Communication Technology

OFFICIAL TRADE JOURNAL OF THE
SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS

FEBRUARY 1999

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Digital, OpenCable, Powering

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Broadband Amplifier Platform

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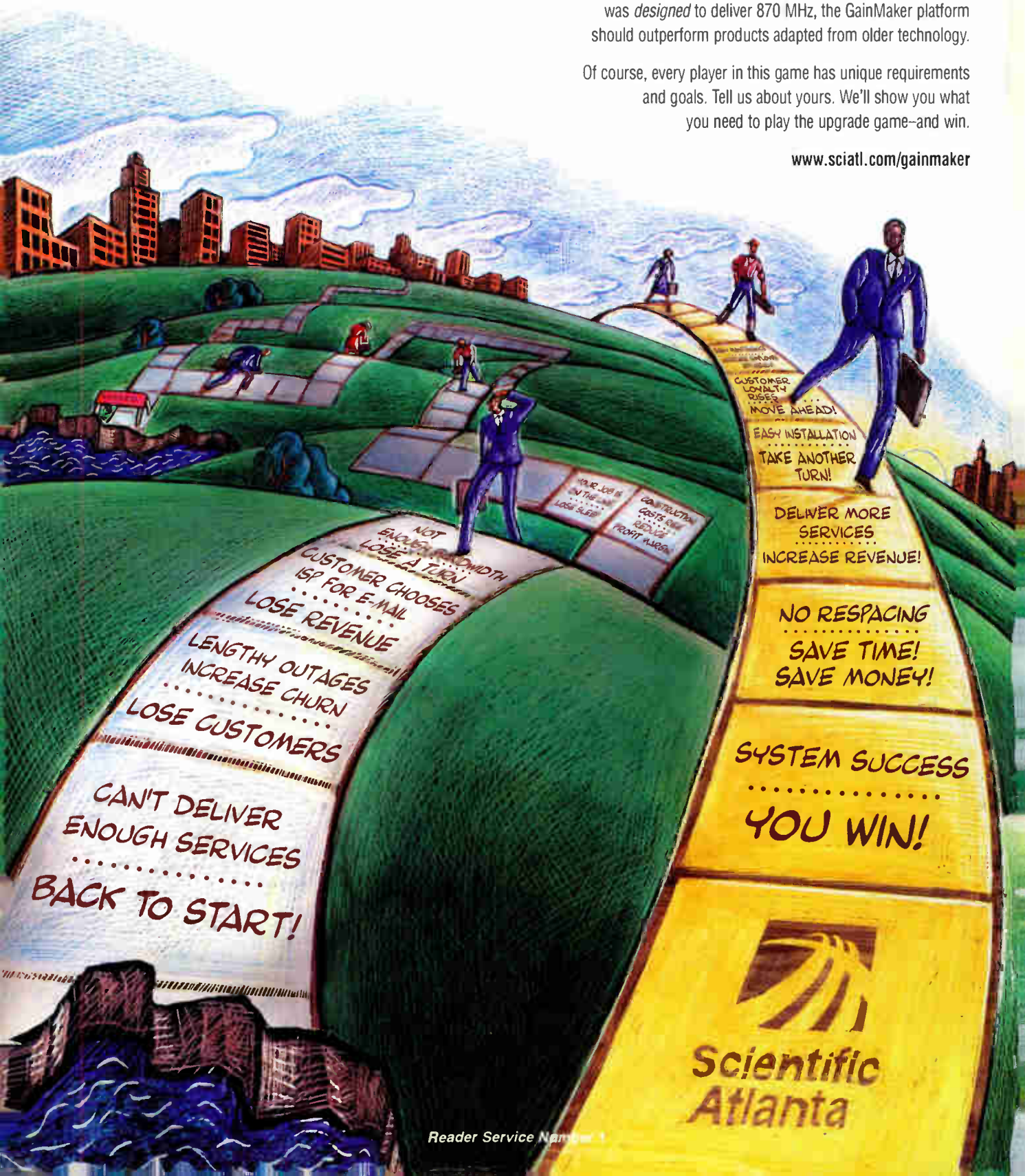

Built on Past Success... Upgraded for Future Excellence

Celebrating milestones remains a key cable industry feature. Last year, we celebrated cable's 50th anniversary. Now, the Society of Cable Telecommunications Engineers pauses to recognize its own 30th Anniversary.

The Society's mission—"Training, Certification, Standards"—has and will continue to impact the industry. Through our partnership with *Communications Technology* magazine, we will spotlight each month some of our key past successes and current enhancements.

Training

SCTE's Knowledge Avenue product line offers a revolutionary way for cable operators, manufacturing companies and other technical businesses to support both in-house training and individual skills development.

The Knowledge Avenue concept focuses on helping individuals learn in multiple ways: group training, individual study, practice exercises and knowledge review.

The Broadband Technology Course's components—a textbook, 31 Leader's Guides for trainers, 31 Student Workbooks, and a package of 24 videotapes—support group learning as well as individual review and reference.

The *Installer Certification Program Leader's Guide* helps trainers prepare installation staff to properly install service in a customer's home and communicate effectively with subscribers.

Additional Knowledge Avenue resources for service technicians, technicians and engineers are being developed for release later this year.

Certification

SCTE's certification programs demonstrate candidates' initiative to acquire knowledge and to improve their skills and abilities.

Started in 1989, SCTE's Installer Certification Program (ICP) has undergone significant changes over the past year to make the program more relevant to today's cable operations.

The *Installer Certification Manual*, completely overhauled last year, includes more than 500 pages of technical information, diagrams and illustrations, and experiential activities.

To test real-life skills, ICP candidates also complete two practical examinations: proper cable drop preparation and connectorization and signal level meter (SLM) reading.

Standards

Maintaining an open standards environment has been the cornerstone of the cable industry and has led to the recent approval of new standards by SCTE's Engineering Committee.

The Home Digital Network Interface With Copyright Protection (DVS194 revision 1) was designed to support cable services for high definition TV (HDTV), allowing them to interconnect audio or video devices on a common bus or network. The copyright protection is for network security.

The Home Digital Network Interface Without Copyright Protection (DVS195 revision 1) was created for those organizations that prefer not to adopt the copyright protection standard.

The Point-of-Deployment (POD) Module for Set-Top Boxes (DVS 131 revision 8) was developed in compliance with the Federal Communications Commission's requirements concerning the commercial availability of navigation devices, which were established last July.

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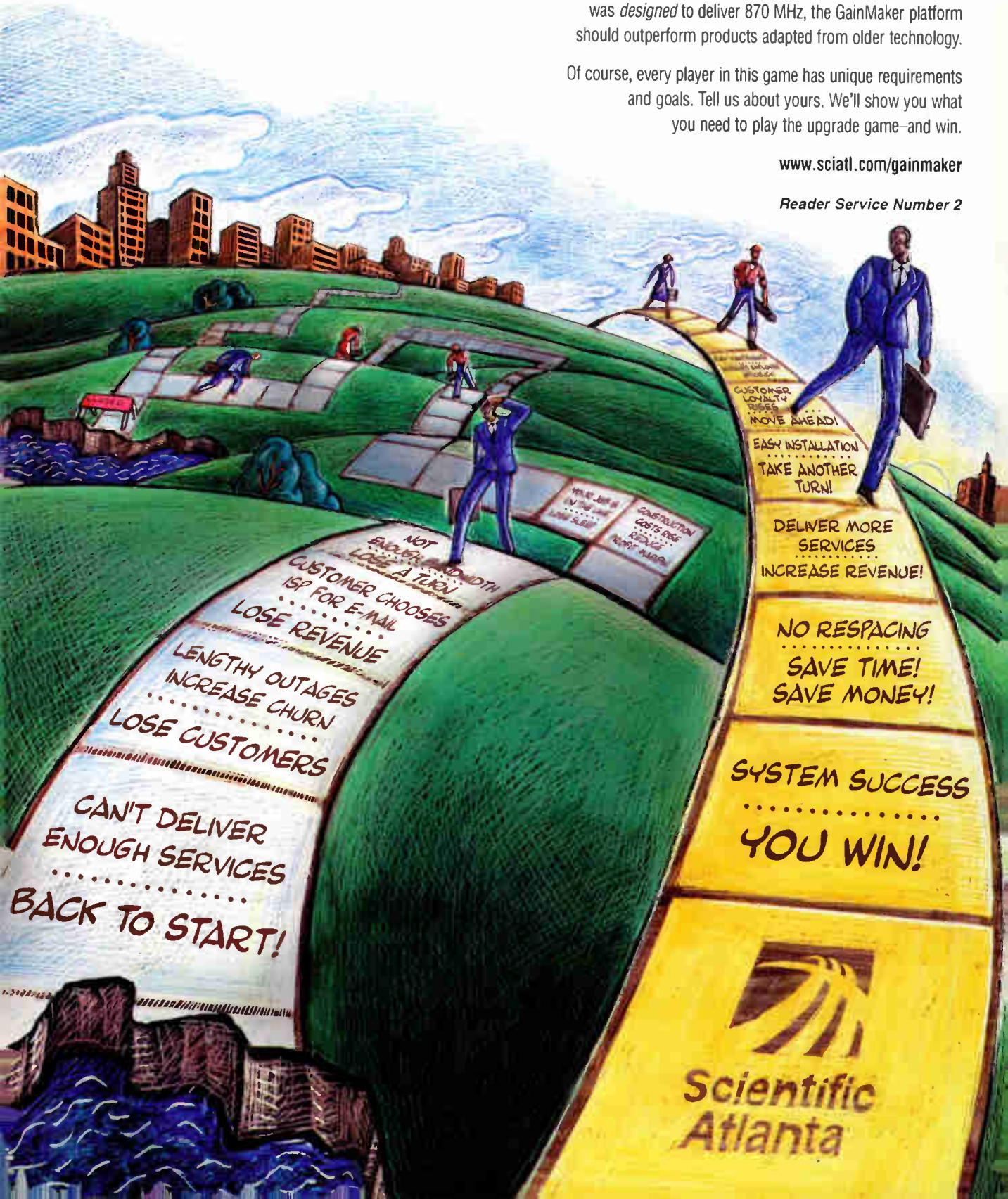

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Finally. A Cable Modem That Can Be Self-Installed.

Anyone can do it. Grandma, the kids, even Dad. Just ask TCA Cable TV. A full 80 percent of their Terayon modems are self-installed by subscribers. That means fewer truck rolls and service calls. You can lower subscriber installation fees, which adds up to satisfied subscribers and more money in the bank for data services.

Proven, Robust Performance

How do they do it? It's built into the box. Terayon's proven, robust S-CDMA technology provides extra margin. Your modems stay up and running, even when your parents are using the hair dryer. No kidding. You can deploy modems over a wider range of cable plant conditions without the usual gold-plated upgrade. Put your gold to better use. Like games for me.

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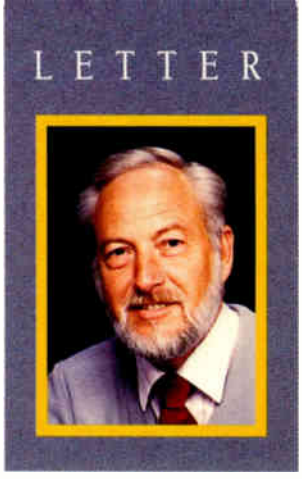
Reader Service Number 3

By Rex Porter



Reflections

This month, I begin my "60s" and edge closer to 40 years in this industry. Until now, it seemed too far away to even consider. I have never had a job outside of cable TV.

I am thankful to an industry that let a young man begin a journey during which he would see so much change and meet or work with so many interesting people.

I worked with tube-type microwave when we shared the 4-6 GHz bands with telephone companies. I built and operated low-band tube cable systems with only two or three channels. "Burning in" tubes for amplifiers was an occasion. Helping to franchise and build two dozen cable systems in my 20s seemed easy then.

In 1965, we carried the Cassius Clay vs. Sonny Liston fight as pay-per-view (PPV) on the Decable Cable TV system in Alabama. We could do that because AT&T brought the fight to Decatur over microwave. But with no TV station wanting to run the fight, they offered it to us. Helmut Deiter signed the contract, and we broadcast it to customers willing to pay.

I met great engineers then, willing to take chances on innovative ideas. Because of them, we have copper-clad aluminum, aluminum braid and tapes, satellite feeds, fiber optics, lasers, multiplexers, spectrum analyzers and such.

I hope to see technology continue to change our lives. I look forward to TV sets with no set-top boxes because the manufacturers will design sets for cable entertainment, data and telephony. I envision mouse-less computers with touch screens: Why use a mouse? Fiber feeder and drops will emerge some day. The Internet and telephony will grow with cable.

A real breakthrough will be Internet-over-cable as local phone service and Internet-over-satellite for long distance. Computers and cable will cooperate and continue to grow together.

Addressability will let cable supply no-truck-roll service. Test equipment controlled by computers will monitor systems remotely and switch signal routing before failures occur. And on and on.

Just as today's young engineers chuckle at our old tube amplifiers, 704 meters, ladder-line and flexible trunk/feeder cables, tomorrow's engineers will grin and think today's technology old-fashioned.

Changes may not come exactly as I think, but change will come. You can't slow technology any more than the passage of years. But I'm not sorry about the changes—or the years. I've been blessed!

Rex Porter
Editor

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By Doug Larson

Terayon Helps Pave Road To DOCSIS 1.2

CableLabs recently selected **Terayon** to help author a detailed technical specification on next-generation physical layer (PHY) technology for integration into the Data Over Cable Service Interface Specification (DOCSIS), creating DOCSIS 1.2. The specification's extension will be based, in part, on Terayon's synchronous code division multiple access (S-CDMA) technology.

Shlomo Rakib, Terayon's president, chief technology officer and inventor of the technology, is bullish on this extension of the DOCSIS spec. "S-CDMA technology paves the way toward cable modems that are plug and play," he explains. "This technology allows cable operators to deploy data services over noisy plants that previously could not support data services and also allows operators to get improved service from improved, well-maintained cable plants."

These improvements are made possible by S-CDMA's approach to impulse noise. "S-CDMA systems, unlike other technologies, can tolerate impulse noise that is both wider and higher, for example 100 microseconds at 360 Hz, while maintaining the maximum throughput rate," explains Rakib. S-CDMA also allows instantaneous reaction to dynamic narrowband interference and improves system reliability by providing rate adaptivity.

Rakib says he expects CableLabs' endorsement of S-CDMA technology to strengthen Terayon's position in the cable modem market but also anticipates other vendors to benefit as well. "We want to enable growth of the cable modem market, which will provide increased opportunities for many players."

CableLabs expects to publish the new specification in the first quarter of this year and says that DOCSIS 1.2-compliant products could be available as early as the first quarter of 2000.

Pushing Fiber's Limits

Have you ever dreamed of unlimited bandwidth and bandwidth on demand? Your dream soon may become a reality. SilkRoad Corp., a fiber-optics technology firm established in 1996, recently made public its patented technology called SilkRoad Refractive Synchronization Communication (SRSC). The technology uses a single wavelength to carry multiple signals.

According to SilkRoad, SRSC can convey as much as 200 Gbps (10^9) of information through a fiber-optic cable and has the potential to transmit at 10 terabits (1,012) per second.

In contrast, typical dense wavelength division multiplexing (DWDM) presently is capable of transmitting around 40 Gbps and requires a laser and receiver per wavelength and other equipment to generate and maintain the integrity of the optical signals. SRSC could represent a way to simplify the transport by minimizing the opto-electronics at each end.

If the technology lives up to expectations, it could revolutionize broadband communications. But is it right for you? Robert Freeman, SilkRoad's vice president of operations, says the SRSC technology is not the ideal application if you're doing

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only one-way video but is "very viable" for multiple services. He cautions, however, that networks differ. "The complexity associated with handling the different wavelengths is truly a function of how extensive your network is," says Freeman. "For very short distances, a DWDM system works fairly well in terms of the wavelengths not having to be managed."

SilkRoad currently is conducting field tests with five non-cable companies in cooperation with Six R Communications, which it recently selected as its systems integrator.

In the Courts

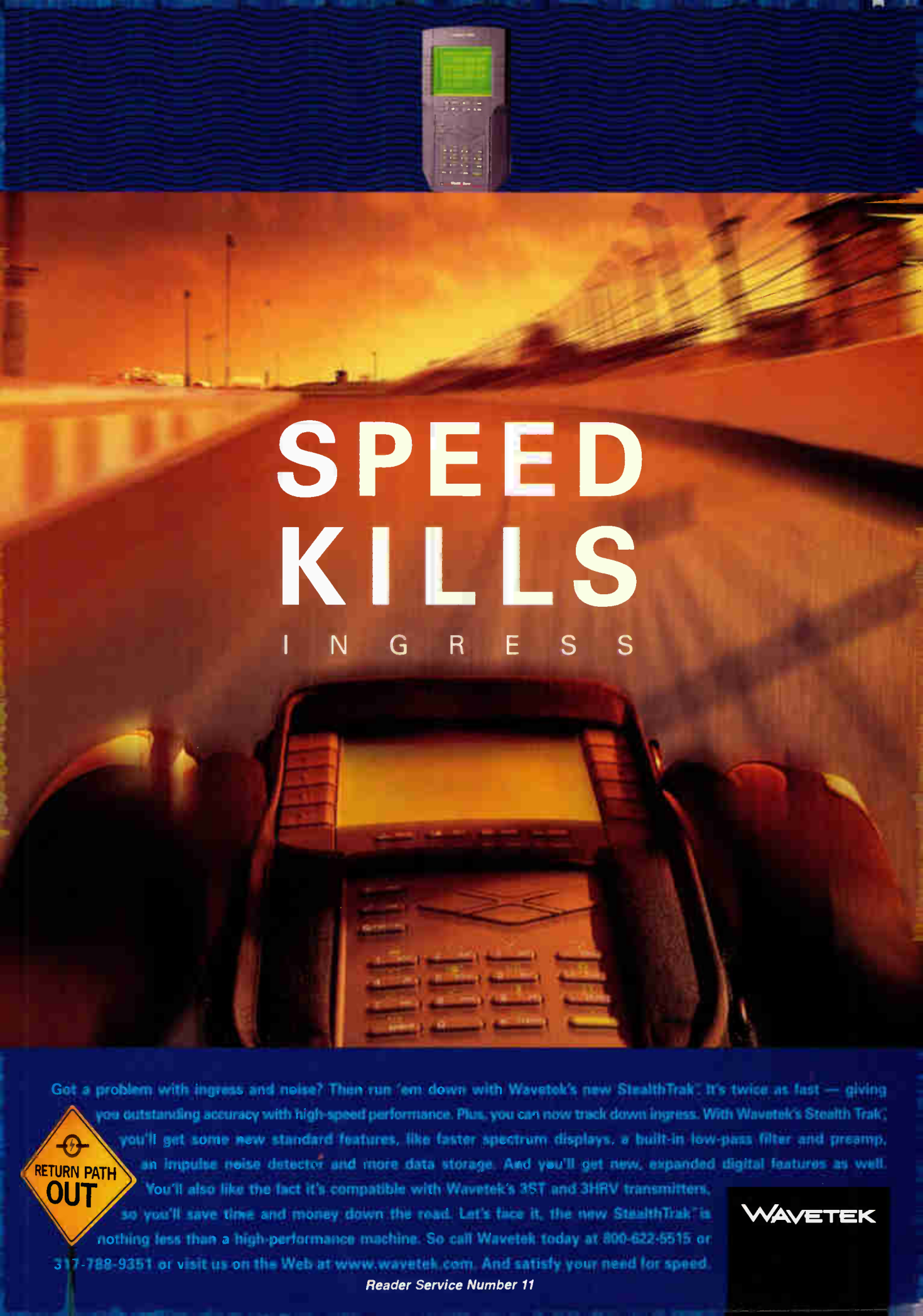
Scientific-Atlanta filed an antitrust lawsuit against Gemstar International Group Ltd. accusing Gemstar of monopolization, attempts to monopolize, restraint of trade, lying and predatory and exclusionary conduct. S-A is seeking to have various Gemstar patents declared invalid.

Gemstar called S-A's suit "baseless and wholly without merit" and in turn responded by filing a patent infringement suit against S-A. The suit claims that S-A willfully infringed certain Gemstar intellectual property, specifically two of the so-called Levine patents, which cover an electronic program guide (EPG) using locally stored or cached data. Gemstar has filed similar patent suits against General Instrument and Pioneer.

NEWS BITES

- America Online announced plans to buy Netscape Communications for $4.2 billion. Some industry analysts expect AOL to create a strong relationship between its service and browser. Set-top manufacturers using Netscape browser technology include Scientific-Atlanta, General Instrument and Pioneer.
- Hughes Electronics announced plans to buy U.S. Satellite Broadcasting for about $1.3 billion to strengthen its DirecTV business. The combined entity will serve an estimated 6.2 million customers.
- Santa Clara, CA-based ELSA Inc. recently announced that it will enter the cable modem market with an MCNS/DOCSIS-compliant product around mid-year. CT

Doug Larson is senior editor at "Communications Technology" in Denver. He can be reached via e-mail at dlarson@phillips.com.



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RETURN PATH OUT

WAVETEK

Reader Service Number 11

SCTE UPDATE

SCTE Announces Candidates For 1999 Board Elections

The Society of Cable Telecommunications Engineers is pleased to announce the nominees for its 1999-2000 board of directors election.

The following individuals are candidates for the open board seats in May:

Region 1
Steve Allen, Jerry Conn Associates
Chuck Harper, MediaOne
Ralph Patterson*, Advantage Technologies

Region 2
Larry Edwards, TeleWire Supply
Steve Johnson*, Time Warner Cable
Mike Phebus, Times Fiber Communications

Region 6
Bill Davis, New Path Communications
Tony Gauer, TSB Inc.

Region 9
James Goins, TCI Cablevision
Keith Hayes, BellSouth Entertainment
Radiene Watson, RamComm

Region 11
Bernie Czarnecki, Cablemasters Corp.
Marianne McClain, Baker Installations
Dennis Quinter*, Time Warner Cable

At-large
Chris Bowick, Cox Communications
Steven Christopher, Thomas and Betts
Bill Cohn, Tektronix Inc.
Tom Elliott, CableLabs
Nick Hamilton-Piercy, Rogers Engineering
Brian James, Tac Test Centre
Joe Jarrell, Jerry Conn Associates
Bill Karnes, ISC Data-Com Inc.
Andy Scott*, NCTA
* Incumbent

Election packages were mailed to SCTE active members in January. Ballots must be returned to the Society's accounting firm no later than March 28; results will be announced in mid-April.

