Communications Technology

OFFICIAL TRADE JOURNAL OF THE
SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS

FEBRUARY 1998

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Reader Service Number 200

contents

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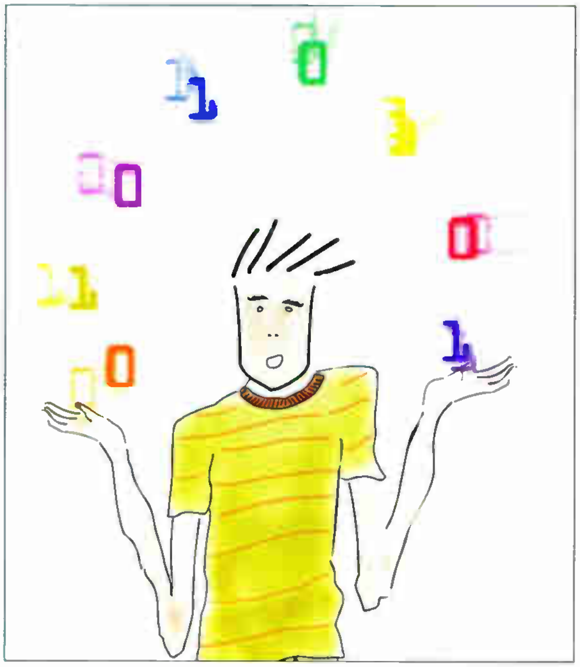
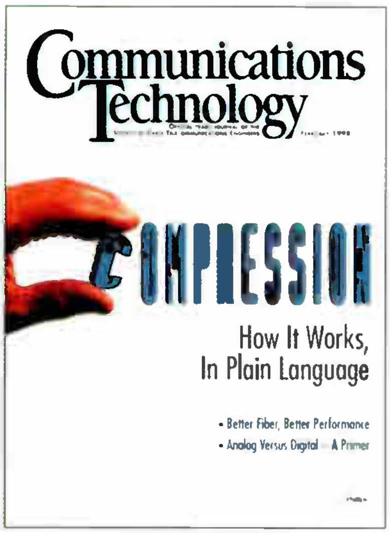


Digital Video Standards • 60



Video Compression • 64

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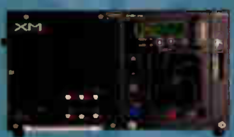

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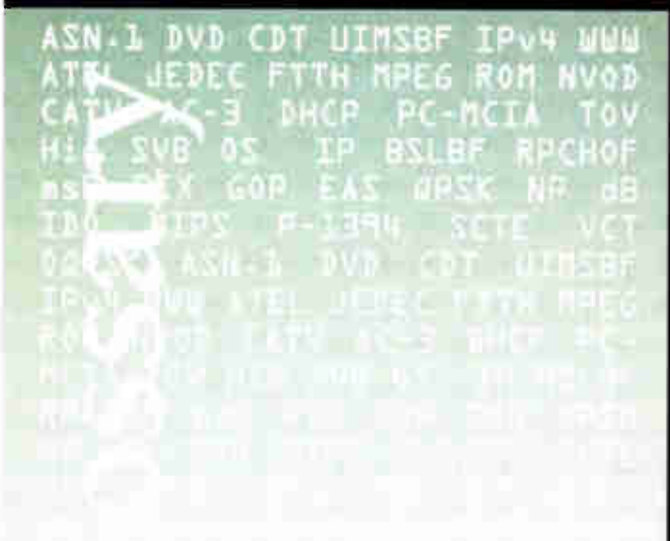
Reader Service Number 15

FEBRUARY 1998

contents

Return Path • 12



Back to Basics • 77

DEPARTMENTS

NEWS & OPINION

REFERENCE

COLUMNS

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Reader Service Number 245

By Rex Porter

The Very First Cable Engineer

What kind of man first ran a signal survey, aimed a yagi antenna and tried to send the signal down a cable to others?

Trudging down the muddy hillsides of Astoria, OR, he must have been ready to give up. The closest TV station was 140 miles away in Seattle. The mountain range between Astoria and Seattle reached over 4,000 feet. The Seattle signal swept across Astoria faintly, but it was there. Somewhat discouraged, perhaps he mumbled that it was not even his idea to have television in Astoria. It was his wife Hertha's idea.

And why did she have such faith in her husband when TV reception seemed so impossible? He had no college degree but was a ham operator since early youth (W7FKZ), somewhat self-taught and trained by engineering trade schools. Six years earlier, he had purchased radio station KAST. He also owned The Radio and Electronics Company and stayed busy adjusting and repairing Astoria's fishing fleets' radars, depth-finders, automatic pilots and direction finders.

For months, he had searched for signals all over Clatsop County. Then a funny thing happened. He lived atop a two-story building in Astoria. And as he was checking out his signal survey equipment at his home, he found a signal right there. With a telephone line strung from his laboratory, up on his roof, to his living room and his TV set, he worked for weeks trying to get a watchable picture.

Calling down to his wife, he never got the answer he wanted. "Nothing," was the unbearable answer, again and again. Then, one day, Hertha said, "A flicker!" That flicker improved to a shadowy, snowy picture. Now Ed designed a tubed receiver/converter. With the three-tube device he could now watch the channel on his own TV set and send the channel to others, if they lived no further than a half mile. That flicker was the start of our business, 50 years ago.

"Trudging down the muddy hillsides of Astoria, OR, he must have been ready to give up."

Leroy E. "Ed" Parsons was a cable pioneer, but he was a pioneer with many interests. He became a registered engineer (Alaska). He was a founder of Comm Supply Inc., a communications engineer/assistant to the president of Wien Airlines for 12 years, a sales manager, a field engineer, a refrigeration engineer and a commercial airlines pilot. In cooperation with the Scandinavian Air Force, he built the Alaskan communications system necessary for the first commercial trans-polar flight.

He completed construction and initial programming of the first Eskimo-speaking broadcast station in the United States (KRBW). Ed was many things but he was not a quitter. He set the standard for all who followed. He was, most of all, a cable engineer.

Rex Porter
Editor

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ADVERTISING/BUSINESS
PUBLISHER, Nancy Maynard
SENIOR PUBLISHER, Paul R. Levine (303) 839-1565
ASSOCIATE PUBLISHER, NATIONAL SALES MANAGER, Tim Hermes: (301) 340-7788, ext. 2004
MIDWEST: Mike Elmer: (303) 839-1565, ext. 34
WEST: David Gillespie: (303) 839-1565, ext. 35
NORTHEAST: Joel Goron: (301) 340-7788, ext. 2106
SOUTHEAST: James Bohi: (301) 340-7788, ext. 2060
CLASSIFIEDS: Nicole Bavre: (301) 839-1565, ext. 33
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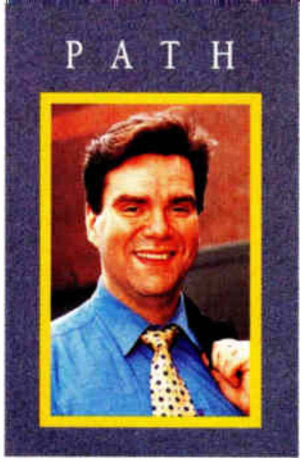
By Alex Zavistovich



Spin the Bottle

A Compression Game

Of the two bottles shown on this page, one is compressed with MPEG-2; the other is not. Can you guess which is which? (I first came up with this game for the cover of the November 1996 issue of *CT*. If you remember that cover, disqualify yourselves immediately.)

Almost anyone can grab a frame of uncompressed video for a still file. A bunch of companies can compress video with MPEG-2. When it comes to grabbing a frame of MPEG-2 compressed video and presenting it as a digital file for graphic design, though, that's different.

IBM's Digital Video Services Division in Atlanta, GA helped. They encoded an MPEG-2 video stream at 9.0 megabits per second on a C-Cube compression engine, and decoded it on a Vela Research MPEG-2 decoder card.

Using a Targa 2000 board on a Macintosh Power PC connected to a Betacam SP video deck, IBM captured a composite analog signal for an uncompressed still image. The same computer setup, connected to the Vela MPEG-2 decoder card outputting a composite digital signal, captured the MPEG-2 still image. Those still images were converted to EPS (Encapsulated PostScript) format and saved to a Hewlett Packard 650 MB CD-ROM for the final image you see here.

