info@rmteng.com
Web site http://www.rmteng.com

TEST EQUIPMENT

Reconditioned Wavetek, HP, Tektronix and more. Signal Level Meters, Sweep Systems, TDR's, Power Meters, Spectrum Analyzers, Frequency Counters and Fiber Test Equipment. Guaranteed to meet/exceed manufacturers specs. 90 day warranty standard.

SATELLITE ANTENNAS

Used Scientific Atlanta, Andrews, Vertex, RSI and others. 7 meter and up.

PTL Cable Services Inc. USA • Phone (407) 747-3647 • Fax (407) 575-4635
BUY-SELL-TRADE

When You Need Quality and Dependability, You Need

RITE CABLE CONSTRUCTION, INC.

Specializing in

Telecommunications Construction – Including Strand Mapping, Asbuilt Mapping, Fiber Optic Routing & Design, Splicing Schematic, Map Digitizing, System Design, Project Management, Fiber Splicing & Testing, Aerial & Underground Construction, Coaxial Splicing & Activation, System Sweep & Proof of Performance Testing, Complete Residential Installation, MDU Pre-Wire/Post Wire & Material Management.

"Do it the RITE way the first time."

Les Smith, President
P.O. Box 3040 (32723-3040)
1207 S. Woodland Blvd., Suite 1
DeLand, FL 32720

1-800-327-0280
Fax: 1-904-738-0870

WE BUY & SELL
SURPLUS NEW & USED

Connectors, Taps,
Headend, Line Gear, Misc.

TM BROKERS
5402 Highway 95 - Cocolalla, ID 83813
Tel: (208) 683-2797 or (208) 683-2019
Fax: (208) 683-2374
SEE INVENTORY ON HOME PAGE
EMAIL:moorst@comtch.iea.com
HOME PAGE:http://www.iea.com/-moorst
We Accept M/C or Visa

BUSINESS DIRECTORY

October

2-5: Antec Fiberworks training course, fiber-optic systems, Denver. Contact (800) 342-3763.
3: SCTE Southeast Texas Chapter meeting, BCT/E exams to be administered, Houston. Contact Richard Grahn, (713) 579-6319.
3-4: Siecor training course, cable TV passive fiber-optic system design, Keller, TX. Contact (800) 743-2671, ext. 5539 or 5560.
3-5: General Instrument training course, advanced broadband applications engineering, Phoenix. Contact Lisa Nagel, (215) 830-5678.
3-5: Philips Broadband Networks Mobile Training seminar, Pittsburgh. Contact (800) 448-5171.
5: SCTE Great Plains Chapter meeting, BCT/E and Installer exams to be administered, Bellevue, NE. Contact Randy Parker, (402) 292-4049.
5: SCTE Greater Chicago Chapter seminar, signal processing and headends, Ramada Inn, Palatine, IL. Contact Bill Cohn, (800) 544-5368.
7: SCTE Cactus Chapter seminar, transportation systems, Dimension Cable Office, Phoenix. Contact Harold Mackey, (602) 352-5860, ext. 135.
9-10: Northern Telecom seminar, fundamentals of the digital network, New York City. Contact (800) 688-7246.
10-12: Atlantic Cable Show, Atlantic City Convention Center, Atlantic City, NJ. Contact (609) 848-1000, ext. 213.
10-12: Philips Broadband Networks Mobile Training seminar, Washington, DC. Contact (800) 448-5171.
10-12: SCTE Wheat State Chapter meeting, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
11: SCTE Cascade Range Chapter seminar, BCT/E exams to be administered, Beaverton, OR. Contact Cindy Welsh, (503) 667-9390.
11: SCTE Delaware Valley Chapter seminar, fiber-optic and hybrid networks, Williamson's Restaurant, Horsham, PA. Contact Chuck Tolton, (215) 657-6990.
11: SCTE Mid-South Chapter meeting, BCT/E and Installer exams to be administered. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
11: SCTE Heart of America Chapter meeting, BCT/E exams to be administered, Blue Springs, MO. Contact David Clark, (913) 599-5900.
11-12: Northern Telecom seminar, fundamentals of the digital network, New York City. Contact (800) 688-7246.
11-12: Scientific-Atlanta training course, interactive broadband delivery system overview, Chicago. Contact Bridget Lanham, (800) 722-2009.
12: Society of Cable Telecommunications Engineers Satellite Tele-Seminar Program, "What's New with Safety in Telecommunications," from Cable-Tec Expo '95, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
12: SCTE Music City Chapter meeting, BCT/E exams to be administered, Nashville, TN. Contact Kenny Long, (615) 244-7462, ext. 392.
16-17: Antec Fiberworks training course, broadband cable TV technology, Denver. Contact (800) 342-3763.
16-17: Society of Cable Telecommunications Engineers training seminar, "Introduction to Telephony," Holiday Inn West, Fort Lauderdale, FL. Contact (610) 363-6888.
16-20: General Instrument training course, broadband communications network design, Boston. Contact Lisa Nagel, (215) 830-5678.
17: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, San Francisco. Contact Bridget Lanham, (800) 722-2009.
17-19: C-COR training seminar, digital video and fiber-optic networking, State College, PA. Contact (800) 233-2267, ext. 4422.
18: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Billings/Laurel Mt., MT. Contact Marla DeShaw, (406) 632-4300.
18-19: Antec Fiberworks training course, compressed video concepts and transmission, Denver. Contact (800) 342-3763.
18-19: Scientific-Atlanta training course, hybrid fiber/coax design, San Francisco. Contact Bridget Lanham, (800) 722-2009.
18-20: Society of Cable Telecommunications Engineers training seminar, "Introduction to Fiber Optics," Holiday Inn West, Fort Lauderdale, FL. Contact (610) 363-6888.
19: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Elks Lodge, Helena, MT. Contact Marla DeShaw, (406) 632-4300.
19: SCTE Mount Rainier Chapter meeting, BCT/E exams to be administered, Viacom office, Tacoma, WA. Contact Bruce Gladner, (206) 869-4116.
19: SCTE Northern New England Chapter seminar, status monitoring, Ramada Inn, Portland, ME. Contact Bill DeRochers, (207) 646-2672.
21: SCTE Sierra Chapter seminar, installer training, Sacramento Cable Office, Sacramento, CA. Contact Patrick Furlong, (916) 273-4866.
23-26: Antec Fiberworks training course, fiber-optic systems, Denver. Contact (800) 342-3763.
24: Scientific-Atlanta training course, analog headend system overview, Atlanta. Contact Bridget Lanham, (800) 722-2009.