Newly elected directors will take office at Cable-Tec Expo '99 in Orlando, FL.

Southern California Partnerships

SCTE's Southern California, San Diego and Desert Chapters will host a "Train-the-Trainer" regional seminar, April 12-14 in Alhambra, CA.

The seminar teaches technical trainers effective techniques for conducting training and testing trainees' understanding of the information presented. On Oct. 19 in Norwalk, CA, these same chapters will host SCTE's "Cable 101" regional seminar in conjunction with their annual vendor show.

This seminar is designed to provide non-technical managers with a better understanding of cable's technical foundation as well as how cable systems can incorporate new technologies.

For further details, contact Gary Adams at (949) 586-3196.

Bahamas Meeting Group Forms

The SCTE Bahamas Meeting Group officially launched its activities by electing its first president, Levi Anderson, technical operations manager at Cable Bahamas.

A group of Cable Bahamas engineers and technicians gathered for their first official meeting in late fall, after being authorized by the SCTE board of directors to operate locally.

Anderson and his four-member board of directors will be responsible for the administration of the organizational group that ultimately will develop into a fully functioning SCTE local chapter.

Anderson said, "Because of the degree to which cable and satellite technology have affected our community, this kind of organization is very needed and long overdue."

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By Ron Hranac

Headend Combining

When designing a headend combining network, one is faced with several often conflicting objectives. First and foremost is to electrically combine a large number of channels into one signal path—say, a cable feeding downstream lasers or maybe the system's first trunk amplifier.

Ideally, the combining should be done with little or no signal loss to maintain a good carrier-to-noise ratio (C/N) at the input of the first active device after the combiner.

To minimize interaction among various headend components, each of the combiner's inputs must have high isolation from every other input. That way, a severe impedance mismatch on any given port will have little or no effect on other channels.

Reality check

In reality, combiners have insertion loss, usually 15 dB or more per combiner input, but a good headend design in conjunction with the relatively high signal levels from processors and modulators can accommodate the loss.

Most quality commercial headend combiners have reasonably good port-to-port isolation, as long as each input device provides a good impedance match to the combiner.

Unfortunately, each piece of equipment connected to a combining network generally has a nominal impedance of 75 ohms only within the channel's 6 MHz bandwidth. Outside of the channel's bandwidth, the return loss can be quite poor.

There are ways to deal with this, and that's the subject of this month's column.

Traditional trickery

One trick that's been around for several years is to use quarter wavelength coaxial jumpers between processor and modulator outputs and the combiner inputs.

The reasoning behind this is the impedance-transforming properties of a quarter wavelength transmission line. Mathematically, the input impedance of a quarter wavelength line terminated in a resistive impedance is:

$$Z_i = Z_c^2/Z_t$$

where
Z_i is the impedance at the input of the quarter wavelength line
Z_c is the quarter wavelength line's characteristic impedance
Z_t is the impedance of the load, or termination at the other end of the quarter wavelength line

> "Forcing an impedance match in this manner makes coax jumper length for the most part irrelevant."

Using basic algebra, the above equation can be re-written as: $Z_c = \sqrt{Z_i \times Z_t}$

This latter formula demonstrates that any given terminating impedance Z_t can be "transformed" into any desired input impedance Z_i using a quarter wavelength line with an impedance Z_c.

Translation: The square root of the product of the input and output impedances equals the impedance the quarter wavelength line must be in order to match the input impedance to the output impedance.

The really tricky part

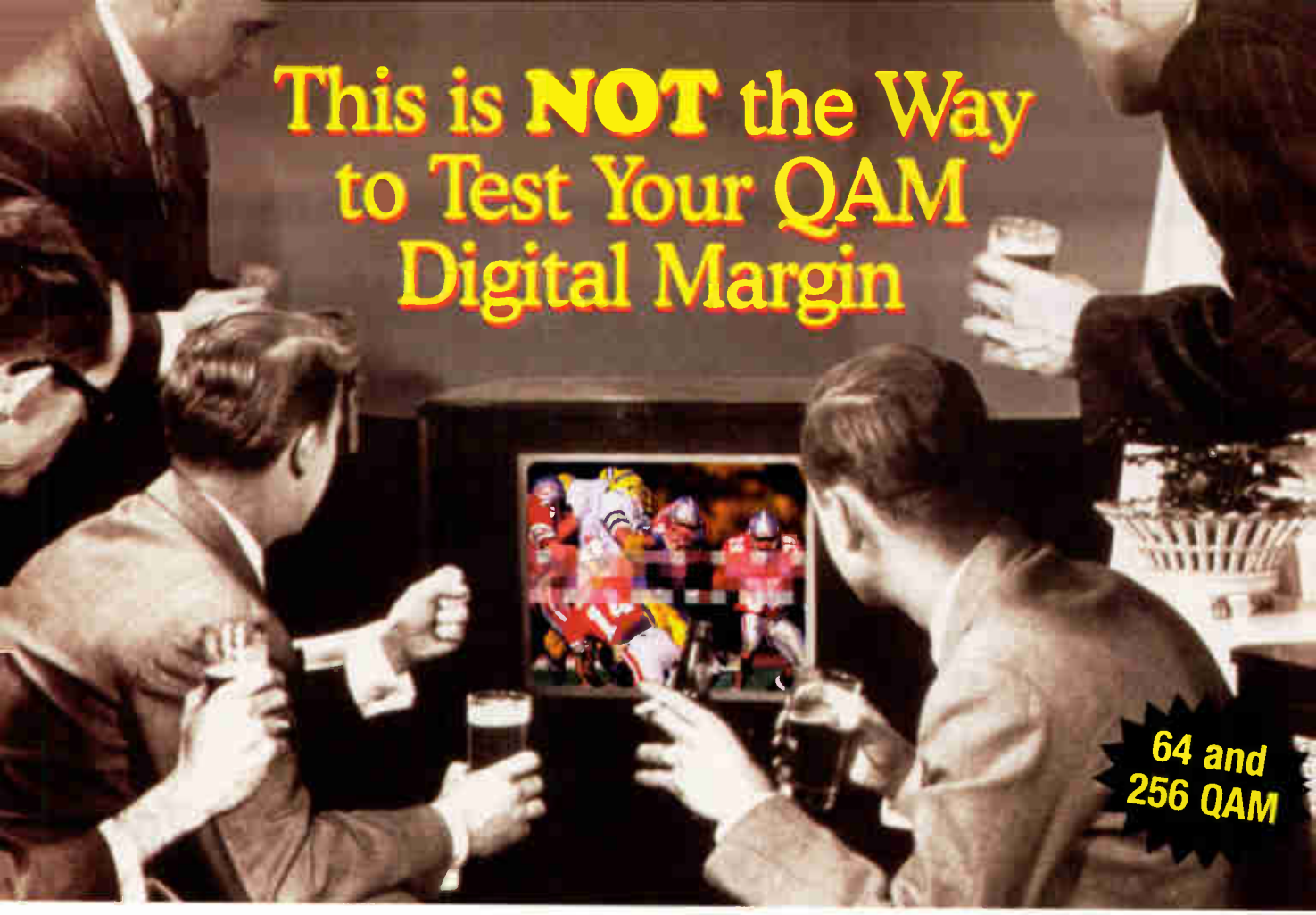
Simply installing a quarter wavelength jumper between the processor or modulator output and the combiner input isn't the complete answer.

First of all, when you consider higher frequency channels, a quarter wavelength can be rather short, sometimes only a few inches. For example, using headend coax with 83% velocity of propagation, an electrical quarter wavelength at Ch. 78's visual carrier is +-15/32 inches. (Note: An appropriate odd multiple of a quarter wavelength could be used to deal with the physical distance while maintaining the same electrical performance.)

Second, what frequency should a quarter wavelength jumper be based on: the visual carrier, the aural carrier or something in between? Remember, each TV channel is 6 MHz wide. At Ch. 2, an electrical quarter wavelength at the visual carrier is 3.694 feet, and at the aural carrier it's 3.416 feet. The difference is about 3-1/4 inches, which is significant as far as obtaining proper impedance matching is concerned. At Ch. 78, the difference is only 1/32 inch. If longer jumpers based on an odd multiple of a quarter wavelength are used, the physical difference will be greater.

You might ask, "Why bother to match the output impedance of the processor or modulator to the combiner input impedance? Aren't they both 75 ohms?" Well, I'm glad you asked. The answer is "not necessarily, and in most cases probably not."

Consider a fixed channel processor such as Scientific-Atlanta's 6150, arguably one of the best processors available and a



The Hukk CR1200 QAM Monitor
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Digital Video can give your subscribers picture quality unmatched by analog technology. Unfortunately, with digital, there is a very small difference between a channel working and not working at all. A picture that looks perfect, may be only a couple dB away from breaking up. The Hukk CR1200 QAM Monitor can tell you for sure the quality of your installation, so you don't have to learn about it from angry subscribers.

Comprehensive Digital Testing

The CR1200 includes a constellation display, bit error rate testing, average power and signal-to-noise ratio so you'll know the quality of your 64/256 QAM signals anywhere in your network, right up to the set-top converter.

Built in Analog SLM

Built for the field, the CR1200 provides unmatched digital testing capability in a rugged, lightweight package. So you don't have to carry two instruments, the CR1200 even includes an analog signal level meter with automated 24 hour FCC testing.

Call For a Demo

Don't leave the success of your digital implementation to chance, try out a CR1200 in your system today. Your subscribers will thank you, especially during the big game!

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Reader Service Number 14

common fixture in many headends. According to the spec sheet, the output voltage standing wave ratio (VSWR—see my column in the December 1998 issue of *Communications Technology* for more on this) is <1.25:1 over the 6 MHz channel.

Assuming a worst case of 1.25:1 VSWR, the return loss will be about 19 dB, which is a pretty good number. That means the actual impedance can be anywhere from 60 to 93.75 ohms. S-A's 68-12TS combiner has an input return loss spec ≥17 dB (1.33:1 VSWR), which means the impedance can be between 56.43 ohms and 99.67 ohms. This range is what is meant when we say the nominal impedance is 75 ohms.

To use a quarter wavelength transmission line to match the impedance of the processor output to the combiner input, it will be necessary to know the actual impedance of each. Unless you have access to a good network analyzer, that might be a little hard to do. But let's make some assumptions here, just to see how this might be done.

Assume the processor's output impedance actually is 75 ohms, and the combiner input is at its possible upper spec of 99.67 ohms. Plug these numbers into the previous formula, and you'll find you need a quarter wavelength line with an impedance of 86.46 ohms to match the two impedances ($86.46 = \sqrt{75 \times 99.67}$).

The quarter wavelength jumper is then installed at the combiner input, and regular 75 ohm headend cable can be used from the jumper back to the processor output. Unfortunately, I don't have any 86 ohm cable lying around; do you?

A better way

There is an easier way. Install a 6 dB inline pad at the combiner input. This will improve the combiner's input return loss as seen by the processor output by double the value of the pad.

Here's why: Without the pad, the combiner's effective input return loss will be 17 dB. Because the combiner input represents a slight impedance mismatch, some of the signal coming from the processor will be reflected back toward the processor at a level equal to the incident signal minus the combiner's return loss.

For example, if the signal from the processor is +59 dBmV, the reflected signal will have an amplitude of +59 dBmV minus 17 dB, or +42 dBmV.

If you install a 6 dB attenuator at the combiner input, the processor's incident signal (+59 dBmV) will be reduced to +53 dBmV at the combiner input. The reflected signal from the combiner input port still will be down 17 dB, but it will be further attenuated by the 6 dB pad, bringing the level of the reflected signal down to +30 dBmV (+59 dBmV - 6 dB - 17 dB - 6 dB).

The effective combiner return loss as seen by the processor will now be 29 dB, which is 1.07:1 VSWR. This means the processor output will see a combiner input impedance somewhere in the range of 69.86 ohms to 80.52 ohms. If your headend design can afford the additional signal loss, install a 6 dB pad at the processor output as well. The overall impedance match will be improved even more.

Forcing an impedance match in this manner makes coax jumper length for the most part irrelevant, except for the added attenuation of the jumper.

One more trick

There is one other trick you can use to improve headend combining performance. Instead of stacking channels vertically in each rack, for instance, Chs. 2, 3, 4, 5, 6, 14, 15, 16, 17 and 18 in the first rack, 19, 20, 21, 22, 7, 8, 9, 10, 11, 12 in the second rack and so on, try arranging channels horizontally.

That is, put Ch. 2 in the first rack, Ch. 3 in the second rack, Ch. 4 in the third rack, Ch. 5 in the fourth rack and Ch. 6 in the fifth rack. Then come back to the first rack and install Ch. 14 (below Ch. 2), put Ch. 15 in the second rack, Ch. 16 in the third rack and so on.

With a little creative work, you can have the combining such that no adjacent channels are connected to any one combiner, resulting in even better adjacent channel isolation. CT

Ron Hranac is senior vice president of engineering for the Denver-based consulting firm Coaxial International. He also is senior technical editor for "Communications Technology." He can be reached via e-mail at rhranac@aol.com.

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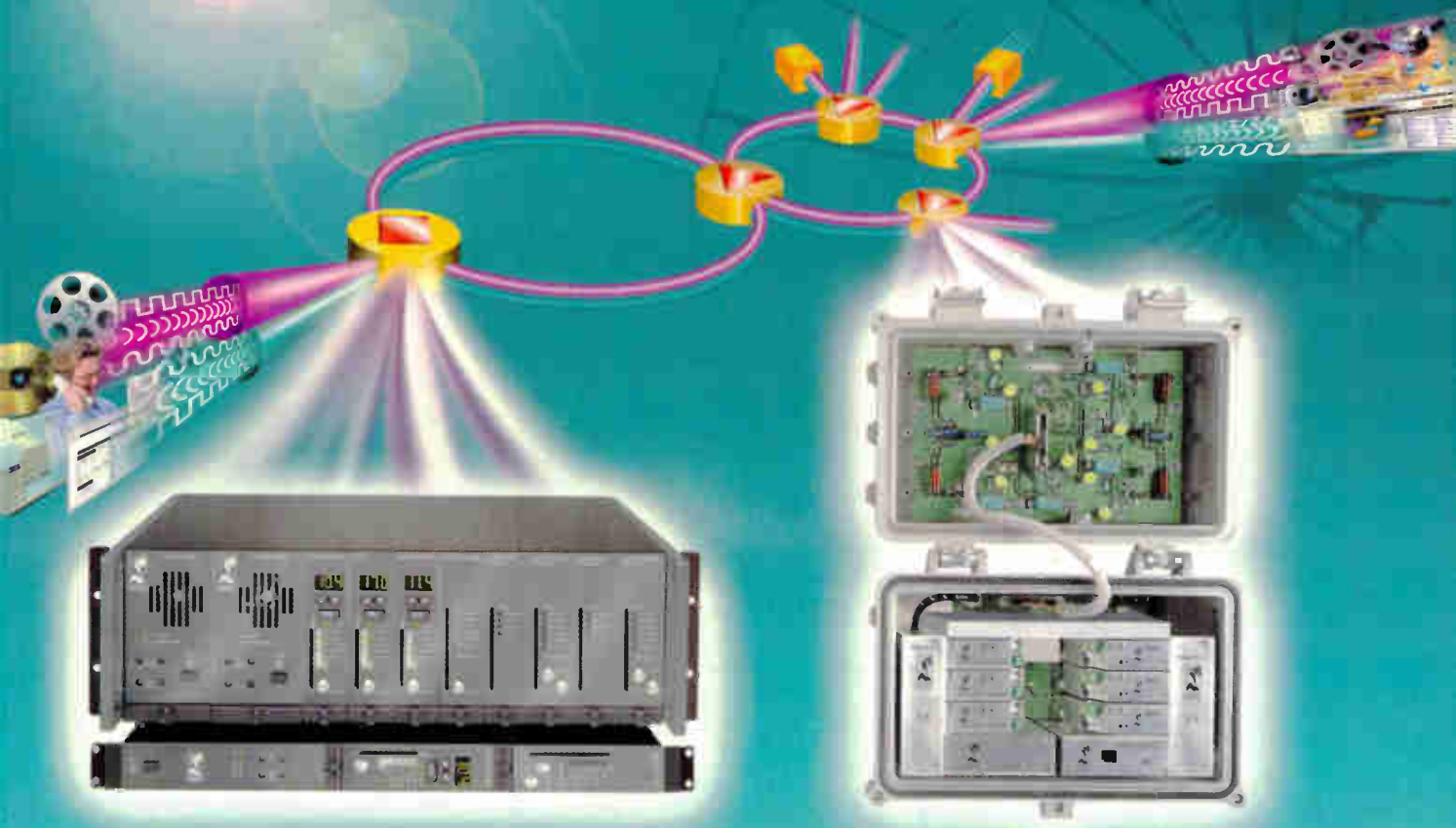

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Reader Service Number 16

By David Devereaux-Weber

Trunk Amp Specs

What Are They Good For?

In the old days, when we swept a cascade of amplifiers, we tried to achieve a specification such as N/10 + 1. Today, with bandwidths of 750 MHz and 1 GHz but much shorter cascades, what are good specifications? Here are comments from the List. These are only a few messages of the many that pass through the List; they have been edited to fit.

Date: Sunday, Nov. 29, 1998
From: Poge Smit

N/10 + 1 for 450 MHz was generally perceived as a "tight" spec, and 10 + 2 seemed to be more generally accepted, as I recall. I have no info about how much more tolerance is worked into this for 750 MHz or 860 MHz systems, but it seems to me that a cascade of 8, even in an 860 MHz system, should have a better peak-to-valley (P/V) than 5 dB!

My nicest cascade of 15 trunk amps has an end-of-line (EOL) P/V of 1.9 dB (450 MHz). My ugliest cascade of 24 trunk amps has an EOL P/V of 4.9 dB (450 MHz). These two examples simply depict the extremes of my situation, and the rest of the plant falls somewhere in between. It just seems that 5 dB P/V is extreme for only 8 actives—even at 750 MHz.

From: Craig Maes

We are in the process of discussing this with our contractors. We are asking for N/5 + 2, which results in P/V requirements of 3 dB for a 5-amp cascade.

The contractors tell me they are unable to obtain a spec much less than 4 dB, even in cascades of 5 amplifiers, but are always able to obtain 4 dB in cascades of even 10 amps. The manufacturers tell us never to touch the internal adjustments of the new 750 MHz amplifiers, and none of us want to deploy trim boards anymore with such short cascades.

I am told the contractor has resorted to swapping amplifiers until finding one that "nulls out" the response problem. Knowing that the ultimate goal is to present very good analog pictures, digital pictures that don't pixel, fast Internet service and reliable telephone service, why do we monkey around trying to get 0.5 dB of flatness, possibly changing the characteristic impedance of the amplifier, creating more problems to obtain a sweep spec of 3.8 dB when the above is met without it?

> "All actives must be swept, even if cascade lengths are only two or three amps deep."

From: Ron Hranac

Folks have asked me this question in the past, and my response has been: All actives must be swept, even if cascade lengths are only two or three amps deep.

Frequency response problems from water ingress, loose connectors, damaged cable or other components, and missing (or damaged) line terminators are much easier to troubleshoot with a broadband sweep.

Furthermore, the higher losses in the downstream tend to mask certain response problems that might be considered acceptable with a simple signal level meter (SLM) check.

These same things likely would cause major response problems in the reverse path of a two-way system because of lower losses in the various reverse frequencies.

Sweeping should be part of a system's preventive maintenance efforts, so you won't have to be in a troubleshooting mode.

Why should frequency response be of concern? Besides the obvious problems such as increased chrominance-to-luminance (C/L) delay inequality (the "funny paper" effect), group delay—which can be caused by poor frequency response—will degrade bit error rate (BER) in digitally modulated carriers.

For more info on group delay, check my column in the January 1999 issue of *Communications Technology* magazine. CT

Dave Devereaux-Weber, P.E., is a network engineer at the University of Wisconsin-Madison. He is a senior member of the SCTE, and he can be contacted via e-mail at djdevere@facstaff.wisc.edu.

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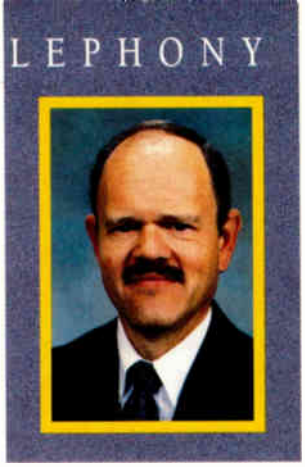
By Justin J. Junkus



How Do I Call Thee? Let Me Count the Ways

So, you think you know all the telephony in cable solutions? This column may surprise you.

In cable, most technical people can think of three ways to get into a land-line based telephony business. Everyone knows the two obvious choices for a cable operator contemplating a telephony offering are either switched telephony over a hybrid fiber/coax (HFC) network or Internet protocol (IP) telephony. If you are an operator with fiber plant that runs near business or apartment complexes, you may have entered the telephony market via a third alternative.

In this case, you may have negotiated agreements with the owners of those multiple dwelling units (MDUs) or businesses to place a remote digital loop carrier terminal on their site, connected to your plant on the side facing the central office switch. Then you could have entered the telephony business by connecting to either your own telephony switch or to leased space on another carrier's switch.

Of course, there are other ways to bring wired telephony to subscribers. You could, I suppose, overbuild the telephone company's twisted-pair network with your own twisted-pair network. But that usually is economic insanity, since twisted-pair is optimized only for voice service, and the cost for voice service alone rarely would be justified.

Another way

Another solution I recently ran across is a special case of fiber to the curb. For those of you who may not be familiar with this technology, a few years ago, fiber to the curb was a strong contender to switched HFC telephony.

The architecture is similar. A host digital terminal (HDT) provides the interface to a digital telephony switch, and hardware called an optical network unit (ONU) serves similar electrical functions to a combination of an HFC fiber node and network interface unit (NIU). The main difference is that fiber is brought closer to the end user than in an HFC system, and the ONU is not necessarily the point of demarcation between the service provider and the subscriber.

> "In cable, most technical people can think of three ways to get into a land-line based telephony business."

The telephone companies liked the fiber to the curb technology because it provides a way to deliver switched digital video (SDV). With SDV, asynchronous transfer mode (ATM) cells for video control can be transported over the fiber, and many of the functions of the set-top converter become part of a centralized broadband switch.