OK, it's not quite an apples-to-apples comparison. Both the compressed and uncompressed images had to be saved as EPS files for design purposes. EPS files are themselves compressed, so the image is not exactly like comparing video quality from two video monitors. Also, video image resolution is 72 dots per inch (dpi), while typical print image quality is 300 dpi. That's why the images may look a little grainy.

So, golden-eyes, can you guess which bottle is compressed?

Answer: The one on the left. Looks good enough to drink, doesn't it? CT

Alex Zavistovich is executive editor of "Communications Technology." He can be reached in Potomac, MD, at (301) 340-7788, ext. 2134.


RETURN PATH
OUT

"Cable 101" Takes Technical Training on the Road

The Society of Cable Telecommunications Engineers has opened new technical training doors for cable system management across the United States with the recent debut of its latest in-house training program. "Cable 101," a training workshop created to give non-technical personnel at all levels an overview of the fast-paced technologies in the broadband industry, was launched on Nov. 20 at the Tele-Communications Inc. headquarters in Englewood, CO.

TCI Senior Vice President of Engineering and Technical Operations Tony Werner, who described SCTE's latest offering as "a really nice gesture to the industry," said the class was extremely well-received by TCI personnel. "Throughout the country, we've added a mix of people to our company, both technical and nontechnical," said Werner. "Technology is changing so fast that it is essential for personnel at all levels to be aware of new technologies."

Attendees, which included financial officers, marketing executives and general managers, acquired knowledge on traditional cable systems and new and evolving technologies during the day-long class.

SCTE Director of Training Development Alan Babcock, who has been instrumental in designing and implementing low-cost, in-house training for broadband employees, discussed the installation process, headends, distribution systems, fiber optics, data-over-cable and digital TV.

"SCTE created this program to take people who have not, in the past, been involved with the technical side of this industry and give them the knowledge to make sound business decisions," said Babcock. "We intend to augment each class so that it addresses what's hot in telecommunications." SCTE plans to roll out future "Cable 101" classes as regional seminars across the United States this year.

FCC Director of Technology Policy to be KeyNote Speaker

The SCTE reported that Michael R. Nelson, Ph.D., of the Federal Communications Commission's Office of Plans and Policy was the keynote speaker at its 1998 Conference on Emerging Technologies held Jan. 28-30 in San Antonio, TX. Nelson, who serves as director of technology policy for the FCC, spoke on the topic, "Regulation, Deregulation and the Information Revolution—The FCC and Broadband Networks." He addressed how the FCC envisions the development of broadband networks and what the Commission's role should or should not be within that progress.

With the FCC, Nelson works on the interface between technology and policy making, including such issues as the improvement of the reliability and security of the nation's telecommunications networks, the convergence of computing and communications, and the FCC's role as a catalyst in the development of new technologies.

On his role within the FCC, Nelson commented, "I am looking forward to better understanding the marketplace, and learning more about the development of technology in the broadband industry."

Prior to joining the FCC, Nelson was special assistant for information technology at the White House Office of Science and Technology Policy where he worked with President Clinton's Science Advisor Jack Gibbons, and with Vice President Gore on a range of issues relating to the Global Information Infrastructure, including telecommunications policy, information technology, electronic commerce, encryption and information policy.

Before joining OSTP in 1993, Nelson served for five years as a professional staff member for the Senate's Subcommittee on Science, Technology and Space, chaired by then-Senator Gore. He was the lead Senate staffer for the High-Performance Computing Act. Nelson has a B.S. in geology from Caltech, and a Ph.D. in geophysics from MIT.

SCTE Director of Standards Appointed to FCC Council

SCTE Director of Standards Ted S. Woo, Ph.D., was appointed to the Federal Communications Commission Network Reliability and Interoperability Council. Woo, who has been instrumental in guiding SCTE's standards development activities since joining the Society's professional staff nearly two years ago, will represent the broadband industry's interests in his new position on the council.

"I value this opportunity to serve the Federal government highly," commented Woo. "This appointment indicates the importance of SCTE as a standards setting organization."

In response to the Telecommunications Act of 1996, the FCC organized the NRIC with selected members representing communications common carriers, as well as international standards-setting organizations including the Institute of Electrical and Electronic Engineers communications society, the American National Standards Institute and the International Telecommunications Union.

As a member of the NRIC, Woo will join other telecommunications leaders in providing recommendations to the FCC and to the industry at large on the interoperability, reliability, planning and design of public telecommunications networks.

The council, which is part of the FCC Office of Engineering and Technology, also assesses the Commission's role in the development of telecommunications standards.

"I feel I have the responsibility as a rejuvenated commission officer," said Woo, who once served as Captain in the U.S. Air Force for radio, frequency and microwave communications. "Leadership and contribution to the FCC will reflect positively on the cable industry."

For more information, contact SCTE national headquarters in Exton, PA, at (610) 363-6888. CT

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Reader Service Number 86

Northern Cal leads "Vendors Day" Success

Here's a boss dilemma: As a vice president of engineering or a technical supervisor, you wish you could bring your technical crew with you to the major trade shows. It's obvious how much they could benefit from all the hands-on vendor demos and the training seminars. But your budget would never allow you to send everyone to a big confab on the other side of the country.

Here's a tech's dilemma: You're an installer or technician, and you'd just love to get the chance to get your hands on some of the great equipment you've heard is out there. Hey, you're the one who uses this kind of stuff in the network every day. Your field experience could go a long way in helping to decide what kind of equipment is best for your system. But you don't usually get the opportunity to attend the major trade shows where all this equipment is on display.

Here's one solution to both dilemmas: Attend one of the Society of Cable Telecommunications Engineers Vendors Day events. They're local. Although they don't replace the big shows, they're cheaper to attend. And a lot of cable telecommunications vendors show up because they are so cost-effective.

Here's what Steve Allen, the brain behind Vendors Day says: "After attending the Expo and the Western Show, I felt that it was important to bring what I had seen at the big shows to some kind of a smaller local regional show where the installers, techs and construction people could come to it and kick the tires."

"I wanted a show where the people who really used the stuff the vendors sold could touch it , feel it, discuss it and learn about it," he adds.

Allen, who works at Roseville Telephone Co. and is the founder of the SCTE Sierra Chapter, handles the bulk of the leg work of the Northern California Vendors Day with a lot of help from his 11-year-old son, Michael. Allen's original idea for Vendors Day in California has inspired several other SCTE chapters around the country to put on similar events. If you'd like to chat with Allen or perhaps thank him at the show, look for the 6-foot-1-inch cowboy with the hat above the rest of the crowd. Or you can contact him at S.Allen.RosTelCo@prodigy.com.

Northern Cal Vendors Day

The first successful attempt at this kind of "mini-show," organized from the SCTE chapter level, happened back in 1991 by way of the SCTE Sierra Chapter's Northern California Vendors Day.

It proved a big success for both system and vendor attendees—save maybe for the coincidence that it started on the same day that the Gulf War did, and the SCTE member who was bringing soft drink syrup canisters in the back of his pickup got lost and went through the gates of a military base. Despite the fact that the canisters were intended to serve the thirsty attendees of Vendors Day, they were ominous-looking enough for the base security guards to search the guy for weapons and bombs.

Fortunately, a military search of your vehicle and your person is not a usual requirement for Vendors Day attendance. A desire to obtain cable product knowledge in a cost-effective way usually suffices.

The California mini-show was originally sponsored by the SCTE Sierra Chapter alone, but now the Golden Gate, Central California and Shasta Rogue chapters help carry the financial load.

This year's Northern California Vendors Day (actually two days) is from March 11-12 at the Hilton Hotel in Concord with a golf tournament slated for March 13 at Franklin Canyon Golf Course in Rodeo, CA.

In addition to equipment demonstrations by somewhere around 110 vendors, there will be technical training sessions and SCTE certification opportunities.

Also offered will be the opportunity to participate in the Cable Games where installers and techs show off their cable skills for prizes and bragging rights.

Representatives from the national SCTE office will be there as well. Steve Townsend will be manning an SCTE booth and assisting with certification testing. He'll also host a regional chapter meeting and luncheon. SCTE President Bill Riker also plans to make the trek out from Exton, PA.

How to register

If you're interested in attending along with the 500-600 others that will be there, the best way to get details is at the SCTE's Web site (www.scte.com). Go to the chapter section, and under "California," follow the hypertext link titled, "Northern California Vendors Day."

Interested in the golf tourney? Contact Tom McGuire of CommScope at (530) 878-1613 or e-mail: SADX58A@prodigy .com. The golf tournament cost is $65, which includes cart, green fees and lunch.