Planning Ahead

Oct. 31-Nov. 2: Private Cable & Wireless Show, Miami Beach, FL. Contact (713) 342-9826.
Nov. 29-Dec. 1: The Western Show, Anaheim, CA. Contact (510) 428-2225.
Jan. 8-10, 1996: Society of Cable Telecommunications Engineers Emerging Technologies conference, San Francisco. Contact (610) 363-6888.
Feb. 21-23, 1996: Texas Show, San Antonio Convention Center, San Antonio, TX. Contact (512) 474-2082.

SCTE INSTALLER PROGRAM INFORMATION REQUEST CARD

The SCTE Installer Certification Program was created to establish minimum skill requirements for CATV installers and installer/technicians. Participants in the program must successfully complete practical examinations in the areas of cable preparation and meter reading, as well as a written examination on general installation practice. The program is being administered by local SCTE chapters and meeting groups under the guidance of SCTE national headquarters. All candidates for certification in the program are recognized as SCTE members at the Installer level, and receive a copy of the *SCTE Installer Manual.*

☐ Please send me information and an application for the SCTE Installer Program

Name ______________________________

Address ______________________________

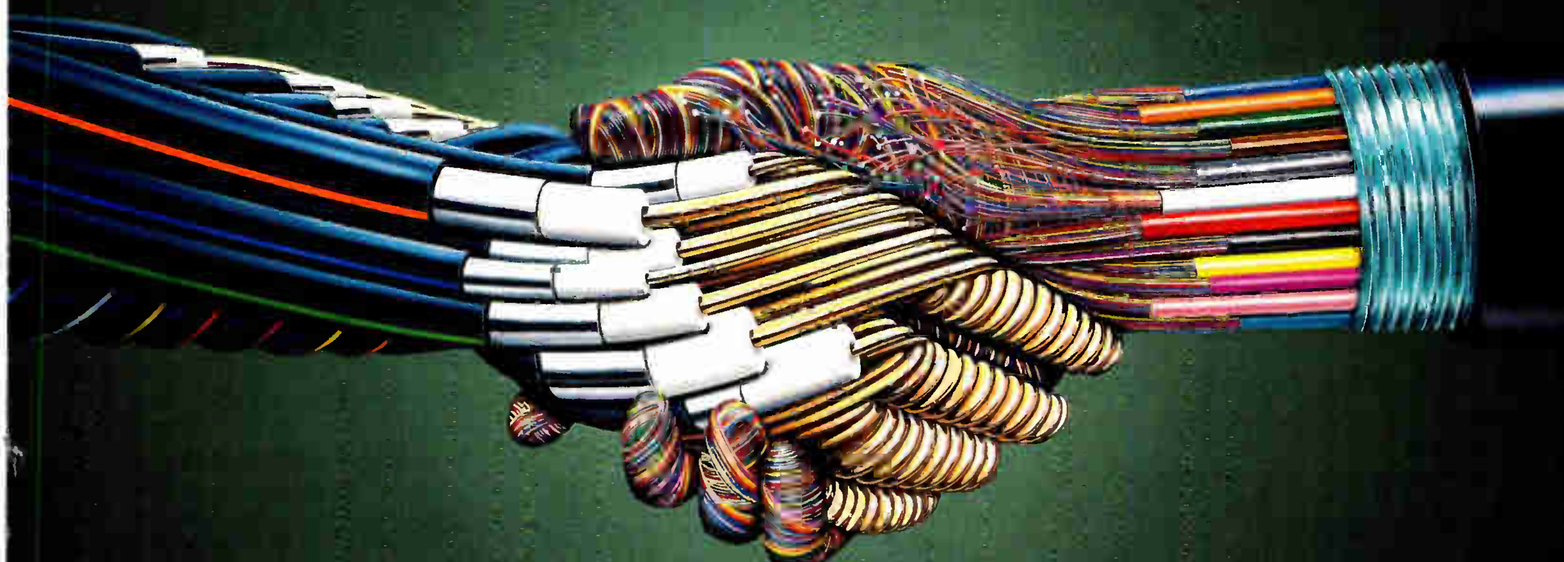
Phone ( ) ______________ FAX ( ) ______________

SCTE 10/95

SCTE®
The Society of Cable Telecommunications Engineers
"Training, Certification, Standards"

Mail to:
SCTE
669 Exton Commons, Exton, PA 19341
OR FAX TO: (610) 363-5898

We Build More Than Communication Systems . . .



We Build Relationships.

- Fiber/Coax Construction
- Repair Services
- Equipment Supply
- Engineering & Design

Visit Us At The Atlantic Cable Show, Booth #158, 160, and 162.

Cable Services Company/Inc.

2113 Marydale Avenue, Williamsport, PA 17701 • Toll-Free 1-800-326-9444

Reader Service Number 14

By Bill Riker, President, Society of Cable Telecommunications Engineers

Planning for the future

I am writing this article on my flight back from a weeklong series of extremely productive meetings in Denver, highlighted by CableLabs' summer conference. During that conference, CableLabs' membership heard about the latest technologies that may play a role in the transition of a cable system into a full telecommunications network.

These reports demonstrated to me how many technological options are currently being considered at the corporate level. It also made me realize how fast SCTE members will be asked to react in learning to install, operate and troubleshoot these new technologies once the final decision is made for widespread implementation.