This makes video technology look a lot more like telephony. The jury is still out on the acceptance of SDV as a commercial offering for single family residences, but there doesn't seem to be much new activity. Fiber to the curb, on the other hand, has found another life in the cable telecommunications industry. It is part of a system offered by Reltec to serve MDUs.

One example

Reltec certainly isn't a well-known name in cable telephony. You may be more familiar with it as a supplier of pedestals. This was the business they grew from, as predecessor company Reliance Comm/Tech. Along the way, they expanded their business to include digital loop carrier systems.

Per Doug McCloud, the video product manager at Reltec, their DISC*S next-generation digital loop carrier system was the first to conform to Bellcore's GR-303 specifications, and they now have systems installed in all the regional Bell operating companies (RBOCs). In the telephone industry, they provide more than 400,000 lines of installed telephone capacity.

Reltec exhibited its DISC*S system at the Western Cable Show and is selling the value of a "deep fiber" solution (their terminology for fiber to the curb) for cable company MDU applications. The company proposes a business case based on combined video, telephony and data to newly constructed MDUs. They suggest that deep fiber is a preferred alternative to separate HFC video and twisted-pair telephony delivery for new MDUs with more than 225 units.

The DISC*S system consists of one or more HDTs and ONUs. On the network side, the HDTs can interface to three networks: video, data and telephony. The medium used for the interface is 1,550 nm fiber. For the video portion, the system can handle either analog or digital video as input on a fiber trunk from a headend.

Data and telephony transport is synchronous optical network (SONET) technology. Data is provided as a 10

Mbps, symmetrical 10BaseT service, offered from a data switch at the service provider's location. The telephony interface complies with Bellcore's GR-303 specification for interfaces between a digital switch and a digital loop carrier system.

On the subscriber side of the HDT, fiber carries the combined signals to the ONU, which usually is within 500 feet of the subscriber's premises. Circuit cards in the ONU perform the optical to electrical conversions, providing coax output for video and twisted-pair for telephony. A separate copper pair between the HDT and the ONU provides power for the video components, telephone ringing and lifeline telephony service. (Eight hours of backup power are available at the HDT).

The maximum distance for power distribution between an ONU and an HDT is 6,000 feet over one 22-gauge copper wire pair. With two pair, the distance can be doubled. For video applications, the distance is slightly less.

Each HDT serves 672 voice channels, and multiple HDTs can be combined into a single system. In an MDU application, one or more HDT shelves usually would be located on the MDU premises, typically in a telecommunications closet.

Both dual- and quad-line cards are available for the ONU, providing an ONU capacity of 12 or 24 lines, respectively. ONUs typically are distributed throughout the MDU complex, either wall-mounted or in pedestals.

But will anyone buy it?

So far, Reltec has one cable customer for its MDU fiber to the curb offering, albeit an important one. TCI agreed in September 1998 to deploy the DISC*S system in The Village development in Dallas. The project will be built out in four phases. It eventually will provide 7,280 units with integrated telephony, video and high speed data service. Time and competition will tell whether others follow.

Justin Junkus is president of KnowledgeLink Inc., a consulting and training firm specializing in the cable telecommunications industry. To discuss this topic further, or to find out more about KnowledgeLink, you may e-mail him at jjunkus@aol.com.

DEPLOYMENTWATCH

By Doug Larson

The adage that the customer is always right rings true in the cable industry today more than ever before. Operators continue to roll out high-speed data and telephony services in a frenzied rush to quench customers' thirst for new services. Here's a look at a few deployments making headlines.

Internet TV Over Cable

Last December, WorldGate Communications announced that it had forged multiyear affiliate deals with five cable operators serving more than 350,000 subscribers. One of those operators is Prestige Cable TV.

According to Prestige's Michael Ingram, director of interactive services, the company rolled out Worldgate's Internet TV Over Cable service in January to subscribers in southern portions of its Mooresville, NC, system serving approximately 35,000 cable customers.

Prestige had activated the return path in 20% to 25% of its system by December and currently is upgrading between 500 and 1,000 homes per week. It expects to complete the upgrade by the year 2000.

Beyond the obvious challenges associated with the return path, Ingram also has been confronted with problems from less obvious sources, such as videocassette recorders (VCRs). The Worldgate system uses an advanced analog or digital set-top box, and customers who run their cable through a VCR lose their picture-in-picture capability and experience other inconveniences.

All things considered, however, Ingram says he feels good about Prestige's progress. "We have been testing Worldgate for a few months and are now comfortable with the technology."

Prestige currently is promoting the new service, which costs about $16 a month, through telemarketing and direct mail and will conduct market tests for six months. Its goal is to reach a 3% to 5% customer penetration rate in its first year.

Cox Telephony Business

"Our greatest success has been to completely disprove all early assertions that customers would not buy telephone service from a cable provider," says Mark Davis, Cox Communications' director of engineering for telephony technology. Cox closed out last year with more than 18,200 residential telephony customers in five markets. Residential and commercial telephony revenues topped $8.7 million. "Cox Communications as a whole has the potential to grow in a few years to rival the larger non-RBOC (regional Bell operating company) telephone companies in number of customers," says Davis.

Getting to that point won't be easy, but Cox has learned a few lessons along the way that will help it grow its telephony business. "The business is very complex and requires heavy dependence on third-party providers," says Davis. "For example, we have third parties providing operator services, calling-card billing and voice mail to name a few. Each of these third parties has to be managed, measured and monitored."

Although Cox is exploring Internet protocol (IP) telephony with its current technology vendors, it is not betting the farm on IP. "At present, [Cox is] convinced IP telephony will grow and prosper, but we are 'optimistically skeptical' that a complete shift of all telephony to IP is inevitable," says Davis.

Media General Cable To Roll Out Road Runner

Media General Cable recently signed an affiliation contract with the Road Runner high-speed Internet service. MGC introduced the service to portions of Fairfax County, VA, passing 40,000 homes in January.

You might find it interesting to know that MGC initially is launching the service over an all-coaxial plant. "We have activated the return path throughout 4,000 miles of our plant," says Dave Charlton, MGC's general manager of high-speed data services, "but we don't have any fiber in the system yet."

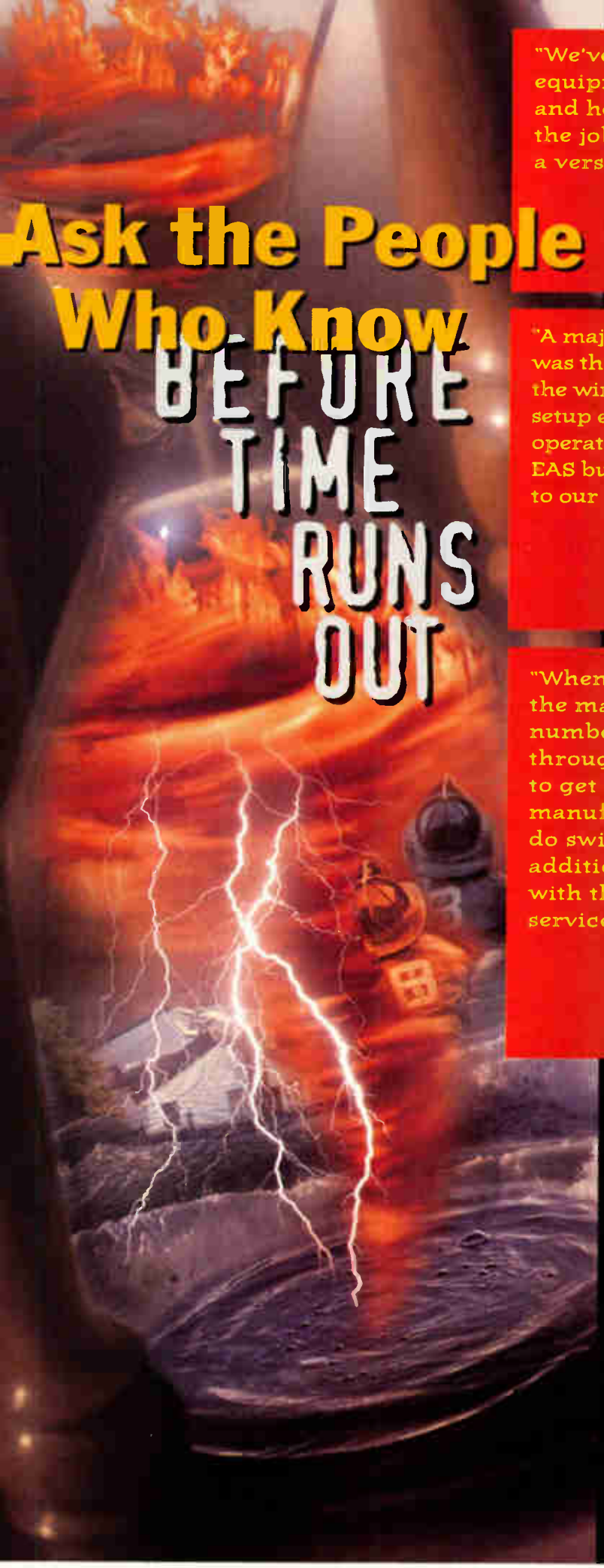
This will soon change. By mid-1999, MGC hopes to have the service rolled out to 120,000 homes and plans to start installing fiber nodes.

Charlton says Media General explored a number of options, but ultimately partnered with Road Runner for its Tier 2 support, revenue splits, flexibility, and Time Warner's local and national content arrangements. CT

Doug Larson is senior editor at "Communications Technology" in Denver. E-mail deployment information or comments to dlarson @phillips.com.

Recent Developments: Who's Deploying What

- **Com21** cumulative cable modem and headend system shipments have reached 54,000 and 390, respectively.
- **Motorola** has shipped more than 300,000 cable modems worldwide since the end of 1996, up from 250,000 in June 1998.
- **Cablevision** and **FrontierVision Partners** have selected **Terayon** equipment for cable modem deployments in New York and Maine, respectively.
- **Samsung** has shipped 10,000 precertified Data Over Cable Service Interface Specification (DOCSIS) cable modems to **Conego Cable**.
- **MediaOne** launched its high-speed data service, MediaOne Express, to an estimated 11,871 households in Holyoke, MA.



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Area Engineer
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Philadelphia, PA

"A major reason for our choice of FrontLine was the ease of installation. They've simplified the wiring issues, making installation and setup easy and helping to assure reliable operation down the road. FrontLine knows the EAS business and they've been very responsive to our needs."

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"When we evaluated EAS solutions on the market, we were impressed with the number of options that were available through FrontLine. Not only were we able to get a complete system from a single manufacturer, with their system we can do switching without having to buy additional equipment. Our past experence with them was a factor as well. Their service and support are excellent."

Tim Doran
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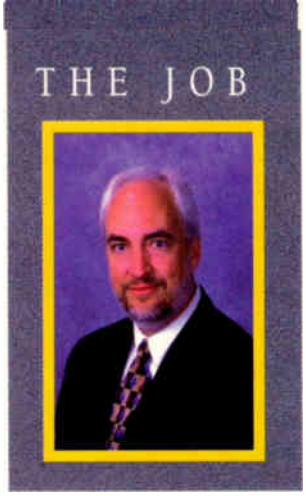
By Alan Babcock



BCT/E Recertification Process Rewritten

Improve Exams, Earn RUs Simultaneously

The Society of Cable Telecommunications Engineers has offered professional certification opportunities since the late 1980s. We began with the Broadband Communications Technician/Engineer (BCT/E) programs and have expanded the offerings to include Installer, Broadband Service Technician (BST) and Associate-level Telephony (AT) certification.

We have tried to listen to the comments many of you have made to try to make participation in the programs as easy as possible.

One comment we have heard lately from those of you who have achieved certification is that sometimes it is difficult to earn the recertification units (RUs) necessary to maintain certification.

Another comment we have heard is that the exam questions aren't as current as they should be in this age of rapid technological change. Well, guess what? The SCTE Training Committee has found a solution to both concerns.

Submit your exam questions

The committee met Dec. 1 in Anaheim, CA. Among other things, the committee considered a proposal to award RUs to individuals who submit exam questions that are accepted for the certification programs. Here is how the idea will work:

If you are certified in the BST, AT or BCT/E programs, you are eligible to submit exam questions for the program in which you are certified. You can submit the questions to Jessica Brady at SCTE Headquarters in Exton, PA, and she will distribute the questions to the committee for consideration. You will need to have 10 questions accepted by the committee to earn one RU. We will have a form available soon for submitting the questions.

To be accepted, a question will need to meet several criteria:

- Questions must be multiple choice.

> "If you are certified in the BST, AT or BCT/E programs, you are eligible to submit exam questions for the program in which you are certified."

- At least one correct answer must be included.
- At least three incorrect answers must be included.
- The correct answer must be verifiable, and a complete reference source for the question/answer must be indicated.

Certified BST, AT and BCT individuals can earn up to two RUs, and BCEs can earn three RUs, during the three-year recertification period.

The committee feels strongly that this change in certification rules will strengthen the certification programs as well as make it easier to retain certification for those who need to earn recertification points.

Those of you who have written test questions in the past know that it is not easy to write effective questions. Frequently, it is as difficult to write good incorrect answers as it is to write the correct answer and question.

We recommend that individuals write and submit at least 15 questions to have a good chance of getting 10 questions accepted. The acceptance or rejection of a question will be at the sole discretion of the specific curriculum subcommittee of the Training Committee responsible for the content of the respective topic.

Duplicate, ambiguous, discriminatory and "trick" questions will not be accepted. Avoid questions referenced to obscure text, training or magazine articles. When possible, include a copy of the complete reference for a question. However, SCTE encourages its members to respect applicable copyright laws.

Check our Web site (www.scte.org) in the near future for a copy of the form that can be used to submit questions.

Category VII

And one last news item about SCTE training: How many of you have struggled with the Category VII exam for BCT/E certification? Well, help is on the way.

By the time you read this article, we will have training available to address the foundation and underlying concepts that cause trouble for most people

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attempting to pass the Category VII exam.

Two programs will be available—one for the technician level and one for the engineer level. The programs are designed to teach the fundamental aspects of a successful business and then present a solid decision-making model and process. The programs will be offered in a self-study, text-based format.

"DigiPoints" is moving

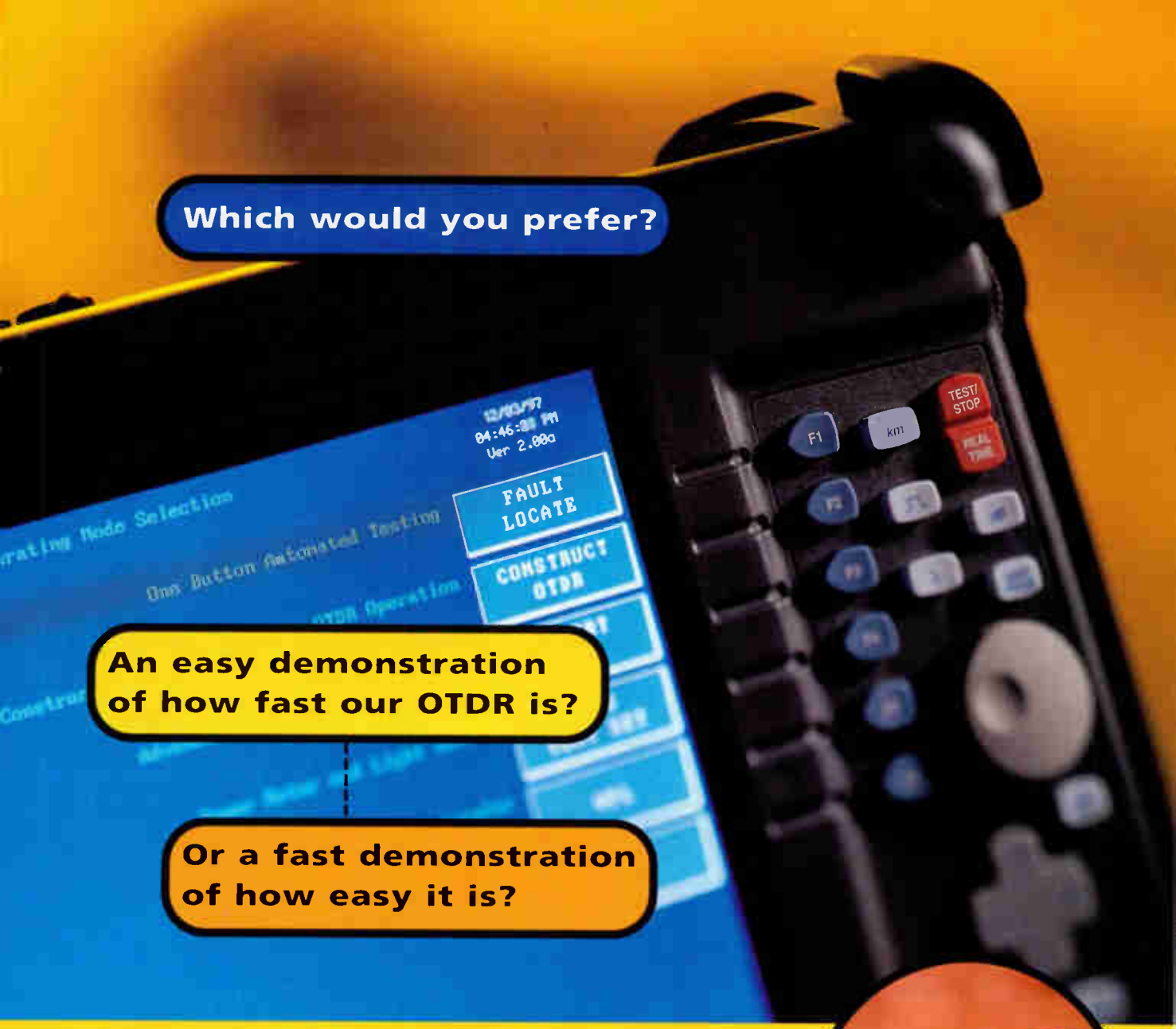
One other Web-related news item: Many of you have grown accustomed to receiving "DigiPoints" as part of the monthly SCTE newsletter, *Interval*. As of January 1999, "DigiPoints" will be published on our Web site rather than in *Interval*.

> "Those of you who have written test questions in the past know that it is not easy to write effective questions."

We made this change in part because we felt it was appropriate to use one of the most common digital data services (the Internet) to deliver the most current training on the digital products and technologies affecting broadband communications. Be sure to check out our Web site each month for the latest copy of "DigiPoints."

You also will see this training benefit change and improve over time to become what we hope will be an extremely effective interactive training experience. We welcome your input on how to adapt this feature to provide the training you need and want. CT

Alan Babcock is director of training development for the Society of Cable Telecommunications Engineers. He can be reached via e-mail at ababcock@scte.org.



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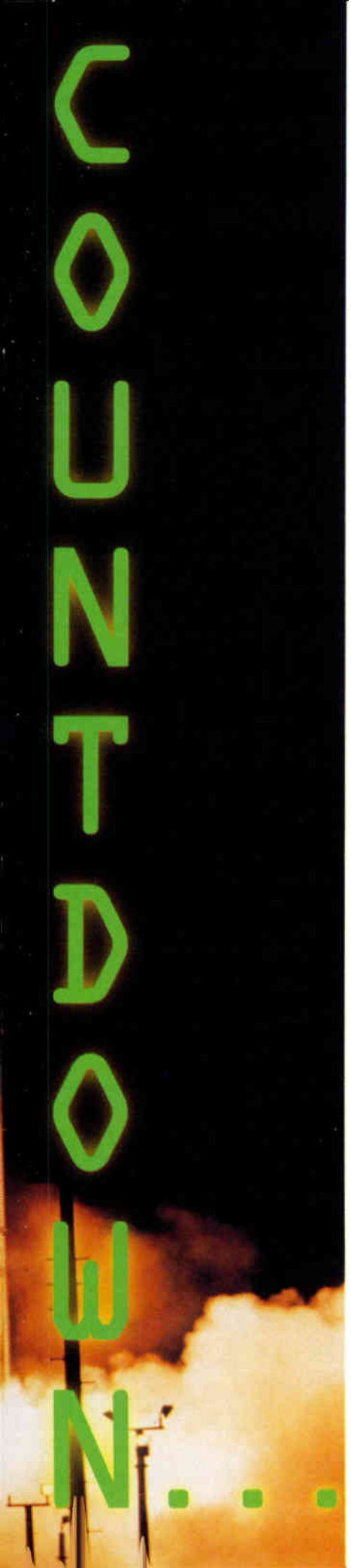


Tips for a Smooth Launch in Your System

to Digital

By Joseph B. Waltrich

Digital technology is rapidly being deployed throughout North America. Five hundred digital systems were launched in 1997, and twice as many digital headends were expected to be in operation by the end of 1998.

Digital technology's rapid growth has created operator concerns about optimizing its introduction into their systems. This article explores some issues operators typically encounter when adding digital technology to an existing cable system and provides solutions for minimizing them.

Digital overview

With larger service offerings, digital systems are more complex than their analog counterparts. For example, a 550 MHz analog system provides about 70 video services. In contrast, a 750 MHz mixed-signal system, with analog channels in the lower 550 MHz and digital channels in the 550-750 MHz range, increases the total number of video services to more than 200.

With a mixed-signal system, program information becomes more complex, making electronic program guides (EPGs) necessary. An EPG must be downloaded to consumers' digital set-tops.

Digital headend equipment configuration also becomes more complicated, requiring equipment control to move from manual operation to computer operation.

The increased number of services to be authorized makes access control more complex.