Vendors looking to grab some of the display area at the show should hit the Web site quickly for information. Space was almost full in early January.

Allen points out that many vendors have remarked that they have reaped significant research benefits from the mini-show because it comes right from the users' mouths. "They take the information back and make improvements based on actual user input, not purchasings or a lab report," says Allen.

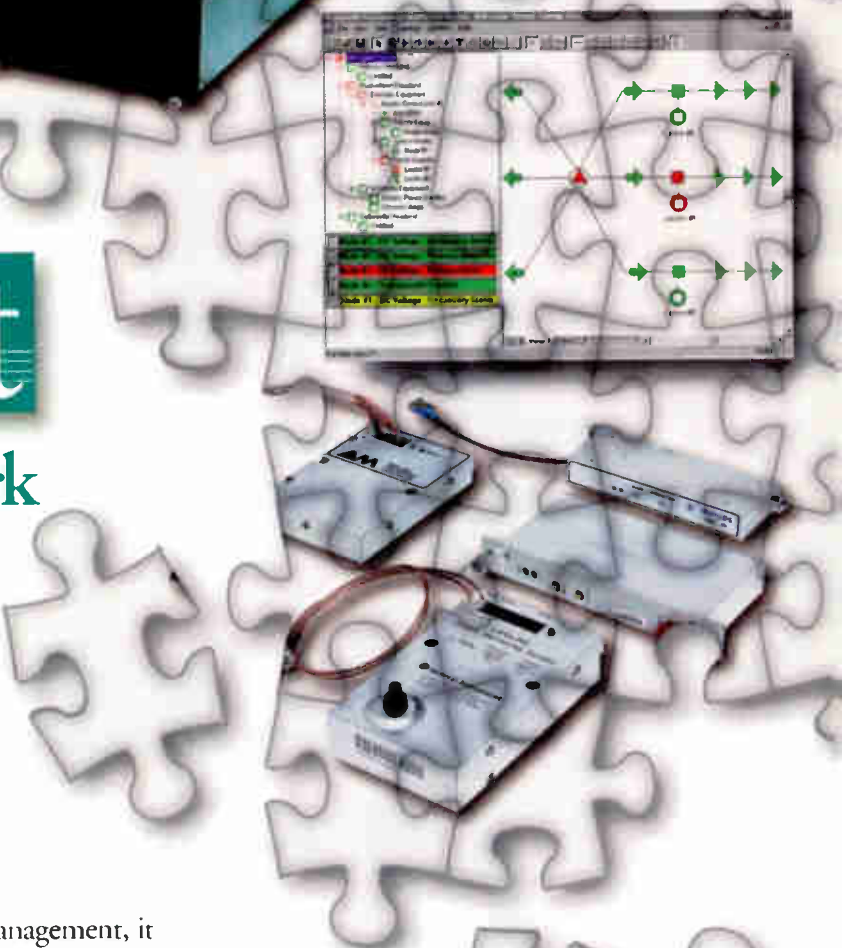
Other "Days"

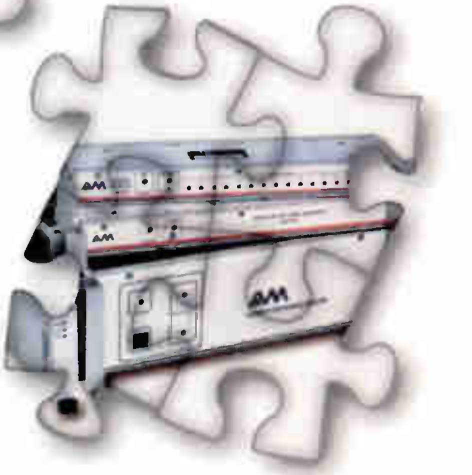
So you're a member of an SCTE chapter that's not in the Northern California area and you haven't heard of any similar event in your part of the country? Want to start your own? Contact Marv Nelson at SCTE national headquarters, (610) 363-6888, or e-mail mnelson@scte.org for details on guidelines being put together for Vendors Day.

Fun

"I try to make mine a really relaxed show with no suits or ties allowed," says Allen, who gave up suits himself a long time ago.

However, the casual tone doesn't mask the serious results gained at the event by vendors, attendees and the SCTE chapters. "Vendors Day is a very personal achievement for me, and one that is now recognized by the SCTE as a supported program," Allen says. — *By Laura K. Hamilton, Senior Editor, Communications Technology* ➤





Cable Modems Go Retail

MediaOne, Adelphia and Daniels Cablevision can tell subscribers in several markets that they can buy cable modems at CompUSA outlets after NextLevel launched its retail product last month, reports *Communications Technology's* sister publication, *CableFax*.

While the retail launch of NextLevel's (soon to be renamed GI) SURFboard modems is a milestone since it can let operators move the $200 to $300 cost per modem unit off their books, GI says operators will still buy and lease some of the modems themselves.

CompUSA is teaming up with MediaOne, Adelphia and Daniels to co-market the telco-return modems. The company's shelf price for the modems is $279, and CompUSA will charge subscribers $50 for installation. GI says subscribers may install the modems themselves, but admits the installation process is not "not consumer proof." CompUSA stores are selling the modems in MediaOne's 400,000-subscriber Jacksonville, FL, cluster, Adelphia's 140,000-subscriber Miami system and Daniels' 68,000-subscriber Encinitas, CA, system.

Platform Users

Broadcom Corp., of Irvine, CA, recently announced new companies that plan to use its MCNS-DOCSIS silicone platform in their modems. Added to equipment manufacturers like 3Com, Bay Networks, Cisco Systems and Scientific Atlanta are Motorola Corp., Samsung Electronics Corp. Ltd., Sony Corp., Thomson Consumer Electronics, Intel Corp. and Hayes Microcomputer Products Inc. Broadcom recently announced the availability of not only its silicon platform, which ensures multivendor interoperability between cable modem equipment, but also its MCNS-DOCSIS cable modem and modem termination system reference designs.

Consumer Electronics Show Update

CT's sister publication *CableFax* reports that Microsoft Corp. and Sun Microsystems emerged from the Consumer Electronic Show in Las Vegas last month with a major stake in cable's future, but it's still not clear how much revenue operators will see from Silicon Valley's (West Coast-California) new-found love for cable.

The arrival of so much cable-related news at the Consumer Electronics Manufacturers Association's annual confab is a major milestone in itself. Set-top boxes are moving rapidly to a consumer retail market business model, giving cable operators the opportunity to move the $300 to $500 cost per each advanced set-top off their balance sheets. Sony fueled the retail set-top distribution model on Jan. 5, when it announced that it would acquire 5% of top hardware vendor NextLevel Broadband Systems in exchange for the rights to distribute Sony-branded set-tops through retail outlets.

While cable operators stand to reduce costs with investments from consumer electronics companies in the industry, both hardware and software vendors need to define exactly which applications and services will be able to run on set-tops.

Sun and Microsoft executives announced separate deals with Tele-Communications Inc. at CES. TCI says a deal with Sun to bundle PersonalJava and an agreement with Microsoft to incorporate a version of Windows CE—both on NextLevel set-tops—will allow subscribers to run applications such as interactive TV, home shopping, banking, e-mail and Internet access.

While Java and Windows give operators the framework for deploying advanced services through digital set-tops, the cable industry will have to wait for application developers to design specific programs that eventually may boost the revenue-per-subscriber operators draw each month.

TCI says it won't begin deploying set-tops bundled with PersonalJava until early next year. So while most operators won't see revenue from these advanced services until 1999, Silicon Valley's commitment to the cable pipe looks promising for operators. Software companies will continue to battle for a

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High Carrier Monitoring

Video and Data Outputs

Return System Operations made Simple...
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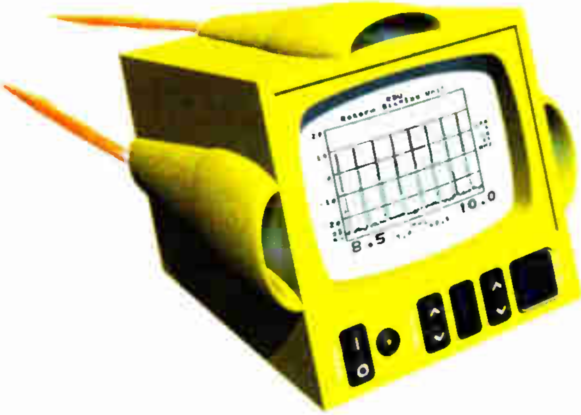


The RDU is a new piece of test equipment. It allows technicians to monitor the return system from any point in the cable system without the traditional and cumbersome HE spectrum analyzer / camera setup.