These challenges were addressed by the Society's five standing committees (training, engineering, operations, planning and finance) during their series of meetings in September at the Opryland Hotel, the site of Cable-Tec Expo '96.

In order to assist the committees in better serving the membership by meeting the technical training needs of an evolving industry, I scheduled a series of "planning meetings" involving the entire national headquarters staff. These meetings took place on Aug. 23-25 and addressed member services, public relations, promotion and training issues geared toward meeting the objectives established by the board following the analysis conducted by the Planning Committee that analyzed the Society's "strengths, weaknesses, opportunities and threats."

Staff ideas and recommendations stemming from these meetings were then presented to the standing committees for review and modification and were eventually presented to the full board for recommendation.

I am confident that through this process, the Society can better foresee the needs of our industry (and therefore, our membership) and quickly act to implement expanded training programs and technical standards development.

I also would like to take this opportunity to update the membership on the current progress of the new national headquarters building. A groundbreaking ceremony was held on July 18 at the site of the new facility, which is only minutes away from the present location of our office. On hand for the ceremony were SCTE national Chairman and Region 12 Director John Vartanian, Region 11 Director Dennis Quinter and the SCTE national headquarters staff.

Those in attendance at the ceremony were given a tour of the lot while I described the plans and layout for the new building. All present were very enthusiastic about finally having an opportunity to see the new location. It is in the well-established Pickering Creek Industrial Park, which has been a home to many large, successful companies for over 25 years. The lot purchased by the Society provides a great deal of privacy because the grounds are almost entirely surrounded by trees, and the building will barely be visible from the road. There also is sufficient space to build an addition if, in later years, the growth of the Society necessitates such expansion. This cost-effective foresight could save the Society hundreds of thousands of dollars should an addition be required, because national headquarters would not need to move again.

The new building will cover 15,000 square feet, and currently is scheduled to be completed in January 1996. As of this writing, the utilities have been installed, the driveway curbing has been completed and the foundation is in progress. With the preparatory work nearly finished, the crew will soon begin work on the actual exterior structure of the building. Fortunately, everything is moving along according to schedule and going very well. The weather has been extremely good for building and I hope this continues over the next few months while the building is being constructed.

The new building will afford the Society greatly increased office space, which will allow us to better accommodate the growth that SCTE has experienced in recent years, both in terms of increased membership and the larger staff that is necessary to serve the growing numbers of its members. On-site warehouse space will be built to house the many publications and video-

tapes offered by the Society. There also will be a conference room to accommodate board and committee meetings, in addition to a classroom in which we can conduct training seminars.

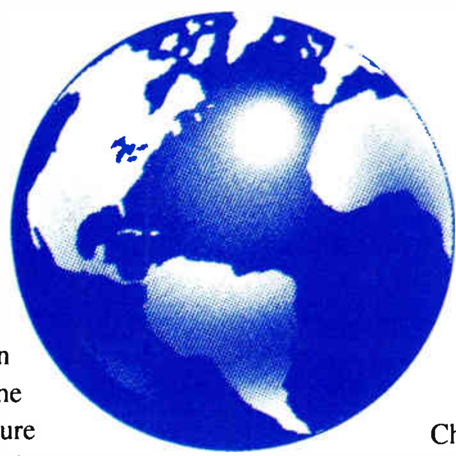
One of the highlights of the new headquarters building will be a room displaying artifacts from periods throughout the history of the industry showing the progress of broadband communications since its inception. We plan to have classic signal level meters and amplifiers, and a sample cable trunk and feeder system showing the hardware that is at the core of the training provided by the Society. Members interested in donating technical artifacts for the display should contact myself or Roberta Dainton at national headquarters, (610) 363-6888.

The convenient proximity of the new headquarters building to the present location will afford the Society the continuity of being able to retain the long-standing relationships with local vendors and service providers.

I look forward to bringing you more good news about the progress of both the new building and the results of the planning meetings to be held with the national headquarters staff. I am glad to see that in a time of extreme change in our industry, the Society is taking actions that will "move with the changes" and accommodate its efforts to provide better services to its membership and the industry as a whole. CT

Cheetah™

See it big...
Keep it simple.



Looking at the "big picture," Cheetah™ came up with a simple idea: a network management system that is designed to evolve and adapt to changing technologies.

As new products for signal distribution and alternative services come into the market, the Cheetah System architecture will be compatible. This system was designed by the Cheetah development team, which includes the best hardware and software engineers from around the world. Simply put, their job is to develop an open system that offers compatibility and flexibility.

The Cheetah System allows you to grow from a few line monitors for FCC testing to a network management system that meets your evolving requirements for network reliability and deployment of new services.

By integrating equipment from multiple vendors into one global network management system, Cheetah provides a flexible solution that offers seamless interconnections. In addition, as you add services like interactive video, telephony and data transmission, be assured that you can expand your Cheetah System to provide one integrated management tool.

From this big picture perspective, we offer you a simple network solution. This is what has made the Cheetah System a standard around the world. From the Pacific Rim to Europe and North America, the Cheetah System has been selected to monitor the world's broadband networks.

Network Management. Performance Measurements. Status Monitoring. The Cheetah solution will work for you now and in the future.

S U P E R I O R   E L E C T R O N I C S   G R O U P ,   I N C .

6432 Parkland Drive • Sarasota, Florida 34243 • (813) 756-6000 • (813) 758-3800

Reader Service Number 105

BRIDGEPOINT

COMMUNICATIONS INC.

Aerial
New Build
Fiber Placement
Installations

Underground
Rebuild
Upgrade Splicing
Splicing

(800) 766-2188

DALLAS • HOUSTON • PHOENIX • BOSTON • HONOLULU

CDS CAD DRAFTING SERVICES,INC.

Charles Wright
(815) 698-2564
Rt. 116 & I-57, Central Plaza
Ashkum, IL 60911

- Base Mapping
- Strand Mapping
- Digitizing Services
- As-Built Mapping
- System Design
- System Walkout

Specializing in high volume precision drafting.