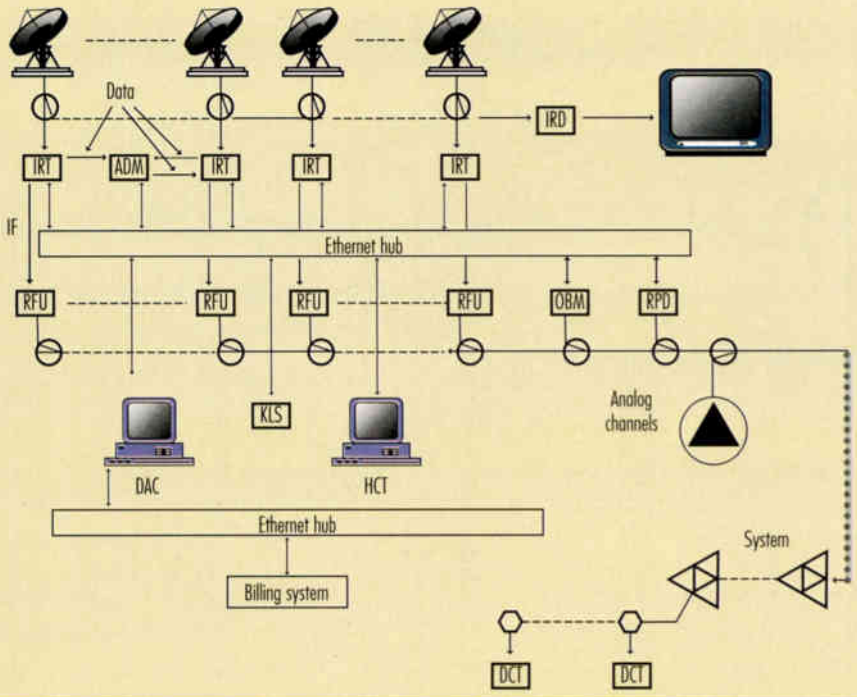
Prepare for launch

Preparation, training and systems integration are the keys to a successful digital launch. By understanding all of the differences between analog and digital technology and by properly preparing for digital introduction, cable operators can make a more efficient transition from analog to digital.

Figure 1 (on page 36) provides an example of a typical digital system. It illustrates a pass-through system incorporating local access control. Its system components include:

- A number of integrated receiver transcoders (IRTs), which receive the satellite signals and convert them to 64-QAM (quadrature amplitude modulation) format for transmission over the cable system
- One or more add/drop multiplexers (ADMs), which select individual services from up to four satellite data streams and then combine the selected services into a single-output stream for transmission over the system
- An out-of-band modulator (OBM), which provides an extra RF channel for transmission of channel maps and authorization data to digital set-tops
- RF upconverters (RFUs), which accept the intermediate frequency (IF) inputs from the IRTs and output them as RF channels on the cable system
- Return path demodulators (RPDs) for decoding the RF return path data from the digital set-tops and passing it on to the digital access controller (DAC)
- A DAC and associated keylist server (KLS), which authorize and encrypt services as well as provide an interface to the billing system
- Ethernet communication among the headend equipment (except for the RFUs)

Figure 1: Digital system block diagram



Headend configuration

The digital system also contains a headend configuration tool (HCT). As its name implies, the HCT is a laptop computer that performs the initial configuration of each piece of headend equipment. The HCT also handles some system monitoring functions and reconfigures the system if a new component (such as a new IRT) is added to the system.

Properly preparing for digital equipment installation before the equipment arrives at the headend helps avoid unnecessary delays during the installation phase. Begin by completing a thorough site survey. Like a site survey for analog system expansion, it should consider such factors as power, cooling and floor space. In addition, satellite dishes should be erected, and satellite signals should be checked for proper levels and carrier-to-noise ratios (C/Ns). An integrated receiver decoder (IRD) should be used to check the received satellite signal's video and audio quality.

Because a digital system is so software-intensive, it is important to train system personnel on the software tools they will be using for configuration and control of the headend equipment. Technicians must have a thorough knowledge of the proper configuration of all headend equipment. They also need to learn how to set digital signal levels and measure digital C/N ratios. Unlike analog signals, digital signals require a bandwidth correction when measuring signal power but do not require a bandwidth correction to the C/N measurement.

Power measurement

Figure 2 (on page 39) illustrates the technique for measuring power level and C/N of a digital signal. The following paragraphs describe the technique.

Set the spectrum analyzer resolution bandwidth to 300 kHz. Set the analyzer's video bandwidth to 30 kHz or lower. If using an analyzer with a video filter, turn the video filter on.

If the analyzer has a signal-averaging mode, turn on the averaging and measure the signal level at the center frequency. If the analyzer does not have a signal-averaging mode, measure the signal level midway between the top and bottom of the "grass" on the signal.

Add a 12.2 dB correction factor to the measured level for a 64-QAM signal to obtain the correct signal level. Add 7 dB to the measured value of the out-of-band (OOB) signal to obtain its correct value.

Signal measurement

The bandwidth corrections for digital signal levels are necessary because unlike an analog signal, which has most of its energy concentrated in the visual carrier, the digital signal power is distributed uniformly over the entire signal bandwidth. This distribution pattern also accounts for why the digital C/N does not require a bandwidth correction.

To measure digital C/N, set up the spectrum analyzer and measure the average

BOTTOM LINE

Digital Blasts Off

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With larger service offerings, digital systems are more complex than their analog counterparts. Preparation, training and systems integration are the keys to a successful digital launch. By understanding all of the differences between analog and digital technology and by properly preparing for digital introduction, cable operators can make a more efficient transition from analog to digital.

Although it is more complex than analog technology, digital technology need not be intimidating. It is vital that a cable system's technical personnel understand the differences between the two technologies as well as how to handle these differences. This understanding, combined with proper site preparation and system maintenance, is the key to a successful digital launch in an increasingly digital world.

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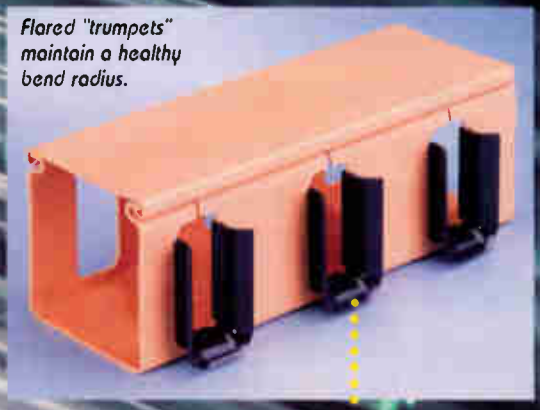
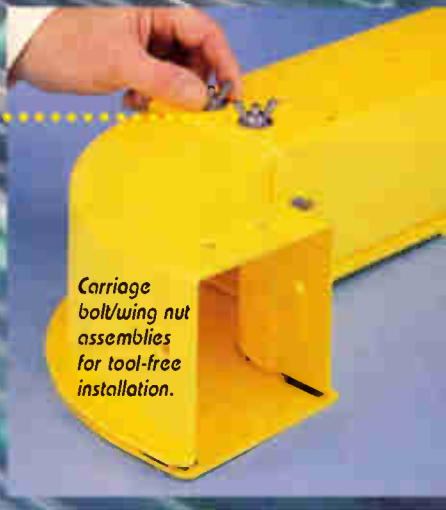
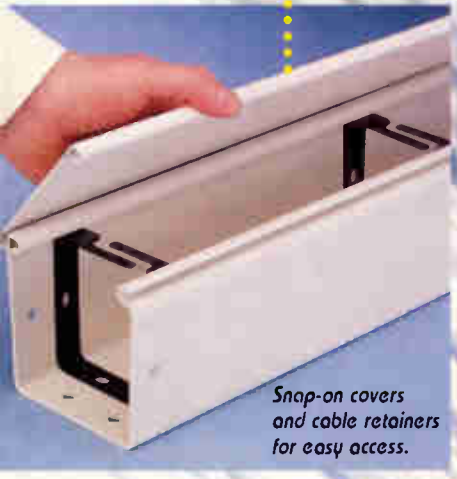


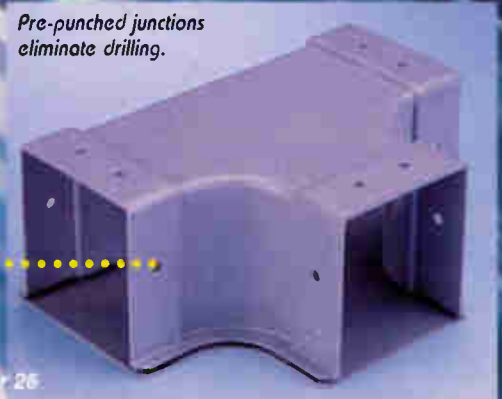
Flared "trumpets" maintain a healthy bend radius.



Carriage bolt/wing nut assemblies for tool-free installation.



Snap-on covers and cable retainers for easy access.



Pre-punched junctions eliminate drilling.

power of the digital signal as previously described. Do not apply a bandwidth correction.

Measure the noise floor of the system in an empty channel. Subtract this value from the measured value of the digital signal to find the C/N.

When making this measurement, make certain that the system noise floor is above the analyzer noise floor. If there is less than 10 dB between the two noise floors, apply a correction as specified by the spectrum analyzer manufacturer.

(Editor's note: This method is recommended only for "flat-top" digitally modulated signals. Measurement inaccuracy will result with "haystack" or other shaped signals. When in doubt, use test equipment that has a digital carrier power measurement capability.)

System considerations

Before putting digital signals on the system, make certain that the system meets Federal Communications Commission Part 76 specifications. This inspection will assure that sufficient margin exists so that the digital signal will remain unaffected by random noise and/or distortions. Also check that composite second order (CSO) and composite triple beat (CTB) levels meet specifications in empty channels, where the digital signals will be located. This examination should be made at a few receive sites near the end of the system.

The return path will become increasingly important as more digital systems are deployed and interactive services are added. Proper setup and maintenance of the return path is just as important as it is for the forward path.

Maintenance

System maintenance for a mixed analog/digital system is no different than for an all-analog system. Fortunately, cable is a fairly benign system, and if good maintenance practices are followed, the digital portion of the system should encounter no problems. However, some precautions to take can minimize potential service calls.

Make certain that the digital signal levels are set up correctly relative to the analog carriers. Use the procedure described previously. In addition, make sure that the digital RFUs are set up properly. The upconverter output should be adjusted with an unmodulated analog carrier at the IF input and the automatic gain control (AGC) on. AGC should be disabled once the digital signal is connected, since the digital signal has no carrier on which the AGC can operate.

Avoid operation in the roll-off area. Although good results may be obtained at some receive sites, this success is not guaranteed for all receive sites. The roll-off area is a gamble, and the odds are against the operator.

Make sure that digital signals are not located next to trapped channels. The group delay in the trap may be more than the digital set-top's adaptive equalizer can correct.

Be careful about sweeping in the digital channels. Use a noninterfering sweep, and program the sweep generator to skip the digital portion of the spectrum. A low-level sweep may place an excessive load

on the digital set-top's error-correction budget, leaving less capability for correcting errors from transmission system impairments. Check with your sweep equipment manufacturer for specific recommended procedures.

Finally, when adding digital signals to a fiber-optic link, the additional signals may overdrive the laser, thereby generating unwanted intermodulation products. To avoid this condition, readjust the overall levels into the fiber-optic transmitter.

Installation and service

The operator has little control over the subscriber's location or circumstances. However, an installer can take several steps to minimize potential problems.

When installing the digital set-top, check the integrity of connections within the home. In particular, inspect the quality of splitters that the customer may have installed. Poor-quality splitters lack enough port-to-port isolation to prevent transient reflections (which are caused by switching another device) from generating errors in the digital picture. If a splitter is suspect, work out an agreement with the subscriber to replace it.

After installing the digital set-top, use the unit's on-screen diagnostics (OSD) to check digital signal quality. The OSD screen will display a signal-to-noise ratio (S/N) estimate in dB. This estimate is actually an equivalent S/N, taking all of the system impairments (such as noise, CSO, CTB and multipath) into consideration.

This figure will be lower than the actual S/N that would be measured if a spectrum analyzer were used. However, the S/N

Figure 2: Digital signal level and C/N measurement

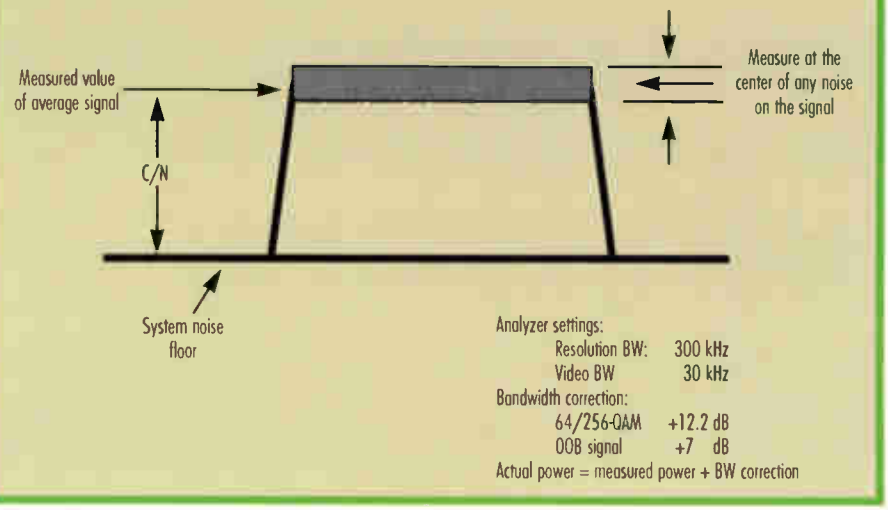
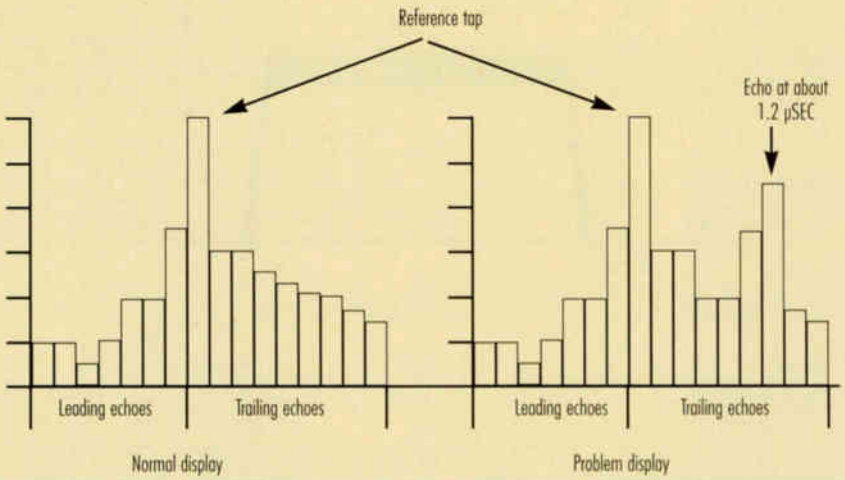


Figure 3: Adaptive equalizer tap displays



estimate likely will be on the order of 30 dB or more in a well-maintained system.

Several test-equipment manufacturers now offer digital signal level meters (SLMs) that are capable of measuring bit error rate (BER) and adaptive equalizer tap values, as well as signal level and C/N. These are useful tools for service technicians. In normal operation, short-term BER readings should be zero. Any other value is cause for concern.

The adaptive equalizer tap display indicates possible system problems such as bad connections and faulty cables. Figure 3 provides examples of equalizer tap displays under normal and problem conditions. Normally, the equalizer taps should decrease gradually in amplitude as the distance from the reference tap increases. A significant increase in one or more of the outlying taps indicates a problem within the system. Figure 3 shows a reflection at approximately 1.2 µsec.

Conclusion

Although it is more complex than analog technology, digital technology need not be intimidating. It is vital that a cable system's technical personnel understand the differences between the two technologies as well as how to handle these differences. This understanding, combined with proper site preparation and system maintenance, is the key to a successful digital launch in an increasingly digital world. CT

Joseph Waltrich is manager of special digital projects for General Instrument's Digital Network Systems. He may be reached via e-mail at jwaltrich@gi.com.

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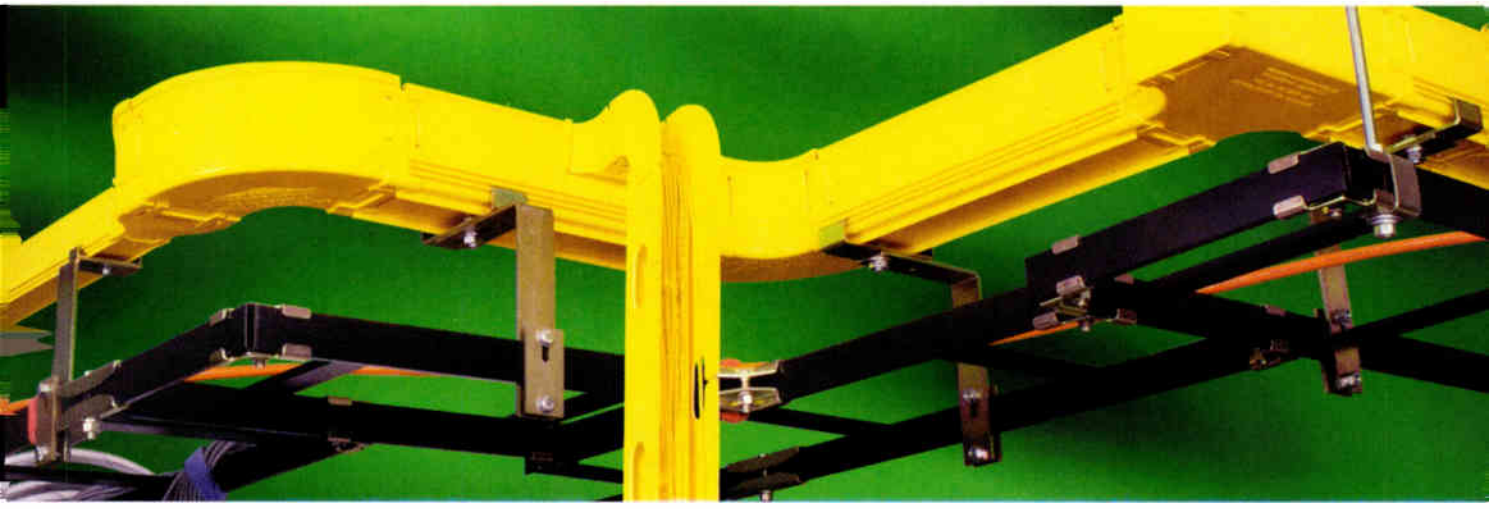

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Reader Service Number 29

CTA19

on Tomorrow's Build

Launch a Solid Plan Today

By Jim Chartre

Planning a successful system extension is becoming more difficult as new technologies become available and enhanced services come into play. Many factors, both in your control and beyond it, will contribute to the degree of success you experience as your build goes forward. A good project planner must be able to recognize and take into account all factors that will have an effect on the project schedule.

Sometimes you will be lucky enough to determine your own build rate and project timelines. In most cases, however, a project completion deadline already has been set, and you must find a way to meet the deadlines with available resources.

Remember that many business plans include reverse activation within the project completion date. From there, one can back into a schedule for ordering materials, design, mapping and walkout, as shown in the accompanying figure (on page 46). Many other factors, such as materials delivery and permitting, can fit into this simplified schedule.

Prepare for setbacks

This approach is straightforward, but does not take into account factors such as power supply activation, phase completion dates, permitting and materials delivery. Many projects begin with a corporate business plan, which may dictate activating a certain number of customers by a specific date to start generating a stream of revenue as soon as possible.

Keep in mind that customers must be notified in advance before they can be cut over to the new plant, so you must come up with a plan for customer notification. It is important to identify the activation requirements and plan the project around them. Meeting the construction mileage requirements in a rural

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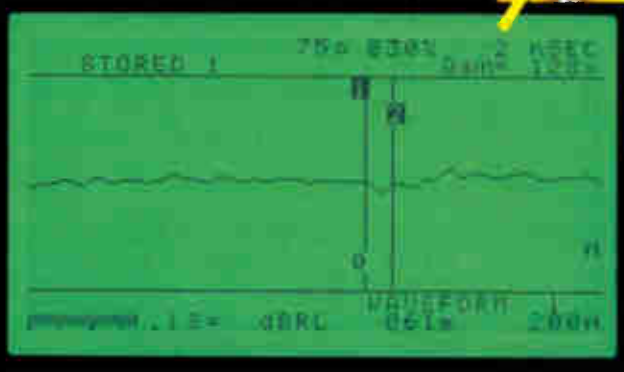

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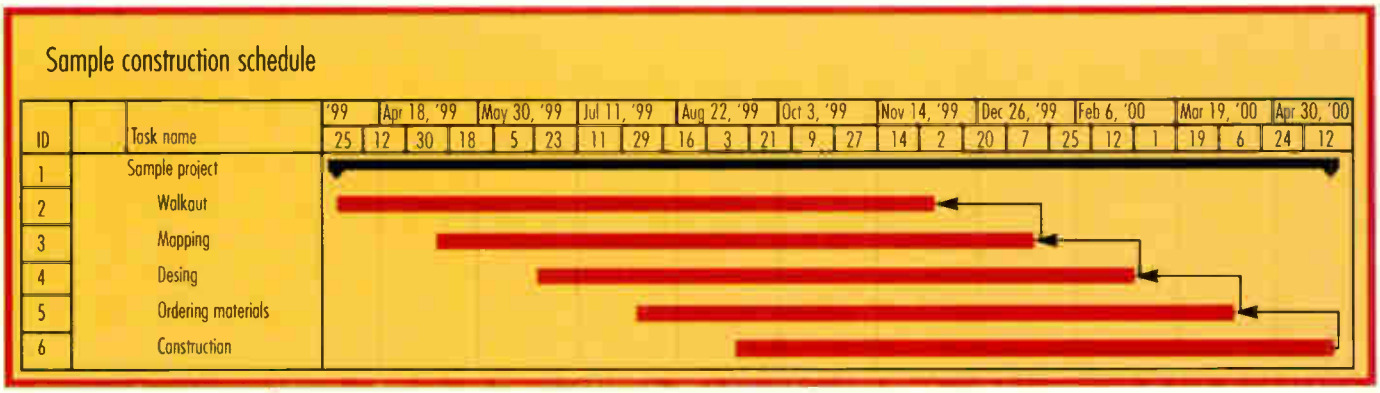

be measured prior to ordering the fiber. Then fiber-optic node locations can be established, and the fiber design can begin while the plant is being walked out. As a general rule, old maps should not be used to design the coaxial portion of the plant, but they can be useful in getting a head start on the fiber-optic design process.

Construction schedule

Be careful to avoid starting construction too early. Although you may be able to keep some crews busy for a couple of weeks, poor planning may result in shortages of design maps or construction materials. In this case, you may have to deal with crews going to other jobs because of lack of work, and it may be hard to get them back.

Make sure that when construction begins there will be a steady flow of work for the duration of the project. This is more challenging when multiple crews or contractors are working simultaneously in different areas of the same plant.