The RDU allows system installers and technicians to view on any TV screen, the RF Levels, Ingress and Noise present back at the HE from a subscriber's home, system amplifier, feeder tap or fiber node.

The RDU processes the X / Y output data generated by an internal spectrum analyzer and converts it to NTSC video for input to a standard CATV modulator. A data output allows the analyzer screen to be viewed on a computer, same as video. Software is Windows 95 networkable so office possibilites are endless.

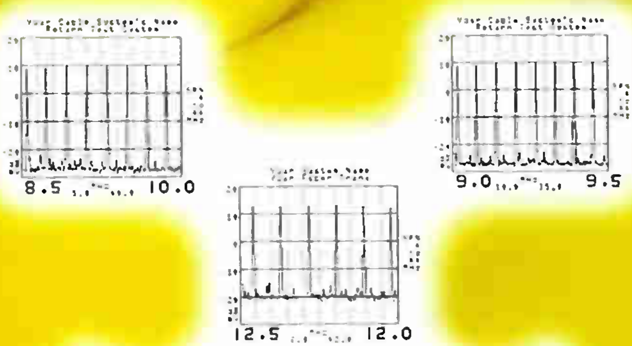
The RDU displays noise, ingress and RF carriers, the same as a spectrum analyzer with a video and computer screen refresh rate of just 350 milliseconds!

The RDU displays HE return levels on two user selectable test carrier frequencies in the 4-44 mhz. bandwidth. Test carriers and ingress / noise levels can be easily documented from every installation and service call. Simple and easy to implement.

RDU software monitors ingress / noise by recording RF energy, where you designate, in 200 khz. segments. The RDU averages the data and displays a ingress / noise number, real time. Response over time charts can be outputed for analysis and documentation.

The RDU is an efficient new tool to activate and maintain broadband networks creating benchmarks for return cable system operations.

The RDU allows you to start your system with a return video channel and migrate to a data stream as your people master the art of return operations. Keep it simple to succeed.



Above are samples of a TV screen that system installers or technicians would "see" in the field.

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Reader Service Number 80

piece of cable's bright future, and market researchers say increased competition should drive down the cost of deploying set-tops.

Local Broadcast Channels on DBS?

Also reported in *CT* sister publication, *CableFax*—Charlie Ergen's EchoStar Communications Corp. launched a huge satellite gamble last month that threatens one of cable's best competitive advantages—its ability to retransmit local broadcast signals.

Ergen announced the controversial plan at the Consumer Electronics Show, demonstrating live EchoStar broadcasts of ABC, CBS, NBC and Fox signals. The move drew sharp criticism from cable operators who claim EchoStar's plan violates the Satellite Home Viewers Act.

Cable operators offer subscribers retransmitted local broadcast signals in every market, but they are subject to must-carry laws in exchange for that right. Ergen claims that EchoStar shouldn't be subject to the same must-carry laws as cable, and therefore should be able to pick and choose which networks he'll carry.

EchoStar began offering signals from the Big 4 broadcast networks to its affiliates in the New York, Boston, Washington, DC, Chicago, Atlanta and Dallas markets last month. Insiders say the National Association of Broadcasters may sue EchoStar if the company continues to offer affiliates signals only from the Big 4 broadcast networks.

The House Courts and Intellectual Property subcommittee plans to hold a hearing this month to discuss Ergen's plan, and also it will review a similar local satellite proposal from Capitol Broadcasting Company. Capitol Hill sources say NAB likes Capitol Broadcasting's plan since it would give DBS providers the ability to carry every local signal in a particular market. NAB will oppose Ergen's plan if he continues to carry only signals from the Big 4.

It's still too early to predict how the local satellite ventures will fare with the regulators. But North American cable operators should beware: Congress may be willing to bend the rules to spur more competition in the multichannel market.

News Bites

- Corning has filed suit against FiberCore for infringing upon its optical fiber patent in order to manufacture optical fiber.
- Online System Services has signed an agreement with American Telecasting for OSS to provide its turnkey Internet product and service package for deployment
- Christopher J. Wera, CPA, was named business and financial officer of The National Cable Television Center and Museum. Prior to his appointment, he was associate director, university health and wellness, University of Denver. CT

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Reader Service Number 9

By Ron Hranac

SCTE Grab-bag

Elections and the List

By the time you read this, you should have received your annual Society of Cable Telecommunications Engineers election package. I'm assuming, of course, that you're a national member. The package contains an important ballot, one which gives all active, senior, fellow, charter, and retired members a voice in the direction and future of the Society. Each of you will have the opportunity to vote for one at-large director candidate. About half—specifically, those of you in regions 3, 4, 5, 7, 8, 10 and 12—also will be able to vote for a director to represent your particular region. International members are eligible to cast their vote for an at-large candidate. This year's election ballot also includes some minor bylaws revisions. There aren't any bylaws changes per se; this is just to clarify some of the wording.

I've said it before, and I'll say it again: The candidates you elect will be representing you on SCTE's board of directors. This group is responsible for setting and maintaining the SCTE's national policies and procedures. In short, the board is building the future of your Society, and your vote is an important part of the process of running the organization. It's a way for you to have a say in the operation of SCTE. Unfortunately, you give up that voice if you don't vote.

Why am I reminding you of this? Simply because the majority of you don't bother to vote in the annual elections. 1996's election had a paltry 17% participation, the lowest in more than a decade! Last year was better with 21% voting, but that's still only about one in five members. Seven or eight years ago nearly a third of the Society's membership voted in the annual election, and except for last year the trend has been generally downhill. This is confusing because each year our membership count goes up, yet the percentage of members who vote in the annual election goes the other way. The math doesn't add up.

If you haven't already done so, why not open up the election package that's sitting in your in-basket, and vote? Right now! It will take only a couple minutes to read the candidate biographies and proposed bylaws revisions, fill out the ballot (simplified last year to make the voting process even easier) and drop the thing in the mail. One change this year is the lack of a membership survey in the election package. Apparently some believed that it was mandatory to fill out the survey along with the ballot and send in both. As a result, many put the survey aside to do later—along with the election ballot—and by the time they were pulled out of the in-basket again, the election deadline had come and gone. So this year, the election package has no survey, only the election materials. Let's see, where was I? Oh, yes. After you've voted and mailed your ballot, walk down the hall and remind all of your co-workers who also are SCTE national members to do the same thing. Be a pest about it and lay on a guilt trip. Let's see if we can get this year's participation up to 25% or more.

"If you haven't already done so, why not open up the election package that's sitting in your in-basket, and vote? Right now!"

SCTE-List

The latest count shows about 1,600 people use the SCTE-List. What's the SCTE-List, you ask? It's an Internet list server, also known as an e-mail reflector.

MAKING SURE YOU GET THE PICTURE

Neighbors. Enemies. Two cultures taking a chance, trusting each other while making history on cable television systems. People from all corners of the planet learn, laugh and think because of the products we design, manufacture and service. Our "open architecture" point 2 multipoint network solutions℠ deliver a global culture with breakthrough products like RF Link™ amplifiers designed to increase and add new revenue streams. ANTEC Network Technologies, getting you the picture. 770-441-0007 or www.antec.com

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Network Technologies

Reader Service Number 14

If you send an e-mail message to the SCTE-List, it is "reflected" or broadcast to all of the List's subscribers. The SCTE-List has become the CATV industry's number one interactive technical information forum, and the best part is that you can use it for free assuming you have e-mail that can access the "outside" world of the Internet. The SCTE-List has been written about several times in the pages of *Communications Technology* as well as the Society of Cable Telecommunications Engineers' *Interval*.

So why am I writing about it again? Well, I'm amazed at the number of folks who have e-mail at work or home but don't know about the SCTE-List. Every time I speak at a chapter or meeting group seminar I ask how many in attendance have heard of or use the SCTE-List. The average figure is about 10%, roughly the same percentage of SCTE members who subscribe to the List (You don't have to be an SCTE member to use the List, by the way.) When I explain the List in more detail, the response is usually along the lines of, "Great idea!"

The SCTE-List is not directly affiliated with the Society, although headquarters staff maintain a presence on it and some members of the national board of directors are regular participants. As well, several chapters regularly publicize meeting and activity notices on the List. The computer system that hosts the SCTE-List is located at the University of Wisconsin-

> "I think you'll find the SCTE-List a very useful tool in your day-to-day job."