"Quality service for all your cable drafting and design needs."

Call for literature.

David Sylvestre
860-953-9240

EDJ

COMMUNICATIONS INC.

WIRELESS SERVICE

Area Evals
Data Base Information
Wireless Installs/Roof & Trees
MDU Prewire/Postwire
65′ Tower Trucks for Site Surveys

GENESIS CABLE SURPLUS SUPPLY

FACTORY AUTHORIZED SUPPLIER PHILIPS BROADBAND REFURBISHED

MAGNAVOX 450

Full Selections
330 & 450 MHz Electronics

8000 Series
Taps & Couplers

SAVINGS! SAVINGS! SAVINGS! 50,000 Surplus Taps Immediately Available

Converters

DPV #5 Refurbished • DPV #7 Refurbished • SA 8550's
Complete Selection of JM Telecoms Remotes Featuring
Cable Only 2 in 1 with Volume Control • Free Batteries
Full Selection Gilbert Connectors • Connectors or Electronics – Cash Paid

Wanted: Surplus Equipment

Let Genesis Cable Surplus **Maximize Return On Surplus Inventory**
Call Ed Manley at 916-971-8989 • Fax 916-971-8988

Genesis Cable Surplus Supply • 3487 N. Orange Ave.,No. Highlands, CA 95660

PYRAMID

Is Quality Construction

Pyramid Industries offers **Quality** Smoothwall, Ribbed or Corrugated Innerduct at **competitive prices** and **immediate** delivery, contact your local distributor or call us at: **814-455-7587.**

PYRAMID INDUSTRIES, INC.

1422 Irwin Dr. Erie, PA 16505 • 814/455-7587 Fax 814/454-8756

QUALITY CABLE & ELECTRONICS INC

1950 N.W. 44TH STREET • POMPANO BEACH, FL 33064

RIPLEY
SCIENTIFIC ATLANTA
MAGNAVOXA
AMPHENOL
TEXSCAN
COMPEDCO
JERROLD
LEMCO
CABLETECH
PANASONIC
BLONDER TONGUE
SYLVANIA
C-COR
COMMSCOPE

DROP MATERIAL / LINE EQUIPMENT / CONVERTERS / HEADENDS

New/Used/ All Equipment/Competitive Prices

Phone: (954) 978-8845 (800) 978-8845 Fax: (954) 978-8831

AD INDEX

We Buy Scrap CATV

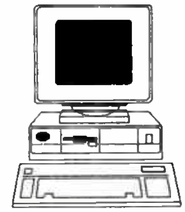
MATEJKA

Cable Recovery Inc.

COAST TO COAST SERVICE

818 W. 3rd St. • P.O. Box 1224
Winona, MN 55987

Tel: (800) 831-2925 BUYERS OF SCRAP CATV



ANNOUNCING PCMS

A PC character generator for under **$500!**

VERY EASY TO USE

Does not require Windows

Optional VCR controller.

Full color graphics / remote entry / multiple users

Dickel Communications
5208 E. Hanbury
Long Beach, CA 90808

call today
FAX 310-496-4716
Tel. **310-496-0674**

Your **No. 1** vendor of

Converters • Remotes • C. G.'s • Parts

with

Price ▪ Service ▪ Delivery

Cable Technologies International, Inc.

2500 Office Center, Suite 300 Willow Grove, PA 19090

(215) 657-3300 Fax (215) 657-9578 E-Mail cti@haven.ios.com

Are You Looking for Installers??

NaCom

Building Communication Systems Throughout America

Celebrating our Silver Anniversary

NaCom, a contractor offering outstanding customer service for:

- Residential Premise Wiring
- MDU's
- Drop Buries
- Primestar
- Broadband Modems

Call (800) 669-8765, Ext. 3046

Nationwide Services

RETURN PATH ACTIVATION

TSB

- **HEADEND SERVICES**
  - COMPLETE HEADEND RELOCATION SERVICE
  - RERACK AND REWIRE
  - OPTIMIZE
- **FCC PROOF OF PERFORMANCE**
  - RF PROOFS
  - VIDEO TRIANUAL PROOFS
- **RETURN ACTIVATION**
- **ON SITE TRAINING**
- **DESIGN AND DRAFTING**
  - AS BUILT MAPPING
  - SYSTEM DESIGN
  - MAP MANAGEMENT AND SYSTEM UPDATES

P.O. Box 305
Ipswich, S.D. 57451
(605) 426-6140

800-292-0126

PDI SURPLUS EQUIPMENT

We Buy, Sell and Trade! New or Refurbished

- **Trunk Amps**
- **Line Extenders**
- **Taps**
- **Converters**
- **Test Equipment**
- **and much more!!!**

All equipment is refurbished and tested in PDI's state of the art test facility.

1 year warranty on all surplus equipment!!

1-800-242-1606 (561) 998-0600 FAX: (561) 998-0608

http://www.pdi-eft.com E-Mail JonPDI@aol.com

CCI

CABLE CONSTRUCTORS, INC.

COMPLETE TURNKEY CONSTRUCTION 1-800-338-9299

- Coaxial and Fiber
- Mapping and Design
- Member SCTE
- Splicing and Activation
- Fusion Splicing
- Aerial, Underground & Fiber Construction
- Material Supply
- Emergency Fiber Restoration
- System Sweep
- Proof of Performance
- Turnkey Headend
- Complete Turnkey Project Management

quality service performed on a timely basis

E MAIL CCI @ cableconstructors.com • http://www.cableconstructors.com

---

WE BUY SCRAP CATV CABLE

MIDWEST CABLE SERVICES

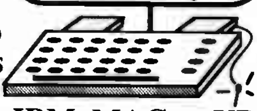
800-852-6276

10 YRS OF NATIONWIDE SERVICE

PO Box 96 Argos, IN 46501

Video Poster™
Low cost Character generators

Hi-res Fonts
Weather
Logos
Graphics
Crawl messages



*Infra-red VCR deck control
*Full weather station options
*Free Hi-res graphics & Logo
*User sets Time & date events
*Battery backed Ramdisk
*Program all via modem from IBM, MAC or VP