In any large build, you also will have to contend with ongoing new construction in addition to the normal build. Various new subdivisions and developments will be the "emergency of the day" that may disrupt your construction schedule. Planning for these things up front can minimize disruption of the build. Lastly, the design maps should be updated to show the actual construction changes for ongoing plant maintenance.

Jim Chartre is senior applications engineer at Cable Constructors Inc. He also sits on the board of directors of the Society of Cable Telecommunications Engineers' Badger Chapter. He can be reached via e-mail at chartrej@cableconstructors.com.

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Reader Service Number 33

Information Delivery to the Home/Office

Competition Drives Interface Efforts

By Chris Huffman

Growing consumer and business demands for all forms of electronic information and the proliferation of rival services present alternative design and distribution challenges for conveying video, data, voice and power into the premises environment.

The current competitive environment within the cable TV, telephone, power and direct broadcast groups is producing not one or two but several communications services that are available to homes and businesses.

The nature of the information transmission media from the various providers—copper twisted-pair, coaxial, fiber-optic or power line, coupled with the end-user requirement to cross-access this information—suggests the need for a practical interface to easily terminate all outside services to any subscribing location.

One method under development is known as the residential gateway and currently is considered the framework for an open project by the Telecommunications Industry Association's subcommittee TR 41.5, Multimedia Building Distribution Systems. The gateway is not a specification unto itself, but attempts to organize a direction for design.

Fundamentals

The fundamental notion for a gateway is a physically centralized, intelligent interface through which all communications services can be channeled to one location for delivery into the home or office network—that is, the interconnection of any service network to its corresponding device via one "door."

The essence of the idea is to supply a simplified and cost-effective means for meeting the objectives of all throughout the chain, providers to users, in bringing information from one point to another.

Arguably, this is accomplished by the demarcation-device approach as it is conceived by equipping the subscriber with access to all forms of communications without repeated installation costs, giving the equipment manufacturer a single interface scheme from which to base design, and providing the network operator with greater latitude in service offerings and management.

Inherent to the consumer concept is its implied ease of use through the provision for true plug-and-play. As the bridging and switching functions are handled by the exterior platform, the gateway, the complexity of mixing separate information delivery systems is hidden.

Cost reduction

Furthermore, costs can be significantly reduced by the removal of equipment. For example, in the case of cable TV, multiple set-top converters conceivably can be eliminated by relocating the hardware to the gateway. Likewise, multiple video cassette

BOTTOM LINE

Residential Gateway Interface

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The fundamental notion for a gateway is the interconnection of any service network to its corresponding device via one "door," which ideally will make for simplicity and reduced costs.

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recorders (VCRs) can easily be removed from each TV receiver location by circuiting one of them as just another service through the system.

As the mix of information services continues to be supplied in both analog and digital formats, an important opportunity afforded by the residential gateway concept is the ability to utilize the existing cabling for multiple services without the need for widespread cabling overhauls or post wiring.

> "Inherent in the consumer concept is its implied ease of use through the provision for true plug-and-play."

As cited previously, VCR, cable TV, direct satellite broadcasting and so forth can be sent over the same inside coax plant. Similarly, data sent in analog format can utilize the existing telephone twisted-pair, although digital information would require the addition of data-grade cabling.

Other efforts

It is important to understand that the work currently being conducted for communications and control within the home or office is widespread.

Additional to the efforts of TIA, the International Organization for Standardization and International Electrotechnical Commission are jointly involved with setting standards for home electronic systems that include video, home automation, security, heating and so on. Detailed information can be found at www.interactivehq.org/councils/html2/feigel/title.htm and www.labs.bt.com/profsoc/sc25wg1/about.htm, respectively. CT

Chris Huffman is director of worldwide marketing for Times Fiber Communications. He can be reached via e-mail at chuffman@compuserv.com.

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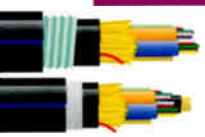

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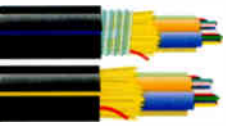

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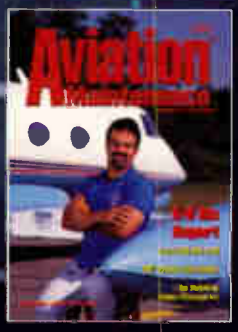

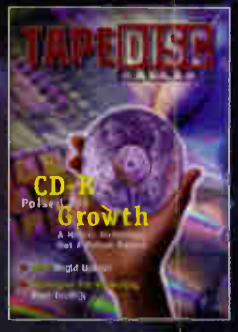

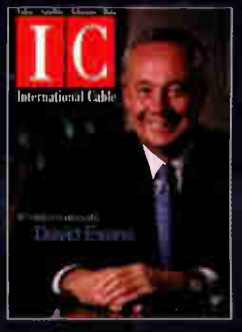

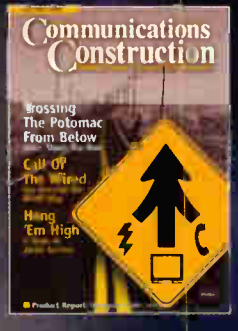

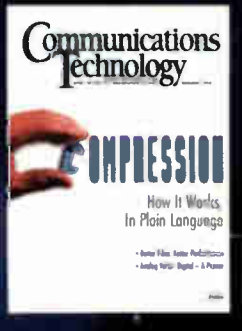

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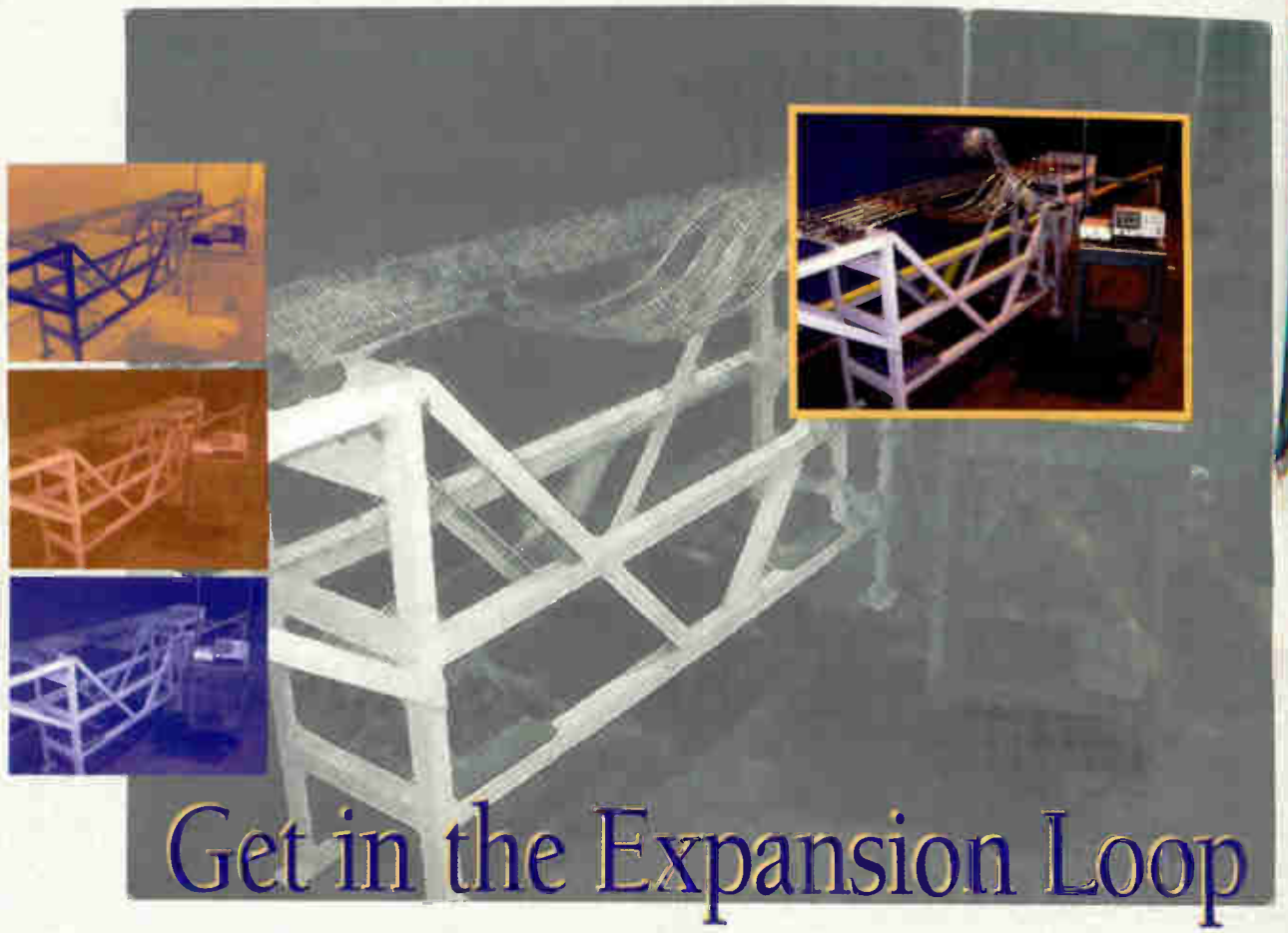

Get in the Expansion Loop

Detect Failure With New Test

By James H. Scelsi

Most coaxial cable manufacturers have a quality assurance testing program to ensure their product is reliable and consistently meets published specifications. One test performed on trunk and feeder cable is known as the fatigue failure test, which is conducted in the laboratory on expansion loops.

This article describes the test apparatus that simulates expansion loop operation and a test method that allows easy detection of the onset of fatigue cracks, even on jacketed cable. This method provides a quantifiable criterion for failure and improves on the existing method of detecting failures visually.

Eye on fatigue

Expansion loops are a necessary part of a cable system to compensate for the coaxial cable expansion and contraction from daily and seasonal temperature variations. Expansion loops are subjected to more mechanical working than any other part of the cable system. Therefore, it is very important that the performance of loops be tested under laboratory conditions to ensure that cables can meet lifetime performance expectations.

Fatigue testing determines the number of expansion and contraction cycles a coaxial cable can endure before the onset of fatigue cracking in the aluminum outer conductor. Testing is accomplished using a laboratory apparatus that simulates the contraction and expansion a loop will experience as a result of temperature variations.

This particular model can accommodate up to five loops, each installed exactly as i an aerial installation. A taut support stran spans each test loop location. The expansion loops are formed with a commerciall available loop tool and are installed on th strand with the correct number and positioning of bands and spacers.

Tie up loose ends

The cable ends are secured with special clamps at each end. One end of the loop is fixed, and the other is mounted to a movable platform that is attached to an electric motor drive that pushes and pulls the cable, achieving expansion and contracti of the loop. The longitudinal displacemer is adjustable to simulate different temperature ranges. A counter is used to keep track of the number of cycles to failure. ➤

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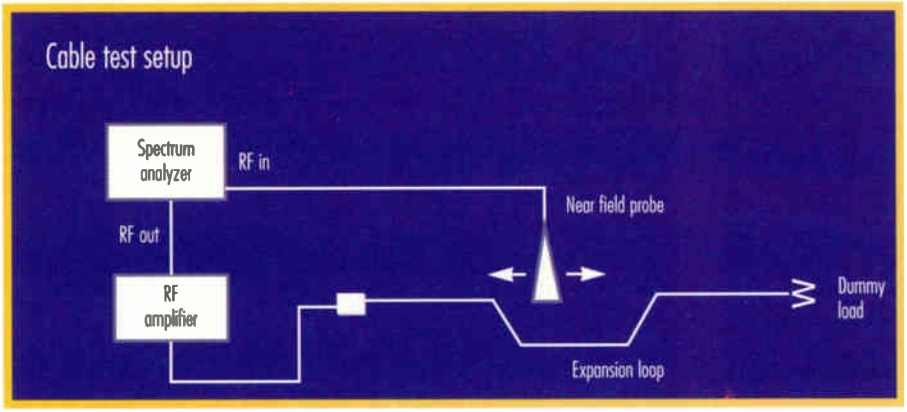

In an actual installation, the cyclic rate is usually one per day (day to night). In the laboratory, an accelerated rate must be used to induce failure in a reasonable amount of time; testing usually is carried out at approximately 10 cycles/min. When a fatigue crack occurs, testing is stopped, and the number of cycles to failure is noted.

Between the cracks

Fatigue failures in unjacketed cable are easily seen with the naked eye. However, with a black polyethylene jacketed cable, applying a visual inspection will not work because the failure is hidden under the jacket. Some other method of detection is required. Even for unjacketed cable, a standardized criterion for determining when a cable has failed is required. Hence, a detection method is needed.

An effective method of solving this problem has been developed that injects and detects a signal in the expansion loop. Sample failure is indicated by signal egress, which is detected by a near field probe. The accompanying figure shows the test setup.

BOTTOM LINE

Fatigue Test Spies Failure

Accelerated fatigue testing is an important cable characterization tool to ensure that aerial coaxial cables are capable of meeting lifetime expectations without failure.

Premature field failure with the resulting signal ingress and egress can have serious consequences. A testing apparatus has been developed to simulate installed expansion loop conditions.

What are the factors that effect cable fatigue life? Good construction practices with correctly formed expansion loops are of paramount importance. Test results indicate that some trunk and feeder cables can achieve an expansion loop life of 30 years or more.

A broadband signal of 50 MHz to 1 GHz is applied to one end of the connectorized sample by means of a spectrum analyzer and an RF amplifier, while the other end is terminated with an impedance matching load. The input signal level then is adjusted to at least 15 dBm. This setup simulates, as closely as possible, actual operating conditions.

A near field probe is attached to the RF input of the spectrum analyzer and placed on the loop in the general area that a crack is likely to occur. A noise floor value is recorded. The loop tester is turned on and the near field probe passed over the sample at regular intervals. As a failure begins to occur, the probe senses the RF leakage. An increase in signal level of 10 dBm above the noise floor is considered the failure point. Once this level is obtained, the number of cycles to failure is noted.

This method detects cracks that are barely visible to the naked eye, as well as those that hide under the cable's outer jacket. This method is an improvement over techniques that rely on a visual inspection of the sample. CT

Jim Scelsi is an RF design engineer at Trilogy Communications Inc. He can be reached at (800) 874-5649.

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OpenCable: Where It Stands

CableLabs Nails Down Two Specs for Digital Set-tops

By Robert Wells

The OpenCable project at CableLabs is a whirlwind of activity, as a team of engineers labors toward the goal of seeing interoperable digital set-tops—conforming with a completed OpenCable spec—on retailers' shelves by July 2000.

The OpenCable project, launched in late 1997, seeks to open up the market to competing suppliers of next-generation technology and to encourage innovation in services that can be delivered over digital set-tops. It also seeks to hasten the retail distribution of set-tops for direct purchase by cable subscribers. Some of the incentive for OpenCable came from a congressional mandate, part of the Telecommunications Act of 1996, that set-tops be sold at retail.

The OpenCable project is running flat-out. Staffers converse in rooms and hallways, littering whiteboards with charts. Or they're laboring over word processors or holding conference calls. When necessary, they're on the road—in another city, attending a standards meeting, conference or trade show. The project forges ahead.

> "Amid the flurry of spec-writing, CableLabs also is preparing to do compliance testing of OpenCable equipment."

As a result of intense in-house labor—coupled with negotiations with external interested parties—recent months have seen two key interfaces reach near-final form:

- OCI-C1 is CableLabs' designation for the interface between the set-tops and digital TV (DTV) sets using the Institute of Electrical and Electronics Engineers' (IEEE) Standard 1394 (FireWire) high-speed data transfer format.
- OCI-C2 is the formal name for the interface between the set-top and a point-of-deployment (POD) removable security card.

This article looks at these two specs, briefly lists some other specs still being written and notes plans for compliance testing and awarding of certification of OpenCable spec compliance.

The block-diagram in the accompanying figure (on page 60) summarizes the various interfaces that comprise the OpenCable spec. All share the same "OCI" designation, short for OpenCable Interface. The "C" designation is for interfaces to customer or client devices on subscriber

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premises; the "N" is for the interface on the cable network linking homes to headends, and the "H" is for two interfaces from the headend to external networks or operations centers.

OCI-C1

CableLabs has given the name Home Digital Network Interface (HDNI) to the portion of OpenCable's link between set-tops and DTV sets, video recorders, DVD (digital versatile disk) player-recorders and other devices in future high-tech homes.

BOTTOM LINE

OpenCable Moves Along

The OpenCable project at CableLabs is wrestling its way through a thicket of interface definitions—all designed to move interoperable digital set-tops off cable operators' books and onto retail store shelves.

One key feature of the new spec is reliance on a pathway between set-tops and TV sets that's formally called Institute of Electrical and Electronics Engineers (IEEE) Standard 1394 but lives up to its nickname, FireWire.

Keeping Hollywood happy by assuring pirate-resistant copy-protection has been no small task, but CableLabs and consumer electronics manufacturers have found at least one approach to point-of-deployment (POD) removable security cards that they both can rally behind.

With more specs still to be defined, including those for linking set-tops to headends and headends to external content suppliers, OpenCable is a work in progress. But a lab already is being set up in Colorado where vendors' equipment will be tested for spec compliance.

If all goes well, set-tops bearing the emblem of OpenCable compliance will hit the stores by July 2000—which just happens to be the FCC's mandated deadline.

The IEEE 1394 format supports data flows at 100 Mbps and 400 Mbps over a four- or six-wire shielded twisted pair of copper wires. Selection of IEEE 1394 as an OpenCable spec, which was announced in March 1998, "was among the easier choices we've had," says Laurie Schwartz, CableLabs' vice president of advanced platforms and services.

Choosing a copy-protection solution to include in OCI-C1, however, proved more difficult. Hollywood studios insisted that copy protection be ultra-secure, given that the medium would be transporting video and audio of high enough quality to make signal thieves salivate.

An ad hoc inter-industry working group, the Copy Protection Technology Working Group, in mid-summer 1998 endorsed an approach formally called the "5C" Digital Transmission Content Protection Specification, gaining the name from being a compromise among five vendor companies (Sony, Mitsubishi, Intel, Toshiba and Hitachi). The OpenCable project did also.

After OpenCable's embrace of 5C, support also was needed from consumer electronics manufacturers, who work in concert through the Consumer Electronics Manufacturers Association, a unit of the Electronic Industries Alliance.

Rather than formally endorsing any single technology, so far CEMA has chosen to endorse IEEE 1394 as one appropriate input for DTV sets and other devices, and also to endorse 5C as one viable copy-protection solution.

Despite CEMA's lack of specificity, OpenCable participants say that at least some DTV sets will support HDNI—meaning both IEEE 1394 and 5C—although it may be up to consumers to make sure they buy the right sets if they want them to work with OpenCable set-tops. The final version of CEMA's standard, EIA 775, was taking shape at year-end 1998.

Another area in which OpenCable and CEMA engineers collaborated and achieved substantial consensus was on supporting the same signal set for command-and-control signaling—which is how the OpenCable box, TV set and video recorder control one another's activities as needed. They also agreed on formats for on-screen display of text and other digital overlays, such as electronic program guide (EPG) content.

In agreeing on common approaches to 1394 signaling, cable and consumer electronics companies were responding to the urgings of Federal Communications Commission Commissioner William E. Kennard.

In an August 1998 letter, Kennard urged the two parties to come to some agreements about the details of the 1394 interface by Nov. 1, 1998—or risk government intervention in the process. In a letter sent Oct. 30, heads of CEMA and the National Cable Television Association sought to assure Kennard that agreement on all major issues had been achieved.

Longer-term, cable's objective—which is shared by consumer electronics companies—is for whatever circuitry is needed to receive and display OpenCable digital signals to be built into "digital cable-ready" TV sets—but such devices could be several years away, Schwartz says.

OCI-C2

In implementing the Telecommunications Act of 1996, the FCC in June 1998 ordered cable and consumer electronics companies to come up with a design for removable security PODs by December 1998 and ordered that the cards be made available by MSOs starting no later than July 2000.

PODs—which will come in the Personal Computer Memory Card International Association (PCMCIA) form factor that's in common use on personal computers (PCs)—are a way of assuring an OpenCable set-top's (or other device's) portability between OpenCable-complaint cable systems. PODs contain system-specific codes for access control, security and copy protection. A copy-protection approach similar to that in OCI-C1 is to be incorporated into the POD card as well.

Successive drafts of the OCI-C2 spec went out for review by vendors and by the Society of Cable Telecommunications Engineers' Digital Video Subcommittee (DVS) in summer and fall of 1998. The spec was slated for formal adoption as a standard, SCTE-DVS 131, in SCTE voting during December 1998.

It's expected that the POD approach will gradually replace current set-tops,

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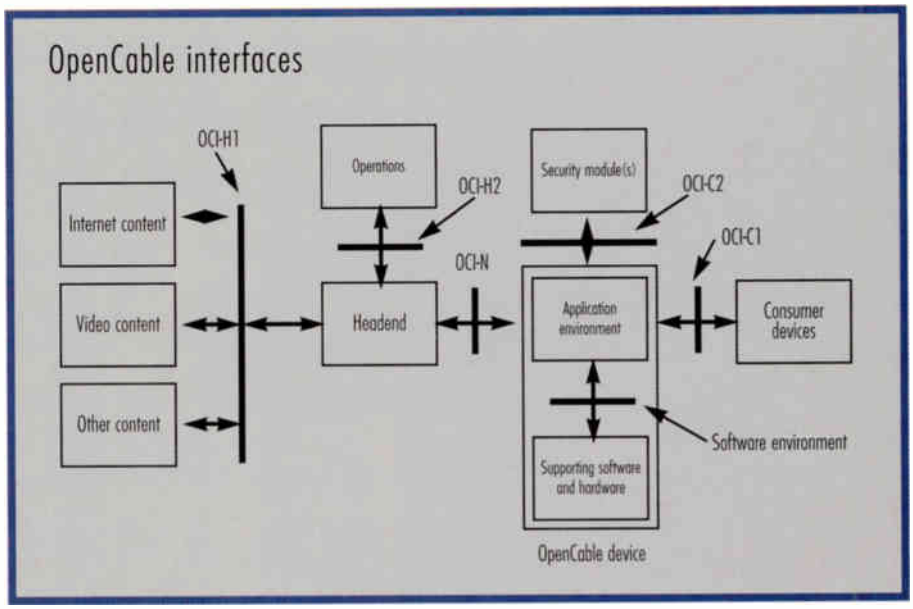

which have their security elements embedded inside them, and which the FCC has stipulated cable operators must phase out by year-end 2005.