Madison, and is administered by the very capable David Devereaux-Weber.

As of this writing, a few of the topics that have been part of ongoing discussions on the SCTE-List include: the pros and cons of using high pass filters in two-way systems; measuring optical return loss; an inquiry about where to find TV repair home study courses; battery life in signal level meters; the quality of consumer-grade splitters and house amps; the value of computer programming skills; and even a few holiday greetings.

As you can see, the topics are quite diverse. On any given day, the number of messages varies from five or six to 20 or more. The real value of the List is that you can post a question about something, and you'll get one or more responses, often on the same day you sent your question! Rarely do you have to wait more than a couple days for an answer or comment.

Getting it

Subscribing to the SCTE-List is easy. First, as I mentioned earlier, you need to

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have an e-mail account that can access the Internet. Other than what you might have to pay for your e-mail service (many use their company e-mail), there is no charge to subscribe to and use the SCTE-List. Here's how you do it.

I'll use my name in this example. The subscription process is automatic, so you just need to send a message to the following e-mail address:
listserver@relay.doit.wisc.edu

You don't need to put anything in the subject line of the message. (The listserver ignores the subject line.) In the body of the message type the following text. Just remember to use your own name where I've shown mine.

subscribe scte-list Ron Hranac

That's all you have to do! After you become a subscriber—which will happen almost immediately after you send the message—you can send general e-mail messages to the List at the following address. Remember, all 1,600+ subscribers will get your message. It's recommended after you first become a subscriber that you send an introductory message to the group, with a little bit about yourself, where you work, what you do, what your company does, how long you've been in the industry, hobbies, etc. The List's address is:

scte-list@relay.doit.wisc.edu

If you want to send a private reply to someone instead of the full List, you'll need to send a message to that person's individual e-mail address. Finally, if you decide you no longer wish to subscribe to the List, send an e-mail message to:

listserver@relay.doit.wisc.edu

The body of the message needs to include the following text. It's not necessary to include your name in the unsubscribe message:

unsubscribe scte-list

Don't send the unsubscribe message to the SCTE-List's address. That won't work, and you'll keep getting the daily messages, plus messages from folks reminding you to send your unsubscribe message to the listserver address.

See? It's easy. I find that I spend about 15 or 20 minutes each morning reviewing my e-mail, which includes a handful of messages from the SCTE-List. Once business-related e-mail is taken care of, I scan the current List messages, send a reply or comment if appropriate, and log off of my e-mail account. Give it a try; I think you'll find the SCTE-List a very useful tool in your day-to-day job. 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" magazine. He can be reached via e-mail at rhranac@aol.com.


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Reader Service Number 123

By Justin J. Junkus

Integrated Telecommunications

Steps to Improving Service

As cable looks at telecommunications, we rightfully see an emerging business, with all the potential for new customers, new services and new revenue. What we may miss, if we aren't careful, is our opportunity and obligation to improve public service with this technology. This other side of the telecommunications business can become a powerful way to enhance our image as our customers' advocate. We have the power of broadband communications, but we need to be sure we match it with coordination, administration, and possibly a touch of narrowband technology.

Let me paint a scenario for you. The event is some natural disaster— you pick the problem from your list of earthquake, flood, tornado, fire, etc. The impact is widespread. This is not just one franchise that is affected. It's one or more counties. Although there are local emergency personnel, some of those injured need expert treatment from facilities outside the affected area, but transportation is difficult or impossible.

The activities of fire, police, and rescue personnel from multiple jurisdictions must be coordinated to maximize limited resources in the shortest time possible. The challenge is to not only keep information flowing, but also to open new lines of communication at a time when adding new physical linkages is difficult or impossible.

In this environment, it certainly helps to have an automatic or semi-automatic way to connect the normally separate communications capabilities of the communities of interest created by recovery efforts. For example, although transportation of the injured might be an insurmountable challenge, medical consultation with remote experts via videoconferencing can effectively bring them to the area. The broadband technology being implemented in many cable companies has the potential to implement many of these capabilities.

The easiest possibility would be to use the routers and switches installed for high-speed data service. If the headend is equipped with an asynchronous transfer mode (ATM) switch or router for Internet access, part of the problem is solved.

The Internet already provides high-speed interconnectivity, which can be used for videoconferences and image transfer. The termination points (where the end users connect to the network) are the weak points.

In many of the disaster scenarios I have mentioned, those points would be vulnerable to disconnection from the network.

Perhaps a solution could be to have "communications trauma centers," similar to the trauma centers in hospitals. These sites would be built with extra attention to maintaining one or more routes to the headend (we do this now with dual ring fiber), but just as important, with protected communications terminals in well-known locations spread throughout a municipality, which would be available to emergency personnel.

But what if your company isn't offering high-speed data? Let's start with

"A solution could be to have 'communications trauma centers,' similar to the trauma centers in hospitals."

videoconferencing or multimedia image transfer capability. At least one broadband technology, synchronous optical network (SONET), provides for mix and match among vendors and automated add-drops of OC-x optical carrier rate lines.

What would be required for our emergency scenario to work would be

physical termination points between carriers serving different, but adjacent, franchise areas, and SONET capability at each termination point.

Fiber inter-connection through a cross-connect system might be one possibility. Interconnection with telephony carrier facilities might be another. Whether these connections are used for nonemergency services could be a negotiated point between the service providers interested in joint ventures. Who knows, perhaps a network created for emergency public service also could have commercial application.

"If cable wants to be viewed as a communications solution provider, perhaps we should consider making these services and their connectivity more of a routine part of our systems as well."

What is this "touch of narrowband technology" that I mentioned earlier? It may help to remember that it's not always necessary to use a sledgehammer to kill a fly, or a terabyte per second to summon help.

In many cases, full broadband capability is not a requirement to solving an emergency problem. Consider the telephone, radio, and paging systems used by fire, police, medical, and even civilian personnel.

Although these systems might be individually intact, emergency coordination and assistance often requires connecting them together, sometimes across municipal, or even state, lines.

Providing the temporary linkage between these systems is technologically simple, but typically outside the domain of the local cable company. If cable wants to be viewed as a communications solution provider, perhaps we should consider making these services and their connectivity more of a routine part of our systems as well.

At least one telecommunications system has this capability today. The iDEN system, manufactured by Motorola, is a combination of mobile communications, radio and paging, as well as low-speed data communications. With this system user groups can be established that include any or all of these communications services.

If the primary need is to have a radio-based phone service, the mobile communications capability is the primary implementation. However, if a community or an organization has a combination of radio and telephony services (such as you might find in an ambulance service or trucking firm), both networks can be accessed using the iDEN handset.

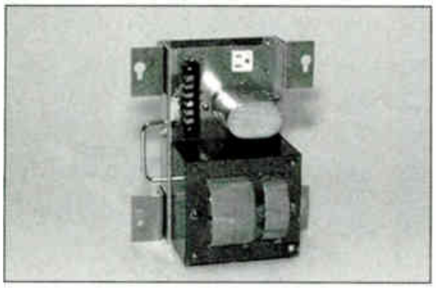
More importantly, however, is that this system has the capability of altering the configuration of the communications groups from a communications center.

Groups can be combined members can be added to existing groups, unrelated groups can be combined, and paths can be established within the groups to the public switched telephone network as required. At present, Nextel is using this technology for its communications network.

The cable telecommunications industry has come a long way from the days when "cable" was synonymous with "community antenna." The more progressive innovators in our industry know that cable must now mean communications.

Thinking broadband is the first big step. Thinking integrated capability is another.

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



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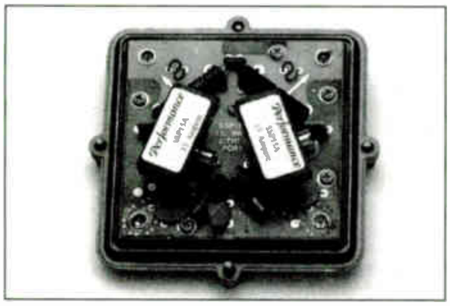

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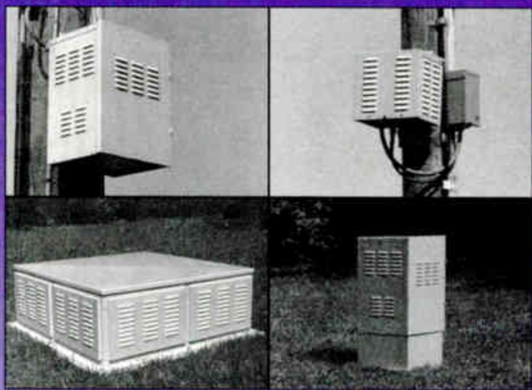

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Reader Service Number 140

By Alan Babcock

Safety Excellence

The Society of Cable Telecommunications Engineers Training Committee met at the Western Show in Anaheim, CA, on Dec. 9, 1997. We had a good meeting and made decisions that will continue to move training forward for the SCTE. Your board of directors also approved a budget that will significantly improve our ability to produce top-quality training materials.