Engineering Consulting
Tel:714-671-2009*Fax:714-255-9984
Ask for Demo video tape
WEB-->http://home.earthlink.net/~engcon

130 SPECIALIZED TRUCKS IN STOCK

1100

(10) Telsta-Versilift 1 Ton Buckets In Stock
(10) Digger Derricks Etc.
(50) 28 To 75 Ft Bucket Trucks In Stock
Call For Price List: (215) 721-4444   Fax: (215) 721-4350

Opdyke Inc.
Truck & Equipment Sales
3123 Bethlehem Pike
Hatfield, PA 19440 USA

We Buy Surplus Trucks

White Sands

Jumper Cables
CUSTOM MADE CABLE ASSEMBLIES INCLUDING:
F to F, N to N, BNC, RCA, F-81

Gilbert AHS	RG-56	Belden
LRC	RG-59	Times
Off Shore	RG-11	Comm/Scope
PPC	RG-213	Intercomp
	RG-214	

We will make any cable assembly. Quick delivery on all colors and lengths.
Fax: (602) 582-2915, PH: (602) 581-0331
335 W. Melinda Drive, Phoenix, AZ. 85027 USA

FIBER OPTIC SYSTEMS

Design • Installation • Testing • Full Turn Key Services

Applications:
Telephone • Cable TV • 802 Networks • Process Control • Security • IVHS • Educational Networks

Services Include:
System Engineering & Design • Outside Plant Construction • Project Management • Aerial & Underground Cable Installation • Systems Integration • Premises Wiring • Splicing • Termination • Testing • Activation • Training • Emergency Service

AXSYS Communications

P.O. Box 571
Danielson, CT 06239-0571
Tel: 860-774-4102 • Fax: 860-774-4783

Planes 1057 • (1405) Buenos Aires
República Argentina
Tel: 582-2915 • Fax: 582-1372

Cable TV Service and Line Technicians

Falcon Cable is seeking qualified, experienced technicians for service and maintenance in several California locations, working knowledge of AML microwave and fiber optics a plus. Must have a good driving record and excellent customer service skills. Tech positions are currently open in Malibu area, and Lead Tech positions are open in the Gilroy and San Luis Obispo areas.

Please submit resume to:
Falcon Cable
7555 San Luis Ave.
Atascadero, CA 93422
Attention Personnel
or Fax to: 805-466-6366.

EEO M/F/D/V

Call Rebekah Markheim

at
1-800-325-0156 x33
for classifieds

SUBCONTRACTORS WANTED

Splicing, Activation & Aerial Construction Crews needed for long-term work in the New England area. Paid weekly.

PLEASE CALL
(800)233-7330

Cable Search Associates

Professional Search and Placement

Engineering • Management • Technicians • Sales • Marketing • Construction

Call or Write
WICK KIRBY
Office (630) 369-2620 FAX (630) 369-0126
P.O. Box 2347 • Naperville, IL 60567
Fees Paid

Wanted!

Experienced long term help for Southeast rebuilds/upgrades

Aerial Crews
Underground Crews
Splicers
Installers
Field Engineers

CABLE MAN, INC.
Call (601) 374-5832
Fax: (601) 374-2198

PERSONNEL SERVICES

ALL LEVELS OF POSITIONS FILLED NATIONWIDE
• Technicians • Engineers • Managers • Sales
Send resume with salary requirement to address below.
Employer Inquiries Invited.

Communication Resources
The Communication Personnel Specialists
Since 1989
P.O. Box 141397 • Cincinnati, OH 45250
606-491-5410 / FAX 606-491-4340

Irwin Utilities of Texas, Inc.

Employees & Sub-Contractors
Aerial, Underground, Splicing, and Activation
Several Locations in U.S.
FAX Resume: 214-388-7994

- **TECHNICAL OPERATIONS MANAGERS**
- **SYSTEM ENGINEERS**
- **HEAD-END TECHNICIANS**
- **CONSTRUCTION MANAGERS & SUPERVISORS**

We currently have multiple openings with Top Five MSO's and foreign clients. Please send your resume and salary history to: **Warren, Morris & Madison, Ltd., Attn: Technical Dept., 132 Chapel St., Portsmouth, NH 03801 or call 603-431-7929.**
An Equal Opportunity Employer

Warren, Morris & Madison, Ltd.

VS Viewsonics inc.

Now part of a 3 Billion $ Corporate Structure

EXPANDS

NEEDED

Sales Engineers
Product Design Engineers
RF/Microwave
System Engineers CATV/MMDS
Live and Work in
Sunny Boca Raton, Florida

1 800-645-7600
Fax Resume 1 561 998-3712
All Information Held Confidential

TESINC

t•e•s•i•n•c
A Dycom Company
6523 N. Black Canyon Highway
Suite 200
Phoenix, Arizona 85015
(602) 242-8110 FAX (602) 242-8227

EXPERIENCED CATV
POSITIONS AVAILABLE NATIONWIDE
LONG TERM VDT PROJECTS
IMMEDIATE OPENING: FL & CA
TESTERS, MDU ENG'S, INSPECTORS
CATV TECH'S. TRUCK & TOOLS REQ'D
BENEFIT PACKAGE A BIG PLUS

An Equal Opportunity Employer

Send Resumes and Call: 1-800-800-7886

25,000 technical people, from Presidents to Technicians, at cable microwave & telephone companies read Communications Technology every month.

To run your Help Wanted ad send a fax to

Rebekah Markheim
303-839-1564

Peter Froehlich & Co. executive search

SCTE Sustaining Member

P.O. Box 339 Weatherford, TX 76086
(800) 742-4947 FAX (817) 594-1337

All levels of Technical Positions - Corporate to Hourly. Operators and Manufacturers
Call or Write. Fees Paid.