Where OpenCable Stands

Schwartz expresses confidence that progress on the key OCI-C1 and OCI-C2 interfaces should convince consumer electronics manufacturers that enough predictability now exists so that they can design and manufacture set-tops, PODs, TV sets and other devices.

Further, she adds, "We're pleased that we've shown the FCC and other potential regulators that cable and the consumer electronics industry can collaborate in a timely manner."

Meanwhile, the work will continue at CableLabs on four remaining specs:

- One, OCI-N, is for the interface, via cable networks, between set-tops and headends. It contains signaling rules that, in particular, prevent the set-top from degrading the digital network's overall activities, Schwartz says.
- A second, OCI-H1, covers the link between cable headends and external content sources, including digital video programmers and the Internet. It will define data formats for enhanced TV services, such as EPGs, and assist cable operators in preparing to accommodate these data streams, Schwartz says.
- A third interface, OCI-H2, provides a link to operations centers such as accounting and billing systems.
- A final, quite complicated spec is for what CableLabs is calling the "Software Environment," meaning application programming interfaces (APIs) linking underlying software elements, such as multiple supported operating systems, to the OpenCable application environment. "This is really more than just a software interface in the set-tops; it relates to software throughout the delivery system," Schwartz notes.

Amid the flurry of spec-writing, CableLabs also is preparing to do compliance testing of OpenCable equipment. Test equipment is being ordered, and a lab is being outfitted at CableLabs' Louisville, CO, facility. The schedule calls for interoperability testing to begin on components in July 1999 and on complete systems in January 2000.

What's expected to follow is the start of certification of vendor equipment as spec-compliant in early 2000. A decal already has been designed for use on boxes and in-store displays. Then, it is hoped that consumers, seeing the decal on set-tops, VCRs and eventually digital cable-ready TV sets, will board the OpenCable bandwagon. CT

Robert Wells is an analyst with Lennox Research LLC, a Boulder, CO, consulting firm. He can be reached at (303) 447-3400 or by e-mail at wells@rmi.net.

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POWER

Power Up For HFC Telephony

Local Powering Can Save a Bundle

By Dan Paone

Hybrid fiber/coax (HFC) telephony has allowed MSOs to successfully capture a market share from incumbent providers. In fact, cable telephony has achieved penetration rates of 7% to 20% within the first year of service, thereby providing higher first-year take rates than any other digital service. Challenges to deploying HFC telephony technology also have arisen, mainly in providing power to the network.

Prior to two-way transmission on the coaxial medium, power was provided to the HFC network by using either centralized or decentralized power equipment, battery backup equipment and backup generator access in the outside plant. Typically, this equipment provided approximately two hours, at best, and a maximum of four hours of power backup to the network.

With the advent of HFC telephony, telephone service has added a complex dimension to provisioning sufficient additional network power to the subscriber's network interface unit (NIU). In addition, the network now must provide lifeline service with at least eight hours of reserve power (battery backup) in the event of commercial power failure. This requirement continues to be the service benchmark.

The added power requirement dimension imposed by the NIU at the subscriber's dwelling presents inherent powering challenges. Therefore, several engineering questions must be asked when building the powering infrastructure to support HFC telephony deployments, including:

- Is my existing powering scheme robust enough to support HFC telephony requirements?
- What are the reserve battery requirements in the event of commercial power outage?
- How can I cope with engineering and placing a robust network powering scheme in an environment of unpredictable penetration growth and load balance the powering to meet requirements?

Network powering

There are several important points to take into consideration in a network-powered configuration. For instance, it can be difficult to determine where the subscriber growth will take place. (See the accompanying figure on page 64.) Therefore, network powering requires constant re-engineering and upgrading as load requirements and

BOTTOM LINE

Local Powering Backs Up

Cable telephony is here. With increasing and unpredictable subscriber service requests, it's time to prepare the network for easy maintenance and extended lifeline backup. The practical use of local powering in the hybrid fiber/coax (HFC) telephony network can simplify outside plant issues and minimize the costs of engineering and managing network powering equipment.

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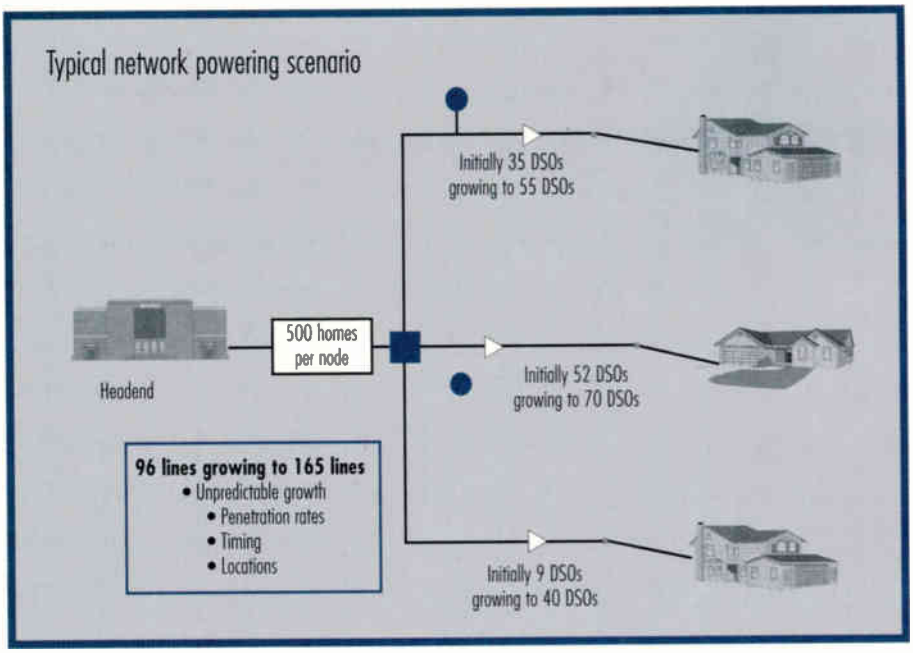

subscriber penetration rates change. Remember: Building to 100% capacity in a changing environment is neither a feasible nor a cost-effective alternative.

Network powering also can place an inordinate strain on the HFC telephony network provider. Proper load balancing and placement of power equipment are difficult, and in many cases right-of-way acquisition to place additional equipment is difficult and costly.

Finally, network powering equipment is subject to environmental exposure and inherent maintenance and security issues. In storm conditions, where catastrophic power failures might occur, it is challenging to manage generator placement, given the requirement to supply power to a large population of telephone subscribers.

Local powering

Many HFC telephony service providers are beginning to deploy small local power supply units (LPSUs) at subscriber premises. By placing the LPSU there, it will not be subjected to environmental issues and security problems.

Local powering also removes the extra power requirement burden from the network power equipment design. Therefore, network power equipment does not have to be 100% engineered or upgraded continuously, and there is minimal effect from unpredictable penetration rates, timing and placement of network power equipment.

To prepare for catastrophic failures, generators still are required for the network. However, local powering provides its own on-board rechargeable battery backup for a minimum of eight hours, thereby reducing the total power drain on the network and meeting the "lifeline" benchmark.

> "The added power requirement dimension imposed by the NIU at the subscriber's dwelling presents inherent powering challenges."

LPSUs also present some unique challenges. For instance, the subscriber must accept an on-premise device that plugs into his or her power outlet. Also, operators must create a battery replacement schedule and determine who is responsible for the maintenance (the MSO or subscriber).

A closer look

Since HFC telephony and its network maintenance issues still are new to cable operators, it's important to learn from the expertise of MSOs that currently deploy cable telephony. LPSU standards suggest:

- Units should be compact in size, measuring less than 8 inches by 10 inches by 3 inches.
- Make sure that LPSUs are wall or table-mountable and that technicians can install them easily in the premises.
- Since the power outlet is not always in the best location, make sure that there is a 100-foot electrical reach from the LPSU to the NIU.
- LPSUs should feature 110 VAC input and 48 VDC output.
- Units need to provide integrated backup battery and charger circuitry.
- LPSUs should provide local physical indicators that display AC power "on," DC power "output on" and "replace battery."

Units also should provide telemetry outputs that indicate the same conditions as the physical indicators. These telemetry outputs are relayed to the subscriber's NIU, which transports the information back through the HFC network equipment to the headend or network operations center (NOC).

This enables proactive maintenance, especially where the battery is about to reach the end of its service life, and maintenance can be conducted only when it is necessary. (Author's note: The telemetry methodology in the LPSU is designed to interface specifically with the particular NIU or voice port placed at the subscriber premise.)

Conclusion

LPSUs provide yet another option to powering HFC networks. Network powering is a feasible choice to power the network. However, the addition of network powering equipment may be required only to bring the network's survival time up to par with classic telephony requirements. Now, the burden of the extra power and backup time for the NIUs can fall on the local power supply unit.

HFC telephony presents many different opportunities. The key to seizing them, however, is to procure cost-effective equipment that will optimize and properly maintain the HFC network. CT

Dan Paone is director of product line management at ANTEC Network Technologies in Norcross, GA. He can be called at (770) 441-0007 or e-mailed at dan.paone@antec.com.

POWER

Backup to the Future

The Ins and Outs of Batteries

By Victoria J. Benz

Cable companies are beginning to undergo a transformation into distribution hubs for other forms of communication such as telephony, Internet access and interactive services. As this happens, reliable backup power will become even more important.

Currently, most backup power in the cable industry consists of a variety of batteries. There seem to be many opinions and some confusion about batteries and which ones are most suitable for cable systems. Before the technology becomes too overwhelming, a few things should be cleared up about the batteries currently used in the cable industry and what alternatives will be available in the future.

Flooded vs. SLA batteries

Probably the most inexpensive route to take is using a flooded or wet battery for backup in power supply units. Although they have more capacity than sealed lead acid (SLA), these automotive-type batteries may not be so economical since they are maintenance-intensive.

The interior fluid level of a flooded battery must be checked often and retained, especially in warm climates. Flooded batteries also present hazards such as spilling, leaking and gassing, all of which can lead to corrosion of the battery and damage to the surrounding environment.

The most widely used battery in the cable industry is SLA. These batteries have almost no chance of leakage and still are competitively priced. SLA encompasses many types of batteries, such as recombinant, valve regulated and absorbed glass mat. They basically are maintenance-free and safe to operate in any position. The electrolyte in these batteries is immobilized in highly porous and absorbent microfiber glass mats that act as separators between the plates.

Often the term "gel cell" is mistakenly used to describe the SLA batteries just mentioned, but gel cells are of a slightly different makeup. The interior contains electrolyte mixed with silica that causes it to harden like a gel. A gel cell is sealed and not likely to leak, yet it won't hold up as well in the long run as other SLA batteries.

Deep cycle vs. stationary

The batteries cited thus far are

BOTTOM LINE

Beef Up Your Backup

Amidst the whirl of advancing technology in the communications industry is the element of backup power. Many say the future will have cable TV companies offering hundreds of channels for serious couch potatoes and adding other services such as telephony, Internet access and a variety of interactive services.

If cable companies begin to take on these responsibilities, they'll have to beef up their backup power systems.

There are several questions now about backup batteries in the cable industry. Which types of batteries are most appropriate, and what will make them long-lasting and fail-safe?

This article provides some answers to those questions and offers tips on getting the most bang for your battery buck.

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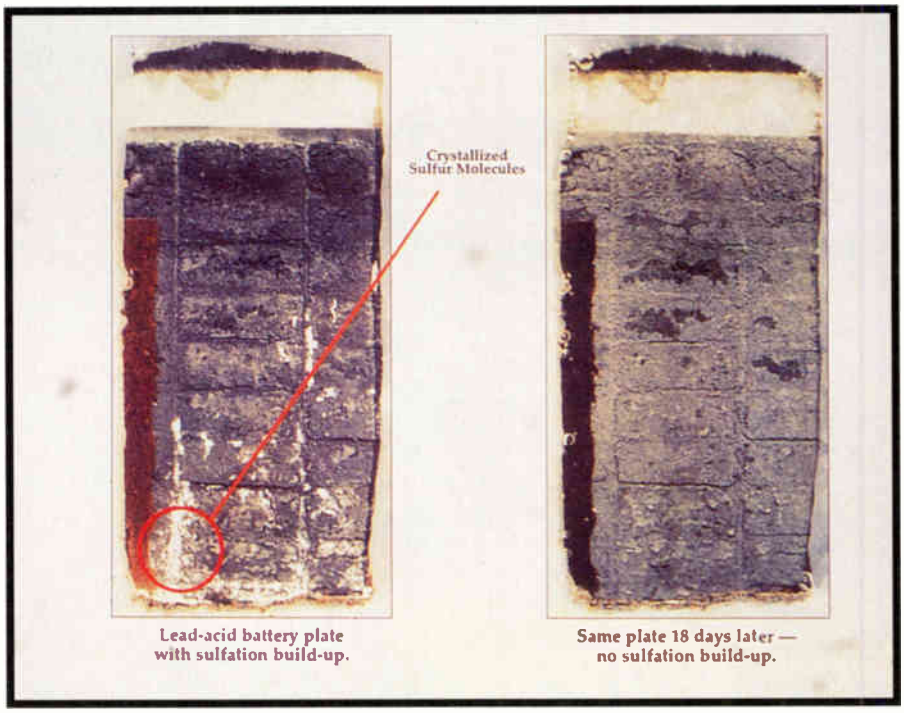


considered deep cycle batteries. They work best when cycled or discharged deeply and then recharged. Batteries used in uninterruptible power supply (UPS) applications receive a constant trickle charge that deep cycle batteries are not designed to accept. They'll get the job done; however, they are intended to be a primary power source, not a backup source.

Stationary SLA batteries have the same basic characteristics as deep cycle SLA batteries. However, their interior grid structure and plate spacing are constructed in a way that allows them to remain stationary for long time periods with an ongoing charge.

"Stationary batteries probably cost 20% to 25% more than deep cycle batteries," says Paul Klatt, technical support specialist at Batteries Plus. "But when used according to manufacturers' guidelines, deep cycle batteries in UPS applications will last three to four years, and stationary batteries will last up to 10 years."

With all the batteries needed to form a reliable backup power system, it can become quite expensive to buy replacements. Knowing what causes damage to batteries and how to prolong battery life can help to reduce that cost.

Temperature and batteries

A battery used with the power supply as backup in the cable industry will be exposed to brutal environmental conditions, and extreme variances in temperature are harmful to batteries.

Excessive heat is most detrimental to batteries. Enclosed in a metal box hanging on a pole, these backup batteries undoubtedly will have the sun beating on them for extended periods of time. In addition, they receive a constant charge that contributes to internally generated heat. These intense temperatures speed up battery discharge and greatly reduce battery life expectancy.

> "There seem to be many opinions and some confusion about batteries and which ones are most suitable for cable systems."

Scott Livingstone, technical trainer for TCI of Colorado, has problems with heat from several sources damaging backup batteries. "There is a lot of heat that builds up from the power supply that affects the batteries. Also, if the batteries aren't spaced properly to allow ventilation around them and keep it somewhat cool, they die more quickly."

Extreme cold also affects batteries. It slows the interior molecules and diminishes battery capacity. So, if it's extremely cold, don't always count on your batteries to last their full discharge time.

Sulfation buildup

Another reason batteries fail is sulfation buildup on the interior plates. During normal charge/discharge cycles, lead sulfates form on the battery plates. The sulfates accumulate and, in a sense, clog the battery, causing it to be less efficient and eventually die. It's an even more prominent problem in hot climates because the rate of sulfation buildup actually doubles for every 10° Fahrenheit increase in temperature.

Pulse technology is a process designed to prevent and eliminate sulfation accumulation in batteries. Battery maintenance products utilizing pulse technology are now on the market and available at battery retailers. These products connect directly to the battery terminals and emit a pulsating DC current into the battery. The pulses remove the sulfate deposits from the plates and

return them to the battery acid as active electrolyte.

TCI of Colorado is testing the effectiveness of pulse technology, and according to Livingstone, the cable industry could be a good application for such products.

Maintenance frequency

Aside from new technology, regular upkeep also can help prolong the life of batteries and is crucial in ensuring that backup power will work when it's needed. Maintenance may be done on a quarterly basis and should include performing a load test and verifying proper operation of the equipment working with the batteries.

It's also important to check the charging system to make sure it's emitting the correct output because overcharging could cause irreversible damage to the battery.

Backup urgency

When cable companies begin offering telephony, 911 emergency calls enter the picture. Emergency communication will require much longer backup than cable companies currently have. In what form this backup power will be is not yet known.

New technology in the battery industry aims to address the need for extended run time. "There are products in development such as fuel cells and flooded nickel metal hydride (NiMH) that will offer increased capacity and energy efficiency," says Shawn Cushman, senior product manager at Batteries Plus.

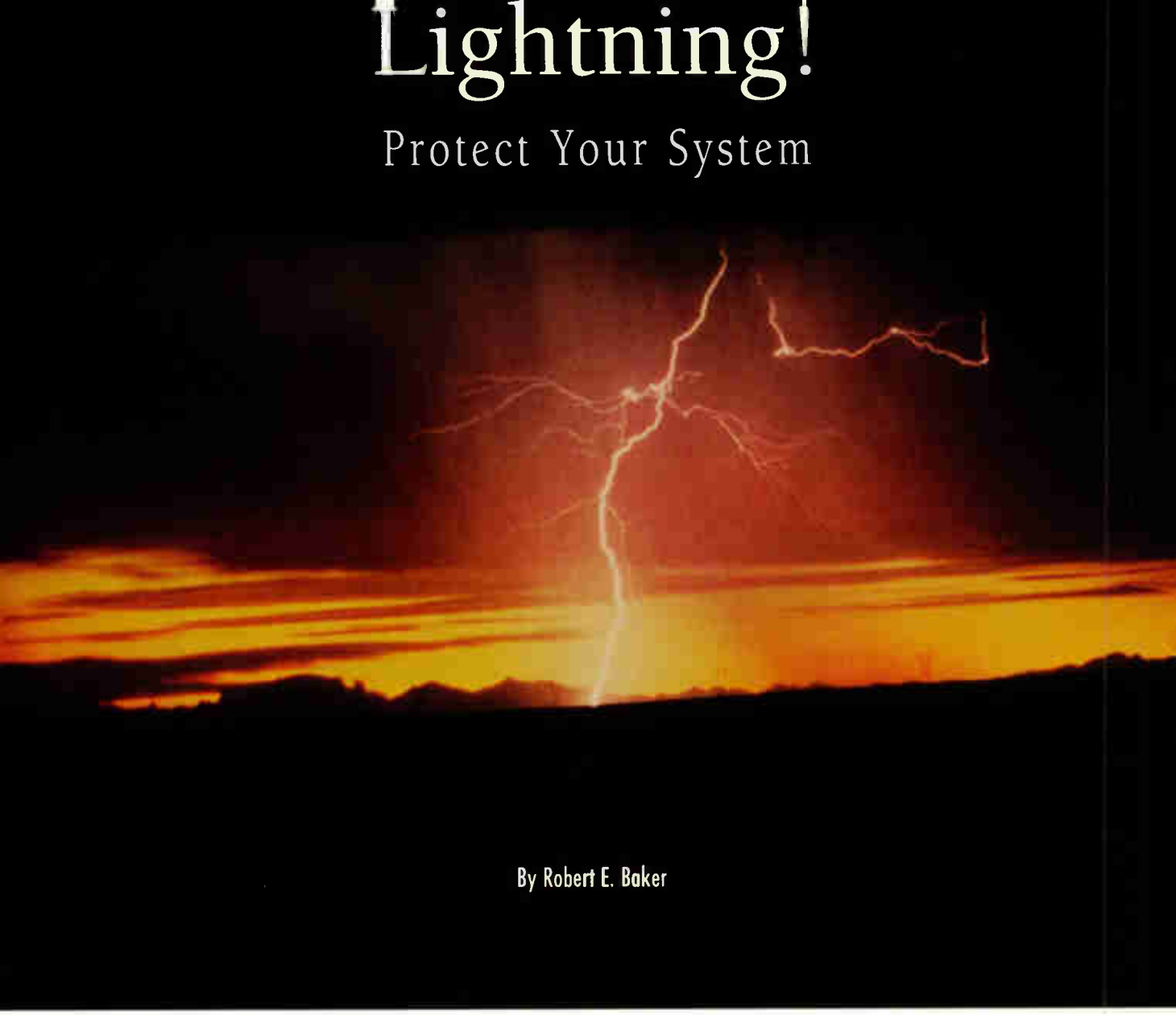
Conclusion

Whatever the future brings for cable companies, batteries always will be in the mix. They power vehicles, test equipment and cordless tools. In most any application, batteries act as a lifeline and require some attention to keep working at their best. Following a few guidelines on proper use and maintenance of batteries can save money as well as eliminate any worry of failure in time of need. CT

Victoria Benz is public relations coordinator at Batteries Plus. She may be reached at (414) 369-0690.

Lightning!

Protect Your System



By Robert E. Baker

If you believe in evil curses and such, you might have heard about the famed "double whammy." But have you heard about Mother Nature's "power whammy?" And do you know what it's all about? Read on. The tale about to unfold may give you an insight into problems you've already experienced or may be prone to.

According to the National Oceanic and Atmospheric Administration (NOAA), each year the United States experiences more than 10,000 severe thunderstorms.

With spring coming right around the corner with increasingly unpredictable weather patterns, many of us may expect an increase in thunderstorm activity this year.