One of the subcommittees that falls under the direction of the training committee oversees activities impacting health and safety issues. Ray Lehr of TCI chairs this subcommittee and presented an idea that we will pursue. According to Lehr, one of the best ways to improve workplace safety is to draw attention to and provide recognition for appropriate safe behavior. While it falls to individual companies, supervisors and employees to work safely, companies are in a position to recognize appropriate behaviors. Many companies either corporately or locally have instituted effective safety programs. The SCTE would like to honor those companies and/or operators who have demonstrated an aggressive and effective focus to improve safety in the telecommunications industry.

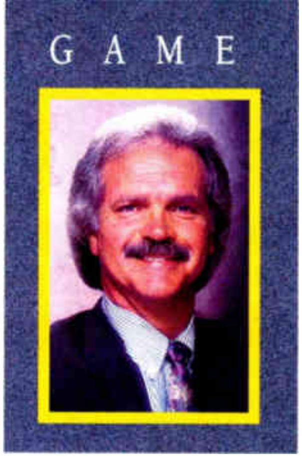
The details of how to provide this recognition are being sorted out even as you read this but I wanted to get advanced information by way of this column to let you know what is going on. One of the ways to determine those deserving recognition is to compare the results of various efforts by evaluating "incident rates" for various accidents. SCTE is considering publishing a survey that will be distributed in various ways to collect data about the frequency and type of recordable injuries that have occurred in the previous year. The information requested would not be of proprietary nature. Occupational Safety and Health Administration laws require this type of information to be made public in February of each year on Form 200.

This information could be used to select a company or individual system for recognition but it also could be provided back to the industry as a valuable tool for safety professionals. Public data collected today from OSHA is too general to be useful for our industry. It would be valuable to look globally at the accidents and recordable injuries occurring in telecommunications to determine what types of safety programs might have the most impact for the types of work we do.

Other evaluation tools that might be used to recognize effective safety programs would be written descriptions of programs, submitted samples of materials used in the programs, and personal testimonies from employees. As stated earlier, we are only at the concept stage at this point. We would like to get input from any interested parties to help establish the guidelines for this recognition program. We are interested in providing a safe work environment and the training committee feels this is an effective way to help in this area. Remember that safety is no accident. CT

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

By Terry Wright



NCs, PCs, TVs, Oh My!

Issues in Cable Data Standards

After such a strong show of vendor support for the Data Over Cable Service Interface Specifications (DOCSIS) cable modem standard at the recent Western Show, it seems appropriate to continue expounding on the long and winding road toward realization of a cable modem standard. This time, let's shift our focus somewhat to a dimension of the data game where the standards issue will likely have the greatest impact. There are larger scale aspects of data services deployment, aspects in which a long-term, high-stakes battle for future *infotainment* and/or cyberspace market share is nearing full-scale eruption.

In the larger context of the data game, the retail availability of standards-based cable modem solutions is simply an enabling milestone that marks the beginning of a new chapter in the quest to define and establish the ultimate cyberspace *access device*.

The winner of this quest, whether it is a single company or an alliance of companies, will wield the heaviest hand in shaping the evolution of the cyberspace/infotainment services marketplace. (Standardized technologies tend to get buried within other products.) For example, network interface controllers imbed standardized Ethernet and token ring chips sets. In the same way, many cable modems and other access devices will contain chip sets that implement some form of the DOCSIS standard.)

This new chapter begins by asking new questions for which there are no immediate, concrete answers. However, as the broadband-based data services game evolves, the answers will inevitably arrive in the form of full-featured, cost-effective market-winning cyberspace access devices. To be appropriately postured to reap maximum benefits from these potential dominant devices when they do emerge, we now have to consider:

- Which form of standards-compliant or proprietary access device will most shape the evolution of broadband-based data services? and
- What are the forces behind these different devices?

To better understand why I think the above questions are the questions we should be contemplating, especially for long-term strategic planning, consider the following questions as general points of interest:

> "Many cable modems and other access devices will contain chip sets that implement some form of the DOCSIS standard."

- Is it more economically and strategically viable at this point to commit to a less-than-optimally-featured cable modem standard for the sake of establishing industry momentum, or
- Should large-scale vendor commitments wait until the existing standard incorporates capabilities to support such features as multiple classes of service and traffic contracts, and perhaps a more robust and efficient physical layer?

With respect to this last question, we might further ask whether the cable industry will find that advanced operational features mentioned above, and a more efficient physical layer, are *required* to effectively compete with existing and emerging advanced telecommunications service providers (such as asymmetric digital subscriber line, or ADSL)?

And if the above issues aren't enough to wrestle with, here's another series of questions I've been contemplating lately:

- Will the introduction of the "Open Cable" set-top initiative, so close on the heels of the DOCSIS standard submission to the International Telecommunications Union, further confuse the marketplace?
- Will Open Cable (which *may* incorporate all or parts of the DOCSIS standard), obviously intended to thwart Microsoft's aspirations to expand its desktop software domination into the set-top services space, actually backfire by causing cable operators to enter a state of decision paralysis, effectively rendering the current DOCSIS standard irrelevant?
- Will any hesitancy on the part of cable operators to support or invest in cable modems compliant with the current in DOCSIS standard be interpreted as a rejection by key players, giving them cause to lead with their own proprietary approaches (complete with all the bells and whistles) to address market demand? ➤

New System Combines Video, Ethernet and T1

A unique new multiplexer, the Series 7000 Supermux will multiplex one baseband video channel, two audio channels, Ethernet, T1 and RS232 data. The product, developed by Radiant Communications, combines information via a high speed TDM system and transmits both ways over one or two fibers for up to 70Km.

New Feature — 30 channel broadband can be added.

Reader Service Number 1

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Reader Service Number 2

Fiber Optic Attenuators

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And here's one of my favorite questions with respect to the current state of affairs in the broadband access device space: Does anyone really think that the approaches adopted and promoted by such players as Microsoft and Sony *won't* make a difference in the evolution of things? When industries of the magnitude and momentum of telecommunications, computing and consumer electronics/entertainment converge, they bring significant baggage with them in the form of significant market share of now-converging traditional market spaces.

So let's get on with our primary questions. Will the ultimate broadband-based cyberspace access device be the network computer (NC), with its near-total dependency on network availability? There are a host of big names (Oracle and Sun, among others) working on these. Perhaps the trusty PC will rise to the occasion with its continued trends towards inherent, highly integrated native multimedia capabilities. I'm sure Intel believes this. PCs connected through cable modems do command a demonstrable lead at the moment.

Certainly digital TV also must be considered a contender as consumer electronics giants and broadcast industry players weigh in. Satellite-based Internet services are starting to become at least a little interesting, although high latencies will likely prevent their capability to support the more exciting interactive applications.

The key issue to consider with nearly all of these emerging access devices is that each of them (designed to provide cable/broadband-based access) will need to incorporate some form of standards-based and/or proprietary broadband data modem technologies. What seems especially pertinent to the evolution and potential introduction of these devices to the marketplace is the opportunity window perspective held by industry leaders. If previous market pressures were so great as to justify a rushed development and adoption of a less-than-optimal cable modem standard, then might even stronger market pressures today be significant enough to rationalize the schizophrenia of an all-out avalanche of proprietary technologies?

Don't get me wrong. DOCSIS is a viable technical standard for cable modems targeted at providing a packet data service, such as residential Internet access. But its lack of support for quality-of-service levels and traffic contract guarantees represents a significant liability when attempting to deliver Intranet/Extranet services to the commercial segment.