Software Engineer: Identify geographical area for client marketing; develop geographical area through use of census data; use AGIS to develop maps; identify telephone numbers in area in relation to locations specified; develop a FoxPro database with individual phone numbers routed to locations as specified by client. Requires: Bachelors in Computer Engineering; ability to interface AGIS data to FoxPro database, to generate complex source codes using AGIS, FoxPro and Windows software, to install and troubleshoot problems with PC based equipment (hardware and software), to develop programs within established software AGIS, FoxPro and DbaseIII. 9:00am-5:00pm, Mon.-Fri. $35,350. Send resume to: Job Service of Florida, 1001 Executive Center Dr., Orlando, FL 32803-3520, Re: Job Order #1510209

ADC, the leader in HFC technology, is building tomorrow's broadband networks today.

Our Systems Integration Group is seeking experienced professionals to help us deliver the network solutions our customers require. We have immediate openings in both our Minneapolis Headquarters as well as regional offices for the following positions:

- **Project Managers**
- **Systems Engineers**
- **Head-end Technicians**
- **RF Plant Engineers**
- **Installation Supervisors**

ADC Telecommunications®

We offer ideal candidates an excellent salary and benefits package along with the opportunity to work and grow with an industry leader. For consideration, send your resume to: **ADC Telecommunications,** Mail Station 57 CTT, 4900 West 78th St., Minneapolis, MN 55435, Fax to: (612)946-3419, or visit our website at www.adc.com
EOE

January

9-11: Society of Cable Telecommunications Engineers Conference on Emerging Technologies, Opryland Hotel, Nashville, TN. Contact SCTE national headquarters, (610) 363-6888.
13-15: Society of Cable Telecommunications Engineers regional training seminar, "Technology for Technicians II" Harvey Hotel, Dallas. Contact SCTE national headquarters, (610) 363-6888.
14: SCTE Cascade Range Chapter seminar, Holiday Inn, Wilsonville, OR. Contact Cindy Welsh, (503) 667-9390, ext. 226.
16: SCTE regional training seminar, OSHA/safety, Harvey Hotel, Dallas. Contact SCTE national headquarters, (610) 363-6888.
16: SCTE Penn-Ohio Chapter, BCT/E and Installer Certification exams to be administered, Sheraton Inn North, Pittsburgh. Contact Marianne McClain, (412) 531-5710.
16: SCTE Rocky Mountain Chapter seminar, consumer interfaces, Louisville, CO. Contact Mike Phebus, (303) 795-1699.
18: SCTE Cascade Range Chapter, BCT/E certification exams to be administered, McMinnville, OR. Contact Cindy Welsh, (503) 667-9390.
22-23: SCTE Big Sky Chapter annual meeting and BCT/E and Installer Certification exams, Little Big Men Pizza, Laurel, MT, and Jackson Creek Saloon, Helena, MT. Contact Marla DeShaw, (406) 632-4300.
23: SCTE Michiana Chapter seminar, national SCTE update and EAS systems and BCT/E tutorial—Category II, "Video and Audio Systems and Convergence of Data," Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.
24: SCTE North Country Chapter, BCT/E Certification exams, Meredith Cable office, Columbia Heights, MN. Contact Bill Davis, (612) 445-8424.
27-28: Society of Cable Telecommunications Engineers regional training seminar, introduction to data communications, SCTE national headquarters, Exton, PA. Contact SCTE national headquarters, (610) 363-6888.
29-31: Society of Cable Telecommunications Engineers regional training seminar, introduction to fiber optics, SCTE national headquarters, Exton, PA. Contact SCTE national headquarters, (610) 363-6888.

February

8: SCTE Llano Estacado Chapter seminar, fiber-optic basics, Cox Cable Office, Lubbock, TX. Contact David Fielder, (806) 793-7475 ext. 4518.
10-11: Society of Cable Telecommunications Engineers regional training seminar, introduction to telephony, Columbus, OH. Contact SCTE national headquarters, (610) 363-6888.
12-14: Society of Cable Telecommunications Engineers regional training seminar, introduction to fiber optics, Columbus, OH. Contact SCTE national headquarters, (610) 363-6888.
12: SCTE Delaware Valley Chapter seminar, Williamson's Restaurant, Horsham, PA. Contact Chuck Tolton, (215) 657-5850.
13: SCTE North Central Texas Chapter seminar, fiber and telephony. Contact Lynn Watson, (817) 790-7557.
19-21: Texas Cable Show, San Antonio Convention Center, San Antonio, TX. Contact (512) 474-2082.
20: SCTE Michiana Chapter, BCT/E and Installer Certification exams, LaPorte, IN. Contact Russ Stickney, (219) 259-8015.
20: SCTE New England Chapter, BCT/E and Installer Certification exams, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.

March

3-4: Society of Cable Telecommunications Engineers regional training seminar, introduction to data communications, Omaha, NE. Contact SCTE national headquarters, (610) 363-6888.
5-6: SCTE Central California, Golden Gate, Shasta/Rogue and Sierra SCTE Chapters Northern California Vendors' Days and technical presentation, Concord Hilton Hotel, Concord, CA. Contact Andy White, (707) 448-7478.
6-7: Society of Cable Telecommunications Engineers regional training seminar, introduction to telephony, Omaha, NE. Contact SCTE national headquarters, (610) 363-6888.
16-19: National Cable Television Association Cable '97, New Orleans. Contact (202) 775-3606—exhibitor information; (202) 775-3669—other information.
19: SCTE Big Sky Chapter seminar and BCT/E and installer Certification exams, Little Big Men Pizza, Laurel, MT. Contact Marla DeShaw, (406) 632-4300.
20: SCTE Big Sky Chapter seminar and BCT/E and Installer Certification exams, Jackson Creek Saloon, Helena, MT. Contact Marla DeShaw, (406) 632-4300.
27: SCTE Michiana Chapter seminar, emerging technologies and how they will affect our industry, and BCT/E tutorial—Category IV, "Distribution Systems," Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.
27: SCTE Penn-Ohio Chapter BCT/E and Installer Certification exams, Sheraton Inn North, Pittsburgh. Contact Marianne McClain, (412) 531-5710.