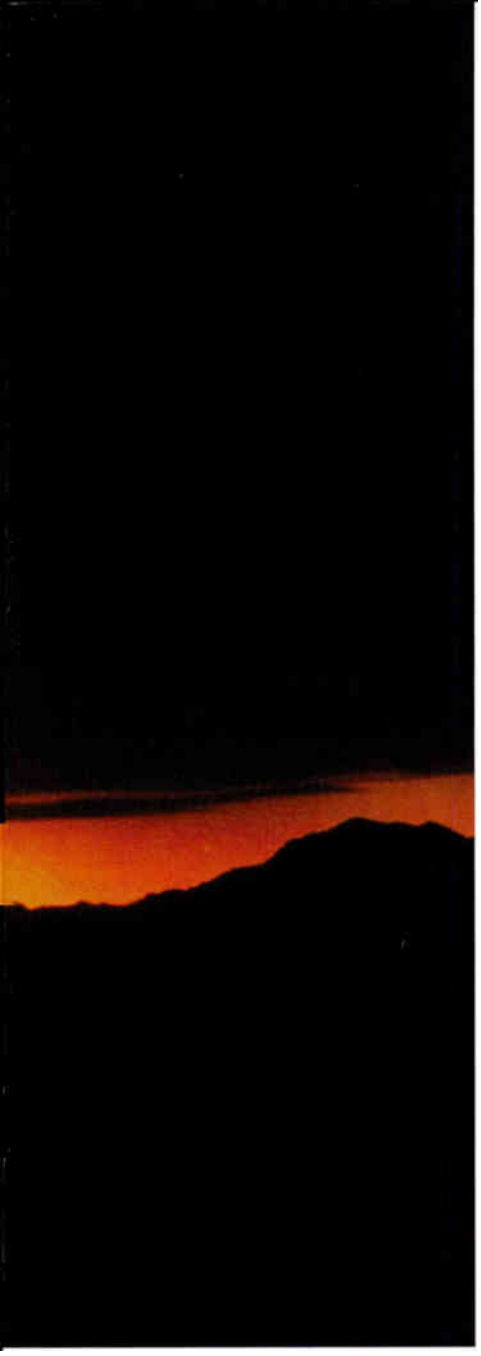
With thunderstorms comes lightning. Just what is lightning? How does it come to be and how can it affect our cable TV facilities from the headend to the subscriber?

Is there anything we can do to reduce our chances of falling victim to Mother Nature's "power whammy?" You bet there is! I hope some of these questions will be answered as we proceed.

Stormy weather

Three factors are necessary for development of thunderstorms: unstable air, moisture and some sort of trigger mechanism.

One trigger is the passage of a cold front, where the invasion of cool air causes lighter, warm moist air to migrate up



into the upper atmosphere. Cooling of this moist air causes condensation of the moisture on small dust particles, which forms a cloud. Cooler dry air surrounding the cloud is forced downward by the cloud formation. This updraft and downdraft mechanism can become very intense in the presence of unstable air, which increases convection and the release of latent heat by the water vapor. Given the right mix of ingredients, a thunderstorm will occur.

The exact mechanisms of how the electrical charges originate within a thunderstorm still are not fully understood, but suffice to say that this upward and downward flow of air and moisture results in pockets of positive and negative charges within the clouds. Electricity also appears to be produced by the freezing of supercooled water droplets. As the storm continues to develop, the lower portion of the cloud typically assumes a negative charge with respect to the upper portions of the cloud and the earth.

This action within the thunderstorm continues until eventually there are sufficient potential differences to cause a discharge. One could liken this to the breakdown of the dielectric material within a capacitor where the charges are the plates of the capacitor and the atmosphere is the dielectric. These discharges can occur within the cloud, between clouds, or between a cloud and the earth. Since most of our facilities are on the earth, we'll only look at it from this point of view.

Without going through a detailed technical explanation of the mechanics of a lightning discharge occurrence, let's just give some facts.

First, during the period prior to a strike, charges on the ground beneath a cloud are directly opposite in polarity. That is, the earth (and any structures on it) assumes a positive charge relative to the cloud overhead.

Secondly, the strength of the ground charge increases in direct proportion to the cloud's charge.

Third, and most importantly, the actual voltage potential (a gradient) at any given point on a structure increases with its distance from the ground.

Finally, as the field intensity increases between the cloud and the earth point, free electrons may begin to flow, causing a corona discharge just prior to the actual strike itself. This discharge may result in positive streamers reaching upward, inviting the actual lightning bolt itself to occur.

From the last point, it is obvious that the lightning bolt will strike at the point of discharge from the ground. While the lightning strike itself is bad, this fact is good because it tells us that we can have some control as to where lightning hits will occur.

The task then becomes one of getting the lightning to strike where we want with little or no damage to our facilities. Better yet, if we can, we want to protect our facilities from being hit at all. Seem impossible? Read on.

Lightning protection systems

Enter the lightning rod, or lightning protection system. By placing lightning rods at carefully selected points, and at the highest points, you create a zone of protection. A zone of protection is that space adjacent to a lightning protection system that is substantially immune to direct lightning flashes.

The ideal situation is for the headend building to be tucked up near the base of an antenna tower that is taller than 150 feet. If the tower is properly fitted with a lightning protection system, the headend will be relatively immune from lightning hits, provided it falls within the zone of protection. Imagine a sphere with a radius of 150 feet. Roll this sphere up against the antenna tower.

If the headend and its associated structures (television receive-only earth station, or TVRO, backup generator and so on) fall within the space covered by the sphere, they are in the zone of protection. In this case, for example, structures 15 feet or more in height and 80 feet or fewer from the tower base are protected. Similarly, structures 10 feet or more in height are protected provided they are closer than 95 feet from the tower base. (See Figure 1 on page 72.)

If more than one tower (or lightning protection system air terminal) is involved, the same sphere may be placed such that it is resting on the two towers (or lightning rods). Then the space beneath the points of contact and under the

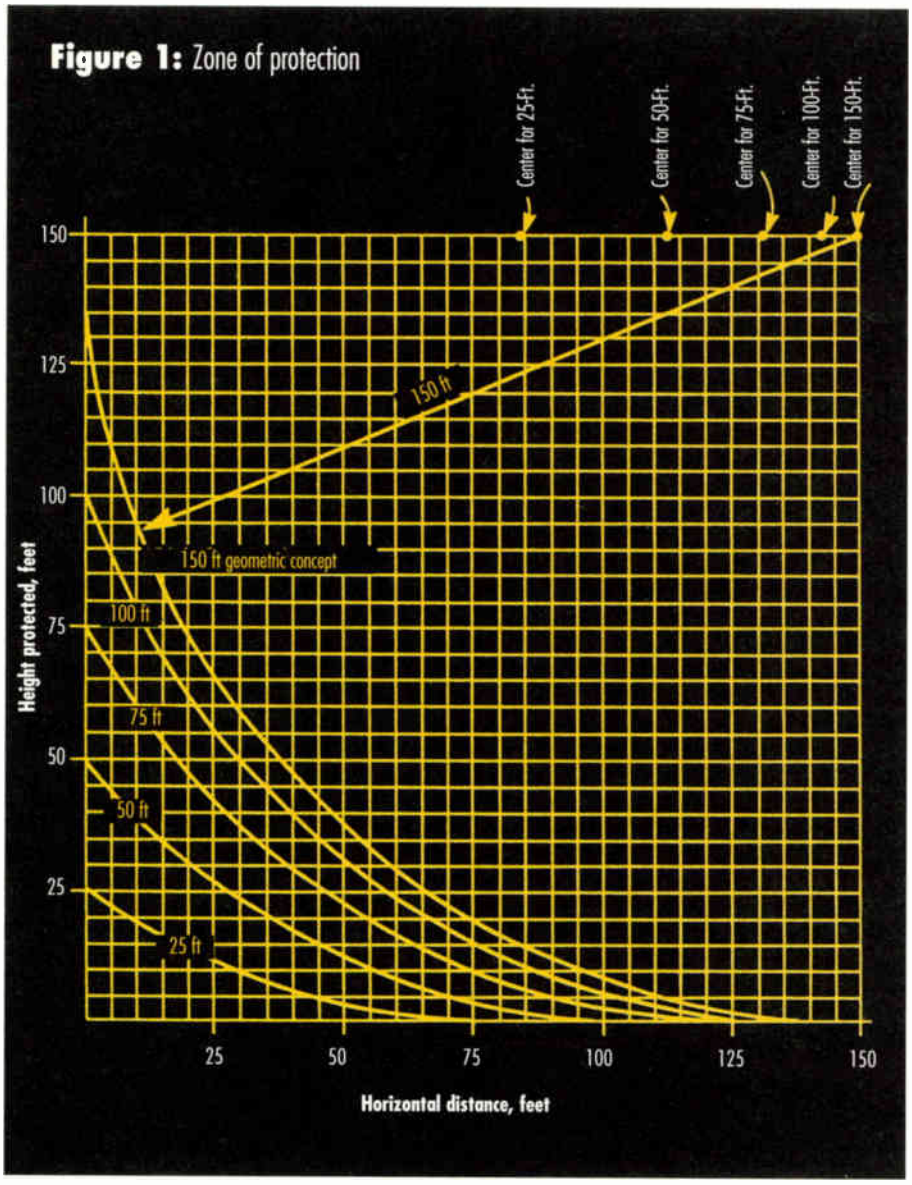


Figure 1: Zone of protection

sphere is in the zone of protection. If more than two towers (or lightning rods) are involved, multiple spheres may be used to determine the zone of protection. (See Figure 2 on page 75.)

All of this assumes that the lightning protection system in use is properly engineered and installed. If you are in the cable TV or another broadband telecommunications business, you probably have both the National Electrical Code and the National Electrical Safety Code in your reference library. You also should have a copy of NFPA 780, the Lightning Protection Code.

Within this code, you will find a listing of Class I and Class II materials requirements. These "materials" often are referred to as lightning rods (air terminals) and associated ground wires (conductors). The code designates that Class I materials shall be used for ordinary structures not exceeding 75 feet in height, while Class II materials shall be used for ordinary structures greater than 75 feet in height. In most cases, our headend facilities fall under Class I, while our towers fall under Class II.

The differences between the classes simply are the size of the rods and conductors. Keep in mind that the larger the conductive surface of both the lightning rod and the conductors, the lower the impedance (sum of resistance and inductance). In this case, bigger is better, as you will see later in this article.

A Class I lightning rod (air terminal) is 3/8-inch copper or 1/2-inch aluminum, while Class II calls for 1/2-inch copper or 5/8-inch aluminum. Conductor sizes vary accordingly, also depending on their composition (stranded or strips) and materials (aluminum or copper). Since most soils contain acid or alkaloid compounds that react with aluminum, any aluminum used must not come in contact with the soil.

Further, if aluminum is used, it may not be in contact with copper or exposed to runoff from copper surfaces. Fittings used for the connection of aluminum down conductors to copper or copper-clad grounding equipment must be bimetallic type and installed not less than 18 inches above earth level according to code requirements.

Placement and height of the lightning rods also are dictated by NFPA 780. The tip of the rod can be no less than 10 inches above the object or area it is protecting. Rods should be placed on the ridges of pitched roofs and around the perimeter of flat or gently sloping roofs at intervals not exceeding 20 feet.

Lightning rods (air terminals) 24 inches or higher may be placed at intervals not exceeding 25 feet. Place air terminals at or within 2 feet of the ends of ridges or edges and corners of roofs. If the air terminal is greater than 24 inches in height, it must be supported at a point not less than one half the height of the air terminal.

Requirements and guidelines

Technical requirements for conductors are too numerous and diverse to cover in this article. The following are general guidelines to follow.

Every building's lightning protection system must have at least two down conductors. Structures exceeding 250 feet in perimeter shall have a down conductor for every 100 feet of perimeter or fraction thereof. Metal towers constructed to receive a stroke of lightning without damage need only bonding to ground terminals.

If antennas and other attachments are at or near the top, a separate lightning rod should be installed to become the highest point protruding above the attachments by the minimum distances required by the code.

Down conductors should be as widely separated as practical, and no bend of a conductor shall form an included angle of less than 90°, nor shall it have a bend radius of less than 8 inches. Conductors must be fastened to the structure upon which they are placed at intervals not exceeding 3 feet.

Worth the effort

Why is all this necessary, and why the specific guidelines in the code? A lightning bolt can result in lightning currents of 200,000 amperes, and up to 30,000 amperes is typical for the average strike. The current waveform will have a very fast rise time, on the order of 1.0 µsec. Decay will be slower and is largely dependent on the impedance characteristics of the current-carrying circuit or protection system.

Inductance is a major factor. Inductance of a straight circular conductor is approximately 1.0 microhenry to 1.5 microhenries per meter and does not change appreciably with conductor size. During the fast rise time of the current, the inductance is responsible for most of the voltage drop through the conductor. During the slower decay, the resistive voltage drop is the larger part of the total.

The voltage drop through a lightning conductor may be calculated by using the formula:

$E = IR + L(di/dt)$

Where:
I = current in amperes
R = conductor DC resistance in ohms
L = conductor inductance in henries
di = change of current in amperes
dt = change of time in seconds (rise time)

Assume a No. 6 AWG copper conductor has a length of 32.8 feet and a total DC resistance of 0.13 ohms. Its inductance is 10 microhenries. A lightning strike produces a current of 20,000 amperes and a rise time of 1.0 µsec.

E = (20,000 x 0.13) + .000010 (20,000/0.000001)
E = 2,600 + 200,000
E = 202,600 volts

The resistive voltage drop is only 2,600 volts, but the reactive voltage drop is 200,000 volts. This demonstrates that the conductor length is far more important than the size. Keep the conductors as short as possible.

"People, we're talking about a lot of energy here."

At least two down conductors are required by code. The primary reasons for this requirement are if one down conductor becomes damaged, there is still a path to ground. More importantly, multiple conductors lower the impedance of the overall lightning protection network (lowering the voltage drop) and providing a better path to ground.

For example, if multiple paths have balanced impedances, two paths will halve the voltage drop, three will reduce the individual drops to one third and so forth, because of current distribution through parallel paths.

Grounding

There are several ways to provide a ground for your facilities. Among them are driven rods, buried electrodes, a grid system (sometimes called a counterpoise) and underground mats. What you choose will depend on the soil and rock conditions at your location. The effectiveness of your grounding system will vary depending on the soil conductivity, soil type, the type of grounding system you've selected and the size of it.

When lightning travels down the conductor and reaches the grounding system, the current entering the grounding electrode(s) radiates equally in all directions, assuming a consistent soil structure. This lightning current traveling through the soil establishes a voltage gradient that decreases in strength with distance.

The ground rod(s) will exhibit an impedance characteristic similar to the

conductor we've examined, which reduces the effectiveness of the deeper portions of the rod(s). The lesson here simply is that longer is not necessarily better. Further, using a grid approach and installing rods (or electrodes) at a reasonable distance apart will increase the overall grounding system effectiveness. Again, this is because of the division of lightning currents between the different rods (and paths) as previously discussed.

Increasing the distance between ground rods results in less overlap of associated voltage gradients between adjacent rods and a better grounding system. Rods in a grid arrangement also should be bonded together. The lesson here is that the spacing between rods is equally as important as the actual number of rods in a grid system. Recommended spacing between ground rods usually is 2.2 times the length of a single rod.

When lightning strikes

As we have seen, lightning current when traveling through a conductor develops substantial voltages. Further, these voltages will vary in potential along the current path because of the impedance offered. These voltages can pose a hazard to personnel and equipment.

With touch voltages, the potential difference between the point of contact(s) on the lightning conductor and the grounding point (such as the feet) can be several thousand volts, enough to cause injury or death. People, we're talking about a lot of energy here.

(Author's note: In the June 1997 issue of "Broadcast Engineering" magazine, there was an article called "Lightning Protection: Remember the Bird." I can't forget the accompanying photo. It showed an antenna down guy near the attachment point, with only the two legs and feet of some poor bird. The bird was obviously perched on the down guy when lightning struck, and the potential difference between its two feet caused it to simply explode, leaving only the two feet on the guy wire. The article said the remains of the bird were found some 40 feet away.)

With step voltages, the earth forms a voltage divider around the ground rod (grounding electrode) during the flow of lightning current. A person or animal standing on the ground may suffer injury or death because of the potential difference between different parts of their bodies. This is common in cattle country where there is grazing on open, flat terrain during thunderstorms.

We've already seen that immense voltage potentials develop on conductors during lightning strikes. And we know that electricity (after all, that's what lightning really is) always takes the path of least resistance. If there are other conductors near a lightning conductor and the potential difference is high enough, a secondary lightning flash may occur.

A secondary lightning flash or side flash can travel from the lightning conductor to the other conductor, which offers a better grounding path. It's these critters that often cause damage inside our headends, by coupling a voltage spike from the lightning protection system over to one of our coaxial cables running down the tower and then into the headend and our equipment.

Minimize your risks

Bonding plays an important role in controlling and minimizing the potential effects of these three common problems. Bonding is defined as the practice of equalizing the potential difference between conductive bodies through metallic connections. We do it all the

time in the outside plant, at all active devices in the plant, at all strand junctions and at ends of lines. We also should be doing it on our towers, tower down guys, TVROs and inside the headend.

For instance, antenna tower structures make superb lightning rods because of their height and conductivity. The vertical tower elements must be electrically contiguous. If not, the legs should be bonded across each junction, or separate lightning down conductors should be used. Keep in mind that the tower offers the most conductive surface area and therefore the least inductance. It is the preferred conduction path. Also, remember that copper can cause corrosion problems if it comes in direct contact with aluminum or galvanized steel.

The headend should have a master system ground, preferably a grid or counterpoise type. This ground should be checked annually to ensure it meets the minimum resistance per the NEC 250-84 (less than 25 ohms). A properly installed grid or counterpoise system should yield a resistance of less than 5 ohms. (Mine tested at less than 1 ohm.)

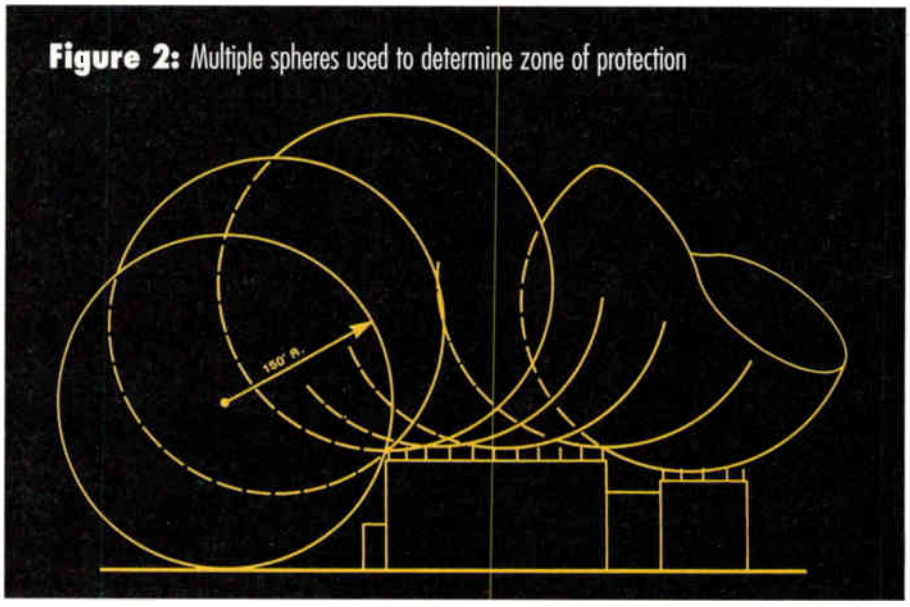


Figure 2: Multiple spheres used to determine zone of protection

The tower base or the tower lightning down conductors should be bonded to the system ground. Tower down guys should be bonded to the tower, and the opposite ground end of the guys should be bonded to a ground rod (or the system ground if it is feasible). Down guys at the same ground location should be bonded together. Antennas mounted on the tower should have their metal masts bonded to the metallic tower or its lightning down conductors. Coaxial cables, waveguides and transmission lines running the length of the tower

should be bonded at both ends and at a minimum of 100-foot intervals.

The same approach should be used inside the headend. A master ground should enter the building and be paralleled to each equipment rack. If the building is of metal construction, it also should be bonded to the master ground. The equipment in each rack should be bonded to the rack bus, which is then bonded to the master station ground bus.

Main coaxial lines from the antenna tower should be bonded and grounded at the point of entry into the headend. Install surge suppressers on all main commercial power lines and communications lines entering the headend, and bond to the station ground bus.

Conclusion

At this point, readers should better understand Mother Nature's "power whammy" and be more prepared to defend themselves against her might. A properly engineered and installed lightning protection system offers the protection desired and helps to prevent avoidable equipment damages and customer service interruptions.

Of course, preventive maintenance on the system is a must to keep it functional and effective. A periodic program should be in place to test surge and protection devices, measure your ground system's resistance, and physically inspect all ground rods and bonding points for damage, tightness and corrosion.

Your program also should involve a rethinking of the overall system design when new equipment is installed, moved or modified. The frequency of these inspections is dictated by the local environmental conditions, but inspections should be conducted at a least once a year.

The grounding and protection of facilities and equipment is an engineering discipline within itself. There is much more that goes into total and effective grounding (and shielding): things that affect not only safety, but also the quality of commercial power, signal noise control and signal quality. CT

BOTTOM LINE

Great Balls of Fire

Lightning current develops substantial voltages. These voltages vary in potential along the current path because of the impedance offered, posing a hazard to personnel and equipment.

With touch voltages, the potential difference between the point(s) of contact on the lightning conductor and the grounding can be several thousand volts, enough to cause injury or death.

With step voltages, the earth forms a voltage divider around the ground rod (grounding electrode) during the flow of lightning current. A person or animal standing on the ground may suffer injury or death because of the potential difference between different parts of their bodies.

Immense voltage potentials develop on conductors during lightning strikes. If there are other conductors near a lightning conductor and the potential difference is high enough, a secondary flash may occur. These often cause damage inside headends by coupling a voltage spike from the lightning protection system over to one of the coaxial cables running down the tower and into the headend.

Bonding is important in minimizing the effects of these three problems. Bonding is the practice of equalizing the potential difference between conductive bodies through metallic connections.

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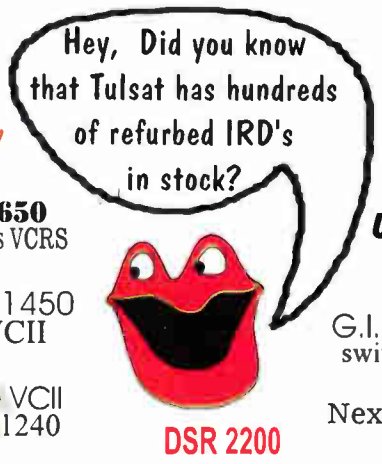

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Compiled by Greta Durr

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Internet protocol

Internet resources

Internet services over cable

Multiple dwelling units

Multiplexing

That's Why We Put So Much Into Upgrading Ours.

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Advanced Battery Management™ (ABM™)

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*Based on 5% efficiency gain and $.08 per kilowatt-hour.

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Other standard features include aircraft-grade aluminum and powder coat paint, two-piece door, two external LEDs, properly sized high-magnetic breaker, standard agency certification and heavy-duty locking mechanism.

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With the demand for network reliability ever increasing, status monitoring is critical. The **Lectro CPR Communicator** can put vital information at your fingertips. And with a variety of monitoring options, MSOs can choose the right solution for today and upgrade to meet future needs.