It's easy to imagine a cyberspace access device that integrates the unique features and advantages of each of the above devices in a single unit. In fact, I see little rationale against the emergence of such an integrated device, although there is currently far too much dust in the air to estimate when such a device might surface

> **"Certainly digital TV must also be considered a contender as consumer electronics giants and broadcast industry players weigh in."**

As of this writing, I have not yet seen the joint press release that is to be issued by the Society of Cable Telecommunications Engineers and Institute of Electronic and Electrical Engineers 802.14 working groups, describing various ways in which the two groups might collaborate in providing a feature-rich cable modem standard that responds to the competitive needs of the cable industry. (I attended the Dec. 9, 1997, SCTE meeting where this was agreed to between the SCTE and IEEE 802.14 working groups.)

I see this as a good thing; the charter of standards bodies *is* to provide industry with useful technical standards that enable marketable value in response to market needs. Hopefully, there can even be some level of coexistence between products based on the old (existing) standard and the new (forthcoming in one way or another). Perhaps even Open Cable settops can fit into the equation somewhere.

Finally, I hope the industry will figure out where it's really headed (and what's really at stake) and simply decide that what it *really* needs to develop is substantial momentum around a singular, robust, and highly-featured technology suite that will allow it to compete effectively in all market segments.

As equipment manufacturers, MSOs, software/content developers, and service providers continue to execute their tactical and strategic agendas, each hoping to optimize its posture with respect to reaping profits/other value from the emergence of the ultimate cyberspace access capability, the industry as a whole is at risk. Time, especially from the perspective of an industry hoping to transform itself from delivering simple entertainment services to provisioning what it hopes will be the most advanced (and valuable) telecommunications services available, is not anyone's friend. The current window of opportunity for cable will not remain open indefinitely. Substantial and well-entrenched forces (i.e., utilities, municipalities, broadcasters) are beginning to weigh in. Some have already made their intentions known, and some are still watching, probing, and listening with respect to the market potential, technology availability (and stability), and ideal market entree opportunity. It would be unfortunate for the cable industry if the importance of winning short-term component/equipment battles clouded its vision of what it will take to win the long-term war for cyberspace access supremacy. The current crop of network access equipment (and related operating software) represents just the tip of the iceberg with regards to the cyberspace-related technologies yet to emerge.

The industry's ability to endorse, absorb, and transform these access technologies into paying satisfied customers today, will likely define a precedent for how well it can do the same with all the technologies yet to come. If the industry is to transition successfully into mainstream advanced telecommunications services, it needs stability around a technical standard. And this standard must be robust, with sufficient features that will allow a large vendor community to develop access devices that enable the delivery of market value through robust, reliable, secure, cost-effective and competitive advanced data services to a rapidly converging marketplace. CT

Terry Wright is chief technology officer at Atlanta-based Convergence Systems Inc. He can be reached at (770) 416-9993 or via e-mail: tlwright@convergence.com.

Better Fiber, Better Performance

Improved Fiber Attributes Enhance Your Network

By Jeffrey R. Jacobs, Patrick C. Brown and Dan O. Harris

Are you interested in improving the performance of your hybrid fiber/coax (HFC) system? You may not have to look any further than the fiber you use. As node sizes get smaller, improvements to the fiber-optic cable are key to improving network performance overall.

When the cable TV industry first used fiber to create HFC networks, individual fibers fed optical nodes serving a few thousand homes. In North America, the standard configuration is now a 500-home node, but when cable TV operators install fiber today they typically include enough fiber to migrate to 125-home nodes or smaller.

Last year, at least one cable operator started up a new network with 60-home nodes, justifying the lower node size with lower maintenance cost. There is every indication the trend to smaller and smaller node sizes will continue, and industry experts are now talking about fiber-to-the-home soon becoming the most cost-effective network.

A reduced node size results in higher fiber-count cables, more splices per kilometer, and increased connectorization. That means more fiber handling and splicing by more people with varying levels of experience. Increased handling, in turn, places new demands on fiber.

Splicing and fiber geometry

Fiber deployment deeper into the network has also fueled the growing use of ribbonized optical fiber. Higher fiber counts give an advantage to ribbonized fiber because of lower installed cost, primarily due to labor savings from reduced splice times, but more importantly due to time savings in repairing a potential cable cut.

Since cable TV generally transmits analog signals, any power loss mechanism gets special scrutiny. Cable TV has always required the best performance for both attenuation and splice loss. Cabled attenuation today is generally good, with specifications at 0.35 dB/km at 1,310 nm and 0.25 dB/km at 1,550 nm. Splice loss is not simply specified but is instead dependent on several factors.

> "Higher fiber counts give an advantage to ribbonized fiber because of lower installed cost, primarily due to labor savings from reduced splice times."

Splice loss between two fibers is primarily a function of fiber geometry variables, which include core/clad concentricity (CCC), fiber diameter, mode field diameter (MFD), ovality, and fiber curl. Ribbonized fiber requires even better fiber geometry because mass fusion splicers generally cannot align individual fiber core pairs and often depend only on matching "V" grooves to align the two fibers.

Corning has conducted analysis on splice loss and created a Monte Carlo simulation that includes distributions for all of the above fiber geometry variables. The simulation results correlate very well with experimental data, both Corning's and from other literature sources. The results indicate that core/clad concentricity is the most significant contributor to splice loss, with curl being the second most important contributor. An example of the correlation between core/clad concentricity and splice loss is shown in Figure 1.

It is important to note that the distribution of fiber attributes such as CCC and curl are important, not just the specifications. For example, the current industry standard specifications state that CCC should be less than 0.8 µm. However, if we have a fiber population where all CCC values are between 0.7 and 0.8 µm, the CCC specification would be met but splice loss distributions would be much worse than those actually observed with today's fibers. This is because the typical CCC is about 0.2 µm for high quality optical fibers—well below the 0.8 µm specification limit.

In order to determine the quality of an attribute distribution relative to the specification limit, we use the following metric:

C_{pk} = -specification(/3(,
where:
(is the mean of the distribution, and
(is the standard deviation.

For a Cpk=1.3, the specification limit is approximately four standard deviations (that is, 4(greater than the mean value of the attribute distribution).

Models can be used to draw conclusions about future fiber attributes necessary to achieve "blind" splicing capability where no testing would be required due to the level of performance of the resulting splice distribution. We will define "blind" as the ability to achieve splices with no testing or re-mating. With a core/clad concentricity distribution characterized by C_{pk}=1.3 against a 0.8 μm specification, and with excellent curl distributions, users should expect blind splicing capability to yield a distribution with 99.99% of all individual splice losses below 0.3 dB and 99.99% of all of the losses from any four splices below 0.12 dB. (The choice of four splices was made as it represents a near minimum number of splices in a typical link and has been used in other studies. Since system designers budget power levels based on average splice loss, on a link basis, this is the most important variable.)

As mentioned previously, fiber manufacturers can improve splice loss most effectively by reducing CCC or fiber curl. For example, in a CCC distribution with C_{pk}=1.3 against a 0.6 μm specification, the average loss from four splices will not exceed 0.08 dB.

Figure 1: Core/clad concentricity data

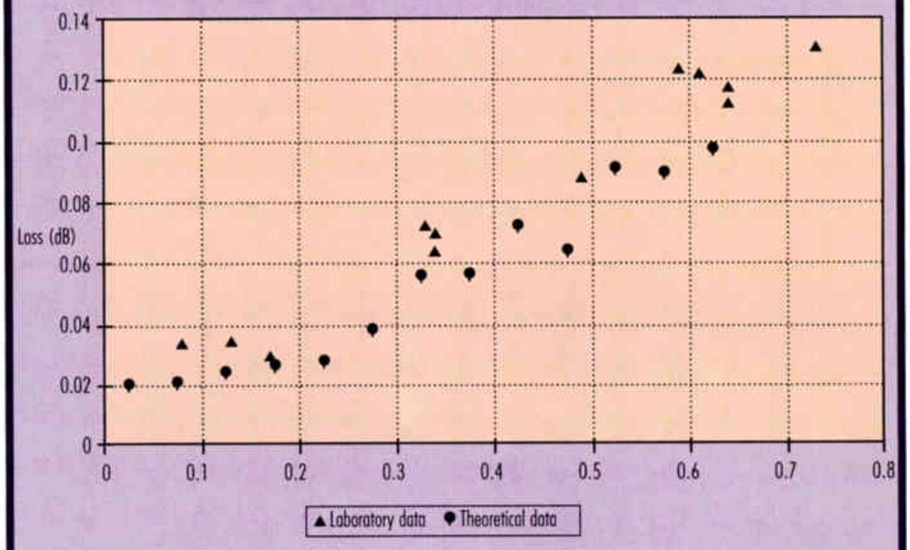
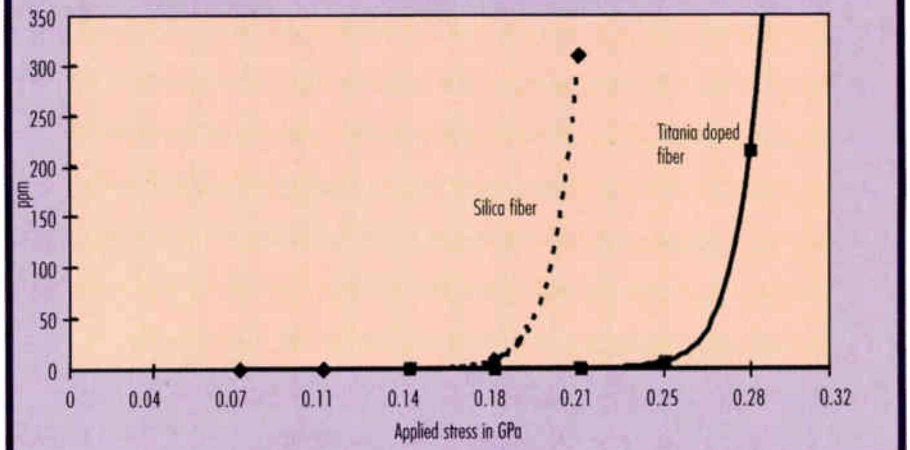