April

8: Society of Cable Telecommunications Engineers regional training seminar, OSHA/safety, Portland, OR. Contact SCTE national headquarters, (610) 363-6888.
9-11: SCTE Society of Cable Telecommunications Engineers regional training seminar, introduction to fiber optics, Portland, OR. Contact SCTE national headquarters, (610) 363-6888.
9: SCTE Delaware Valley Chapter Vendor Fair, Williamson's Restaurant, Horsham, PA. Contact Chuck Tolton, (215) 657-5850.
10: SCTE North Central Texas Chapter seminar, EAS and telco updates. Contact Lynn Watson, (817) 790-7557.
17: SCTE New England Chapter BCT/E and Installer Certification exams, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.
19: SCTE Llano Estacado Chapter seminar, headend tests and measurements, Cox Cable Office, Lubbock, TX. Contact David Fielder, (806) 793-7475 ext. 4518.

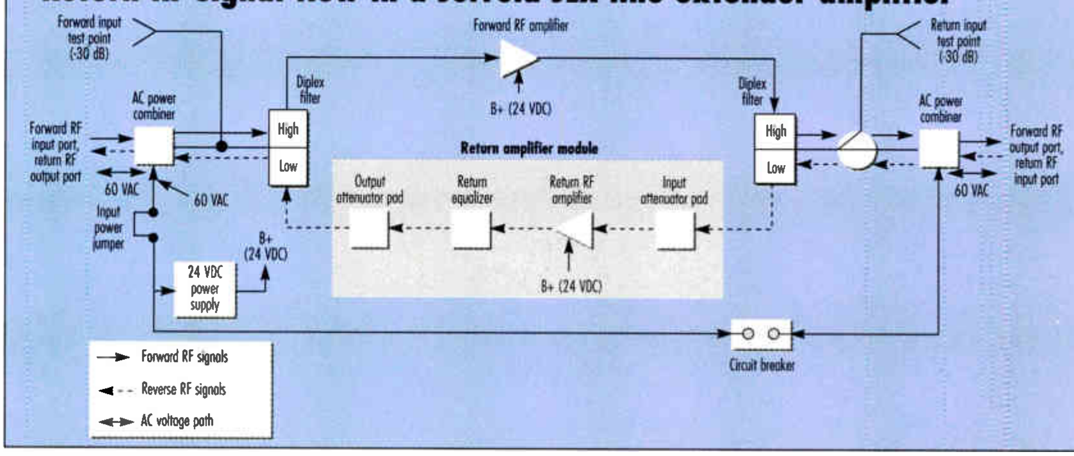
Planning ahead

June 4-7: SCTE Cable Tec-Expo '97, Orlando, FL. Contact (610) 363-6888.

By the National Cable Television Institute

Return path in line extenders: Part 1

The answers to last month's review questions are provided below. This month begins the first part of a series on the return path in line extender amplifiers. Its purpose is to provide useful information complemented by training suggestions to reinforce the material in a classroom setting. The top portion is excerpted from a lesson in NCTI's Installer Technician Course. The hands-on training suggestions are modeled after NCTI's new facilitator training courses for administering the hands-on labs. © NCTI.



Return RF signal flow in a Jerrold JLX line extender amplifier

The return amplifier either is a separate module that plugs into the forward amplifier module or is directly mounted on the circuit board in the amplifier module itself. The return amplifier module amplifies the return signals (also known as reverse signals) for transmission to the next return amplifier upstream. Full return capability is designed into most new or upgraded system designs to accommodate interactive services. Knowledge of the return amplifier operation is necessary when maintaining, troubleshooting and replacing the return amplifier module. Always learn the operation of your system's particular return amplifier module.

Return amplification path

The common frequencies used in return amplifiers fall within the sub-band (5-30 MHz for 550 MHz bandwidth and 5-42 MHz for 750 MHz bandwidth). Most manufacturers also make available other combinations of return path frequencies. The accompanying figure is a functional diagram of one example of a return amplifier, the Jerrold JLX series.

The figure shows that the lower return path frequencies are received at the forward RF output/return RF input port and directed to the return amplifier module via the output diplex filter, as indicated by the dotted line. The diplex filter separates the higher frequency forward RF signals from the lower frequency return RF signals. The return RF signals then pass through an input attenuator pad where, if required, the signals are attenuated to an appropriate input signal level prior to the return RF amplifier.

After the input attenuator, the return signals are amplified by the return RF amplifier to a level high enough to reach the next return amplifier upstream. Next, the return signals are routed through an equalizer, which induces slope to offset the effects of cable tilt on the return signals. The return signals are passed through an output attenuator pad where, if required, the signals are attenuated to an appropriate signal level for the next upstream return amplifier. Finally, the return signals are sent through an input diplex filter before being output to the next upstream return amplifier.

Next month's installment will cover return path setup in 750 MHz line extenders.

Hands-on performance training

***Proficiency objectives:** Identify the frequency band, signal flow and major components and their functions in the return path of your line extender(s).*

Provide each student with a block diagram of your system's line extender(s).

Describe the frequencies used and types of information transmitted in the return path of your system.

Use the block diagram (and if possible, the actual amplifier) to show the return signal flow through the major components, while describing what each does and how it affects the signals in the line extender's return path.

Verify that each student knows the return frequency band and signal flow, and can identify the major components and describe their functions in the return path of your line extender(s). **CT**

Answers to last month's review questions
1) reverse RF signals; 2) video, status monitoring, addressable response or data signals; 3) low-pass filter; 4) optical output power level; 5) 1 VDC = 1 mW

Reader Service Number 130

By Bill Riker

Exercise your right to vote

Every January marks the time when SCTE national headquarters mails its members an election package for the Society's annual board of directors election.

Open seats

This year, there are seven open board seats to fill. Two of these positions are for At-Large Directors, which can be voted on by the entire membership. Only members based in the five regions represented by board members whose terms expire in 1997 will be eligible to vote for their respective local representatives in this year's election.