Want status monitoring? It's your call.

The Lectro CPR Communicator is available in three versions:

- Local Version—Standard on all units. UPS and battery information is displayed on an intelligent LED panel located on the UPS and via two external LEDs on the outdoor enclosure.
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- CheetahNet™ Version—All UPS digital information and environmental signals are processed through an on-board, internal CheetahNet-compatible transponder and delivered as RF signals directly from the UPS on to the coax—fully compatible with the CheetahNet network monitoring system.

With the increased investments required by MSOs and the demand for service reliability from subscribers, Lectro CPR is the most advanced system available today to protect your network—and your bottom line.

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How to Shrink the Hub with DWDM, John Trail, *CT*, May, 1998, 72.
Digital Set-Top Strategies: Add Service without Breaking Your Budget, David Fritch, *CT*, March, 1998, 48.
D-Day Is Coming. Are You Ready? Bob Van Orden, *CT*, March, 1998, 44.
Nix the N on NVOD: How One System Did It, Laura K. Hamilton, *CT*, January, 1998, 38.

Year 2000

Defuse the Y2K Bomb, Greta Durr, CT, November, 1998, 72.
Planning '99, Laura K. Hamilton, CT, October, 1998, 52. CT

Digital Platform

TeraLogic has announced the Cougar Digital TV Reference Platform. The Cougar platform gives original equipment manufacturers (OEMs) a time-to-market advantage in developing next-generation digital TV (DTV) sets, set-tops and DTV/PC (personal computer) systems. Cougar's open architecture leverages the capabilities of TeraLogic's new TL850 integrated DTV decoder integrated circuit (IC). The TL850 uses approximately 10,000,000 transistors to perform all-format decoding. It delivers high-end graphics processing and allows multiple camera angles. Cougar was developed in cooperation with component and set-top box manufacturers, as well as software and PC graphics suppliers. Partners include Sun, General Instrument, NEC, PlanetWeb, QED and Oren.

Reader Service #308

Heavy Duty Cabinets

Equipto Electronics Corp. has announced the Heavy Duty product line, made of steel or stainless steel. These cabinets promise shelter from rough conditions, vibrations and shock. Specialized reinforcements may be customized for heightened protection from earthquakes through Zone 4 testing, excessive dust and moisture. Standard cabinets can hold an estimated 3,000 pounds of equipment. They come in four depths, three panel widths, and 37 panel heights up to 84 inches. Equipto offers customizable options in assembly alternatives and color.

Reader Service #309

Speaker Probe and Tone Generator

Wavetek has introduced the 540 series, the 542SP Inductive/Sensing Speaker Probe and the 541TG Tone Generator/Sender.

Designed for moves, adds and changes to telephone, local area networks (LANs), security systems, cable identification and connector tracing, the units are compatible with similar devices as well as each other.

The probe detects tones and uses an audible signal to inform the user which wire is carrying the tone signal. The probe also has a light emitting diode (LED) display and sensitivity knob.

The tone generator sends an alternating frequency signal for detection by the probe.

An RJ-11 connector for standard telephone jacks, datacom RJ-45 jacks and a pair of alligator clips are included.

The 540 Series is covered by Wavetek's warranty program and is widely available.

Reader Service #310

VRLA Battery

Yuasa has introduced a series of valve regulated lead acid (VRLA) batteries for subscriber loop carrier, signal repeater, telecommunications and other outside plant applications. VRLA was designed to withstand the effects of widely fluctuating temperatures, such as those in harsh remote terminal environments. The Independence Tel-Power Series 30 and 40 products with absorbed glass mat (AGM) technology feature a hermetically sealed, flame-retardant polypropylene cover capable of withstanding a discharge temperature range between 5° F and 176° F. The case reduces the rate of water loss, and the steel sleeve's design helps to promote heat dissipation.

Reader Service #311

Cable Modem Subscriber Kit

Deeming Terapro the first user-installable cable modem, Terayon has introduced a subscriber installation kit for high-speed access using synchronous code division multiple access (S-CDMA) technology. Terapro provides cable operators with increased flexibility by reducing the need for on-site cable modem installation. The kit includes retail-ready packaging and all the components needed for installation. The two-way ready modem delivers 14 Mbps speed on fully coaxial and upgraded hybrid fiber/coax (HFC) networks. The kit comes with power cord, 10BaseT Ethernet cable and a user's guide with warranty and registration. Operators can add user-installable components such as a splitter and customized software as needed.

Reader Service #312

BOOKSHELF

The following listing covers several books and 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.

- *Modern Cable Television Technology*—By Walter Ciciora, David Large and James Farmer, this book covers the many nuances of current headend design, how to make reliable calculations, and achieve the most efficient equipment interface possible. Advanced and comprehensive, this work serves cable and telecommunications engineers in a rapidly changing broadband universe. Order TR-40, $80.
- *DigiPoints Volume One*—This was designed to train cable telecommunications workers in digital technology. Although analog has served the industry well and will continue to coexist with digital technology, the latter will enable cable operators to deliver the emerging products and services needed to be a competitor in broadband telecommunications. This book provides information on the many challenges and opportunities of digital technology. It provides training on the basics of digital theory, digital transmission technology and applications in current market. Topics covered in the chapters include binary numbers, how network efficiency can be maximized through multiplexing, bandwidth management, error correction, digital data compression, data protocols in switched data networks, local area networks (LANs) and access protocols. This basic tour of digital communications theory concludes with a look at cell-based packet technology. Order TR-33, $45.
- *Fiber-Optic Communications Systems*—Stay ahead of the rapid advances in fiber-optic communications technology. This comprehensive and pertinent guide to the finer points of fiber optics has much of what a broadband telecommunications operator needs to know to stay on top of the fiber-optic game. Order TR-36, $80. CT

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CALENDAR

February

1-3: Arizona Cable Convention, Phoenix Airport Hilton, Phoenix. Call (602) 955-4122.

2-5: Satellite '99, Washington, D.C. Convention Center, Washington, D.C. Call (800) 777-5006.

8-10: CTAM's 16th Annual Research Conference, Hilton San Diego Resort, San Diego. Call (703) 549-4200.

9-11: CableLabs Winter Conference: Countdown to Technology 2000, Westin Tabor Center, Denver. This conference is open to CableLabs members only. CableLabs members call (303) 661-9100.

10: Oregon Cable Telecommunications Association's Special Events Day, OCTA headquarters in Salem, OR. Call (503) 362-8838.

12: SCTE Satellite Tele-Seminar Program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Topic: "Introduction to Digital Technology (Part One)." Contact SCTE national headquarters, Janene Martin, (610) 363-6888, ext. 220.

13: SCTE Llano Estacado Chapter technical seminar, Cox Communications, Lubbock, TX. Topic: "Digital Principles and Cable Modems," with John Litton of Cox Communications. Contact David Fielder at (806) 793-7475.

15-18: Western Communications Forum, Hyatt Regency Dallas-Fort Worth. Contact the International Engineering Consortium at (312) 559-4101.

21-26: Optical Fiber Communications Conference, San Diego Convention Center, San Diego. Contact the Optical Society of America at (800) 723-4632.

24-26: Texas Cable Show '99, San Antonio. Call (512) 474-2082. CT

Planning Ahead

March 3-5: CTAM Digital and Pay Per View Conference, The New Orleans Marriott Hotel, New Orleans. Call (703) 549-4200.

March 23-24: Digital Engineering Conference: The Consumer Electronics Future, Hasbrouck Heights, NJ. Call (703) 907-7660.

April 27-28: Women in Cable Telecommunication's Executive Development Seminar Mastery Course, Sylvan Dale Ranch, Loveland, CO. Call (888) 275-9428.

May 3-6: Women in Cable Telecommunications National Management Conference, San Francisco Hilton and Towers, San Francisco, Call (888) 275-9428.

May 25-28: SCTE Cable-Tec Expo '99, Orlando, FL. Contact the SCTE at (610) 363-6888.

June 13-16: Cable '99, the National Cable Television Association's Annual Convention and International Exposition, Chicago. Contact the NCTA at (202) 775-3669.

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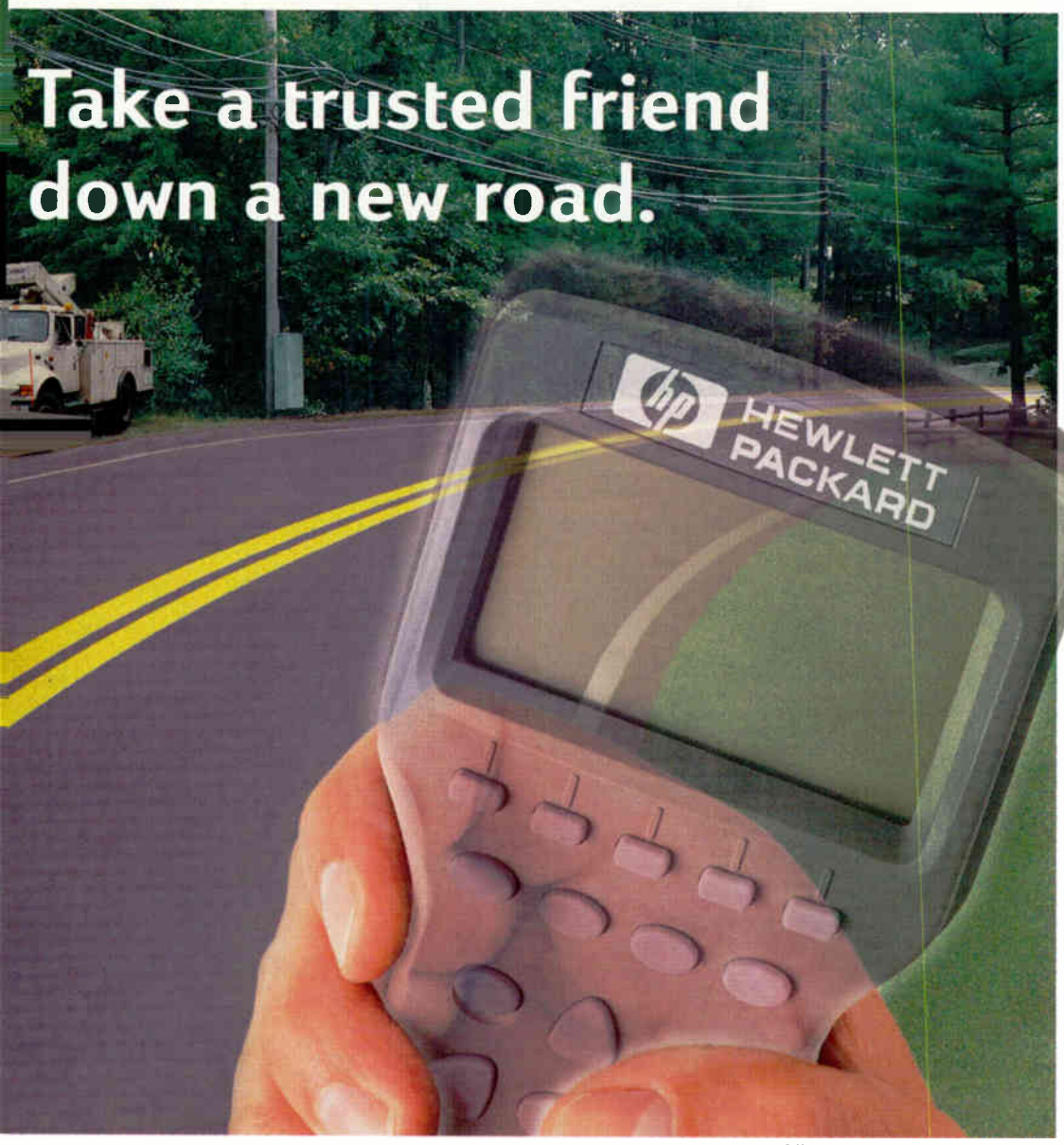

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Vendor Connection is *Communications Technology*'s resource for up-to-date information on the industry's leading technology suppliers. These vendors have advertised in this issue. Check their ads for products and services that will improve your cable system's reliability, efficiency and capacity.

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TRAINING

By the NCTI

Troubleshooting Hum Modulation, Part 5

This month's installment continues a series on troubleshooting hum modulation. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI.

Last installment covered checking picture quality on the customer's TV set and VCR and the set-top terminal to determine if any of these are the source of the hum. This installment moves the troubleshooting process out of the customer premises to the tap.

As emphasized previously, because an electrical shock hazard may exist when troubleshooting a hum modulation problem, always carefully observe all appropriate safety precautions.

- *Measuring hum percentage or checking picture quality at tap port.* Go to the customer's tap port and measure the percentage of hum modulation with a signal level meter, or check the picture quality using a TV test set, to confirm abnormal hum modulation at the tap port.
- *Measuring hum percentage or checking picture quality at tap input port.* If the SLM indicates excessive hum modulation or if there are one or two hum bars on the TV test set at the customer's tap port, test for the presence of hum modulation at the tap's input port. To do this, connect a port test adapter and an SLM or a TV test set to the tap's unused input port. An excessive hum modulation reading on the SLM (Figure 1) or two hum bars on the TV test set (Figure 2) at the input to the tap usually indicates that the problem is caused by an amplifier's defective DC power supply in the trunk or feeder system and that more than one customer will be affected.
- *Replacing defective tap face plate.* A defective tap face plate can cause hum bars or a hum modulation of greater than 2% at a tap port, but no hum bars or an acceptable hum measurement of less than 2% at the tap's input port. A power-passing tap with water damage or corrosion (Figure 3) can cause the feeder line AC voltage to modulate the RF signals and can produce an excessive amount of hum modulation. Depending on system procedures, replace the water-damaged or corroded tap face plate with one of equal value. Also, replace the tap housing if necessary. Remeasure the hum percentage at the customer's tap port on the new faceplate (Figure 4) to see if it is now acceptable.

It is possible to have more than a 2% hum modulation reading at the tap's input, but upon removing the tap face plate, the percentage of hum at the tap's input decreases to less than 2%. Although rare, this type of problem may be caused by hum modulation backfeeding from another customer drop connected to the same tap.

The next installment will continue with procedures for systematically isolating the cause of visible hum bars. CT

Figure 1

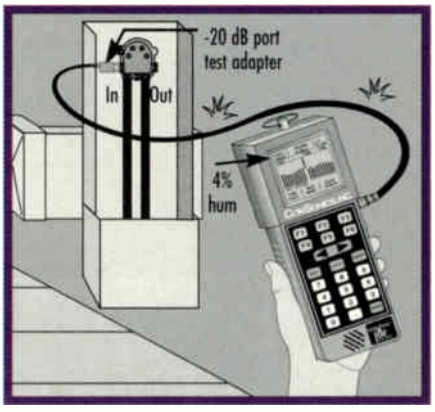

Figure 1: Measuring hum at tap input using test port adapter and SLM

Figure 2

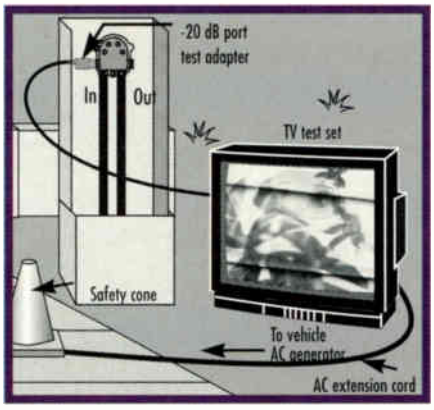

Figure 2: Checking picture quality at tap input using test port adapter and TV test set

Figure 3

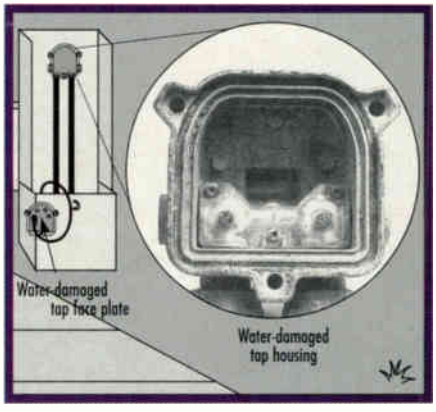

Figure 3: Water-damaged tap causing unacceptable hum

Figure 4

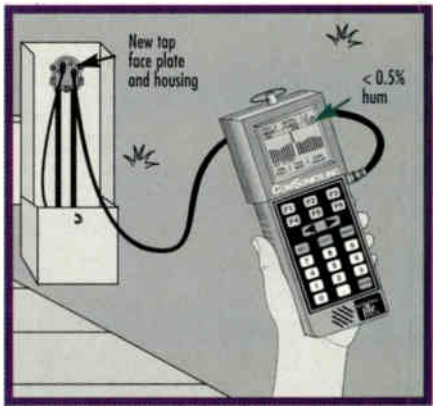

Figure 4: Measuring acceptable hum after replacing tap face plate and housing

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By John Clark

SCTE at 30: Proud of Heritage, Excited About Future Prospects

1999 marks a special milestone for the Society of Cable Telecommunications Engineers—the celebration of our 30th Anniversary Year.

All of us involved with SCTE owe a special debt of gratitude to the pioneering charter members who had the vision, energy and commitment to launch the formation of SCTE in 1969 and the follow-through to continue building its foundation.

And our gratitude is shared with the many men and women who followed in their footsteps in contributing to the important role SCTE has played in the history of our industry and to the unique *esprit de corps* of our members. We sincerely salute you all for a job well done.

A mission for the present and future

Our mission—Training, Certification, Standards—has never been more important to our industry. In fact, the results of our combined missions may be the single most important factor needed to widely deploy and deliver the benefits of new technology to our customers.

The recognition of the critical role technology and engineering play in the overall telecommunications landscape has never been greater. We have the opportunity to build on this, moving forward.

Our charge is to deliver the best mix of programs and actions to help meet our joint challenge. We need your help to accomplish this.

Honor the past by shaping the future

As an SCTE member, this can be one of the most rewarding times of the year—the time you directly shape the leadership and future of the Society. Two valuable tools are at your disposal—your ballot for the 1999-2001 board of directors' election package and your 1999 membership survey.

Although each is different in its own way, together they both play an important role in the future of SCTE. Active member participation has been one of the building blocks of SCTE's past. You can carry on this tradition by completely filling out and returning both your ballot and the membership survey. This input aids the SCTE board and staff and keeps the connection among SCTE members and the future of the Society.

Other participation activities

To give you some advance notice, there are several additional upcoming activities in which you can participate as well. Let me highlight these opportunities for you.

Technical Sessions at the Texas Show: Each year, SCTE collaborates with the Texas Cable and Telecommunications Association to develop technical presentations for the Texas Show. I encourage those of you planning to attend this year's Show (Feb. 24-26 in San Antonio) to use these sessions to learn something new and to get answers to your questions.

New York State Cable Show: The New York State Department of Public Service Communication Division sponsors an annual technical seminar in Lake George, NY (May 3-5). SCTE representatives will be on hand to administer certification exams and answer questions about SCTE.

Cable-Tec Expo: Ideally, you already have registered for this year's Cable-Tec Expo—the industry's premier hardware show (May 25-28 in Orlando, FL). If not, you have until April 16 to qualify for preregistration discounts. Help your Society celebrate its 30th anniversary by attending Expo!

Technical presentations at the Atlantic and Western Shows: Look for upcoming calls for papers for technical presentations at the 1999 Atlantic Cable Show (Oct. 12-15 in Baltimore) and the Western Show (Dec. 14-17 in Los Angeles).

SCTE coordinates the sessions in partnership with the show sponsors. These shows represent your opportunity to share your technical knowledge and expertise with your peers.

SCTE local group vendor shows: Members will have more opportunities than ever to network with their peers, get "hands-on" training with the latest tools and participate in friendly competitions during Cable-Tec Games. Almost all of SCTE's chapters and meeting groups sponsor vendor shows.

For details on these and other upcoming events, visit the SCTE Web site at www.scte.org and check out the events calendar in each edition of *Communications Technology* magazine.

A closing personal note

In my nearly 20 years of cable experience—at the system, regional and MSO corporate levels—I have worked closely with many outstanding and talented technical staff people. Together we have helped build an industry that has changed for the better the ways people around the globe are entertained and informed. I have been a longtime admirer of SCTE, and I am proud to be part of it with you. CT

John Clark is president of the Society of Cable Telecommunications Engineers.

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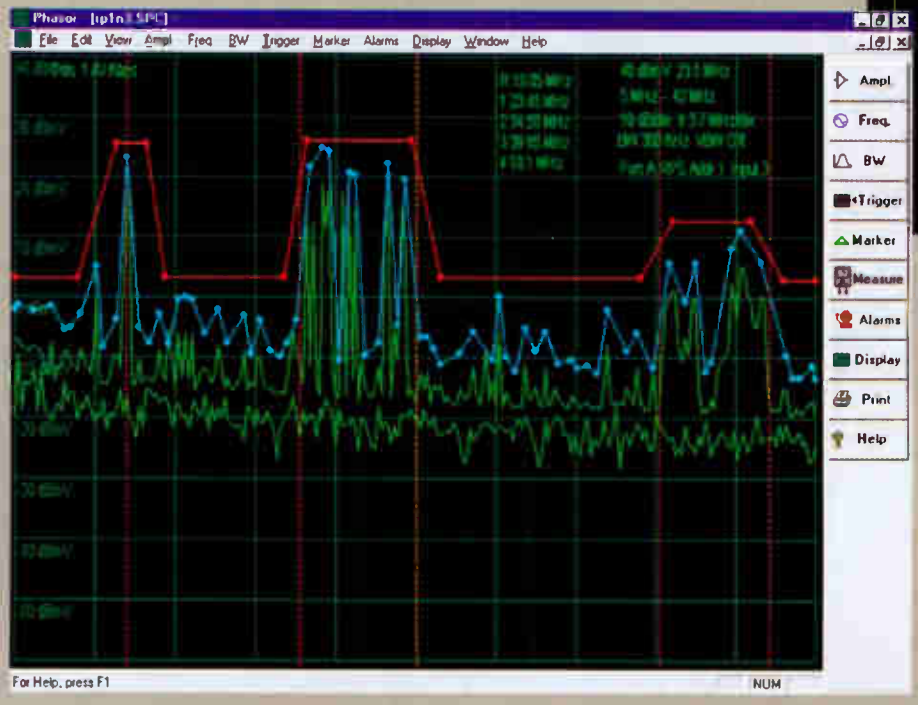

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