The following seats are open:

- At-Large Director, representing the entire United States (two positions available);
- Region 1 Director, representing California, Hawaii and Nevada;
- Region 2 Director, representing Arizona, Colorado, New Mexico, Utah and Wyoming;
- Region 6 Director, representing Minnesota, North Dakota, South Dakota and Wisconsin;
- Region 9 Director, representing Florida, Georgia, South Carolina and the Caribbean; and
- Region 11 Director, representing Delaware, Maryland, New Jersey and Pennsylvania.

As always, I urge all SCTE members to vote in the 1997 board of directors election to ensure that the entire membership is properly represented. As an SCTE member, please exercise your right to vote and make your voice heard. Only 17% of eligible SCTE members participated in the board election last year. Please help us rectify this trend through your participation.

Even for members who live in a region that is not electing a new director this year, it is still important to vote for the two At-Large Director positions, which will represent members in all regions and internationally. Although you may not personally know all of the candidates, by reading the election package, you can familiarize yourself with each candidate's background, accomplishments and previous participation in the Society.

Current directors

The directors who were elected last year to serve during 1996-1998 are:

- At-Large Director: Ron Hranac, representing the entire United States;
- Region 3 Director: Norrie Bush, representing Alaska, Idaho, Montana, Oregon and Washington;
- Region 4 Director: M.J. Jackson, representing Oklahoma and Texas;
- Region 5 Director: Larry Stiffelman, representing Illinois, Iowa, Kansas, Missouri and Nebraska;
- Region 7 Director: Jim Kuhns, representing Indiana, Michigan and Ohio;
- Region 8 Director: Steve Christopher, representing Alabama, Arkansas, Louisiana, Mississippi and Tennessee;
- Region 10 Director: Maggie Fitzgerald, representing Kentucky, North Carolina, Virginia, West Virginia and the District of Columbia; and
- Region 12 Director: John Vartanian, representing Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

These members will continue to serve on the board until next year's election.

Member survey

Also enclosed with the election package will be the annual membership survey. Again, I'd like to stress the importance of completing the survey and returning it to national headquarters. This is a vital way for SCTE's board and staff to receive large amounts of information directly from the membership. We use the survey to evaluate our existing services and to consider the implementation of new programs.

We also need your comments to determine if we need to focus on new issues facing our members professionally, and if we should expand existing training programs, services and merchandise. We read every survey and closely evaluate the comments from our members, so please take the time to fill out your membership survey so that we may continue to meet your technical training needs.

As I am writing this, the 1997 Conference on Emerging Technologies has not yet taken place. However, after the conference, I will report on the numerous technical events that occurred at the Nashville-based event. With so much activity in the technical arena of the telecommunications industry, there is no doubt that our 1997 Conference on Emerging Technologies will be the biggest and most well-attended yet. (For more details on ET '97, see page 78.)

This year's conference is organized similarly to earlier ones in that it is being presented with a general theme. This year's theme is "data." This is significant because cable systems will most likely offer data transmission services to consumers before offering telephony. These data services require digital technology, which many systems do not currently employ. Those who are not equipped to compete risk getting left behind.

For those of you unable to attend the conference, a proceedings manual containing all of the papers presented will be available through SCTE national headquarters.

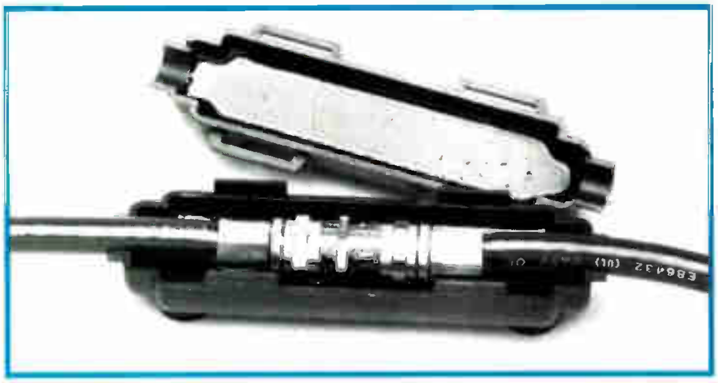
1996 was a very eventful year for the Society. Because of our new national headquarters facility and increased staff, 1997 will be very productive, with new certification programs in the works, new publications and videotapes under development, more technical seminars scheduled across the country and even more efficient service for SCTE members. Your input guides the Society, so again, please complete and return your 1997 election ballot and member survey. We look forward to hearing from you! **CT**

Bill Riker is president of the Society of Cable Telecommunications Engineers. For more details on the SCTE national board election, see "Hranac's View" on page 22.

GELSEAL™

RE-ENTERABLE

Three 1 Step Splice Kits that Fit All Your Underground and Direct Burial Emergency Repair Needs



Part No. 3610-GS For RG6/59 Drop Cable Twisted Pair

Part No. 3611-GS For RG11/7 Drop Cable Twisted Pair

Part No. 3612-GS For .412 - .750 Feeder Cable

Mechanical Specifications

Splices protected when direct buried and exposed to temperature ranges of -40°f to 140°f.

Test	Test Conditions
Environmental Cycling	-40°C to 60°C 3 cycles/day 100 cycles
Heat Aging	60°C, 30 days
Water Immersion	Room temperature, for 30 days, 2 foot waterhead
Freeze-Thaw Cycling	-40°C to 60°C, 2 cycles per day, 100 cycles
Salt Fog	per ASTM B-368, 30 days
Soil Chemical Resistance	30 day immersion in: 0.1N Na_2SO_4 0.1N NaCl 0.1N H_2SO_4 0.1N NaOH
Fungus Resistance	per ASTM G-21

Multilink™

Engineered to Make the Difference

587 Ternes Avenue, P.O. Box 955, Elyria, Ohio 44035
Office & Plant (216) 366-6966 Fax# (216) 366-6802

Reader Service Number 16