Figure 2: Comparison of failure rates in silica and titania-doped fibers



Mechanical reliability

In general, the mechanical reliability of silica-clad optical fibers has been taken for granted; it is widely as inherently high. This is substantiated by the relatively few mechanical reliability issues in the field that can be linked to shortcomings in strength or fatigue characteristics of the fiber. It is also true that, together with the characteristically high strength of fiber, most applications have been designed to not have a deleterious effect on the mechanical performance of fiber.

The majority of installed optical fiber cables decouple the applied tensile stresses from the optical fiber within. In addition, optical performance limitations in bending have limited the majority of fiber bends in the field to greater than 50mm in diameter. The applied stress from a 50mm bend is not considered to have a great impact on the mechanical performance. However, as optical fiber is pushed farther into the network, the desire to place more fiber in smaller areas may increase the severity of applied stresses on the optical fiber. This may be realized by cablers designing denser, higher fiber-count cables including ribbon designs, and by end users placing fibers in tighter bend diameter configurations. It therefore becomes necessary to evaluate potential fiber enhancements for their impact on the mechanical reliability of fiber.

One improvement that can be made to a fiber is to dope the outer clad with titanium dioxide (TiO_2). To compare performance of silica-clad vs. titania-doped fiber, Corning conducted an analysis for cabled fiber stress assuming 1000 km of field-installed fiber over a 40 year time period.

In the past, an industry "rule of thumb" was to ensure that cable stresses stayed below one-fifth the proof-test level. Generally, a 0.14 GPa maximum is adhered to; however, there is some evidence that ribbon fiber is under greater stress than loose tube fiber, and as fiber is being deployed deeper and deeper, the probability of higher-stress installations with less-controlled conditions goes up. Figure 2 indicates that silica fiber is "safe" when the rules of thumb are followed. You can also see the significant safety factor that titania-doped fiber offers. Essentially, an extra 0.07 GPa (40%) is added for the same level of risk when compared to silica fiber, which can be important when using less forgiving ribbon cable designs.

Titania doping offers another significant advantage for optical fiber—abrasion resistance. When coating is stripped from optical fiber, the surface of the glass is damaged. Connectorization causes additional abrasion. It is the abrasion and the resultant surface damage that weakens the fiber. When the surface of the glass is impacted by the actions of a human operator, not only is the surface abraded, but the variability from one coating removal or connectorization to the next is great.

To more clearly investigate the potential advantage titania doping may offer for abrasion resistance, consider the following repeatable abrasion technique. This method involves chemically removing the coating and then abrading the bare fiber with a grit in a way that the particle size distribution, total volume, and impact force are all well controlled. Set points for these variables were then empirically determined to bring the average strength of

BOTTOM LINE

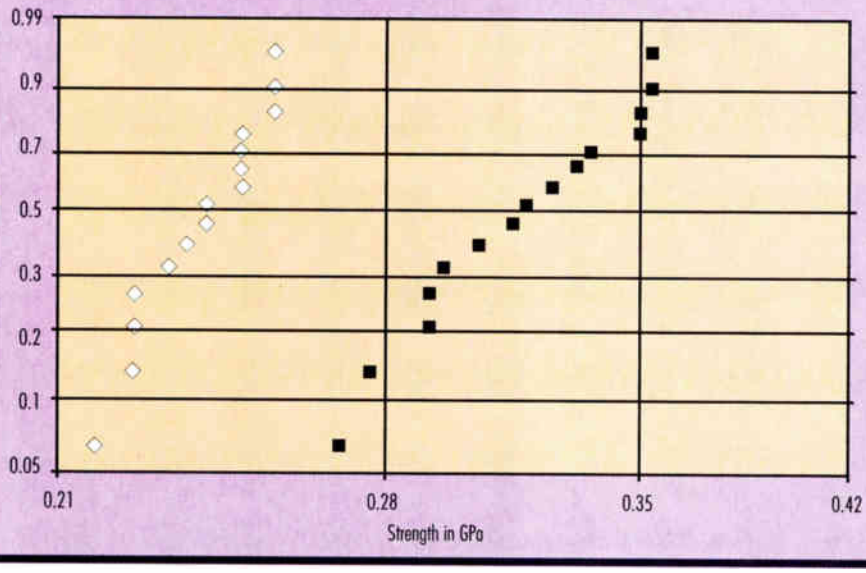
Pushing Fiber Deeper into Networks: The Optical Fiber Challenge

Twenty years ago, the cable TV industry began to consider how fiber optics might be used to its advantage. Since these first experiments, cable TV now has the greatest annual consumption of fiber optic technology in North America. What impact is the market having on optical fiber today as CATV operators install increasing amounts of fiber into their networks and split node sizes into smaller and smaller serving areas?

What are today's fiber optic challenges? Higher fiber-count cables, more splices per kilometer, and increased connectorization. That translates to more fiber handling and splicing.

How can improved fiber characteristics improve system performance and reduce cost? The benefits of tighter fiber geometry can be significant, as product enhancements in splice loss and splice yield represent critical cost savings. Core/clad concentricity, fiber diameter, mode field diameter, ovality and fiber curl are key features to consider. Findings indicate that core/clad concentricity and fiber curl are the top two contributors to splice loss.

Figure 3: Strength comparison in silica and titania-doped fibers



silica-clad fiber to the same level as it would be from a standard coating strip procedure. Once determined, the same experimental set-up was used on both silica-clad and titania-doped fiber. In Figure 3, you can see the significant advantage that titania doping offers—a 30% to 40% increase in strength over silica-clad fiber.

Conclusion

The greater use of ribbonized fiber and mass fusion splicing will increase average splice loss, and fiber-rich networks face greater challenges in the areas of potentially greater installed stress and increased abrasion. We have seen how fiber enhancements like improved core/clad concentricity can significantly lower splice loss and add a new level of robustness. We have also seen that titania doping of fiber significantly improves both the failure rate from installed stress and the strength after abrasion. The attributes of the next generation optical fiber will greatly influence how tomorrow's fiber-rich networks perform. CT

Jeffrey R. Jacobs is market analyst for Corning Inc. He may be reached via e-mail at jacobsjr@corning.com. Patrick C. Brown is cable TV market manager for Corning Inc. He may be reached via e-mail at brownpc@corning.com. Dan Harris is manager of market development, engineering for Corning. His e-mail is harrisdo@corning.com.

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Making Waves

Use WDM to Save Money and Maximize Network Performance

By Jason Shreeram and Don Sipes

As new video, data and voice services are deployed over hybrid fiber/coax (HFC) networks, demands on bandwidth have become significant and systems have grown more complex. These services also are requiring operators to make important decisions to maximize efficiency, reduce obsolescence and allow for the expansion of future services.

However, recent developments in wave division multiplexing (WDM) technologies and the availability of low-cost 1,550/1,310 nm overlay transmitters are allowing operators to create a low-cost, highly flexible broadband network that will meet the needs of the future.

Transmitting targeted services

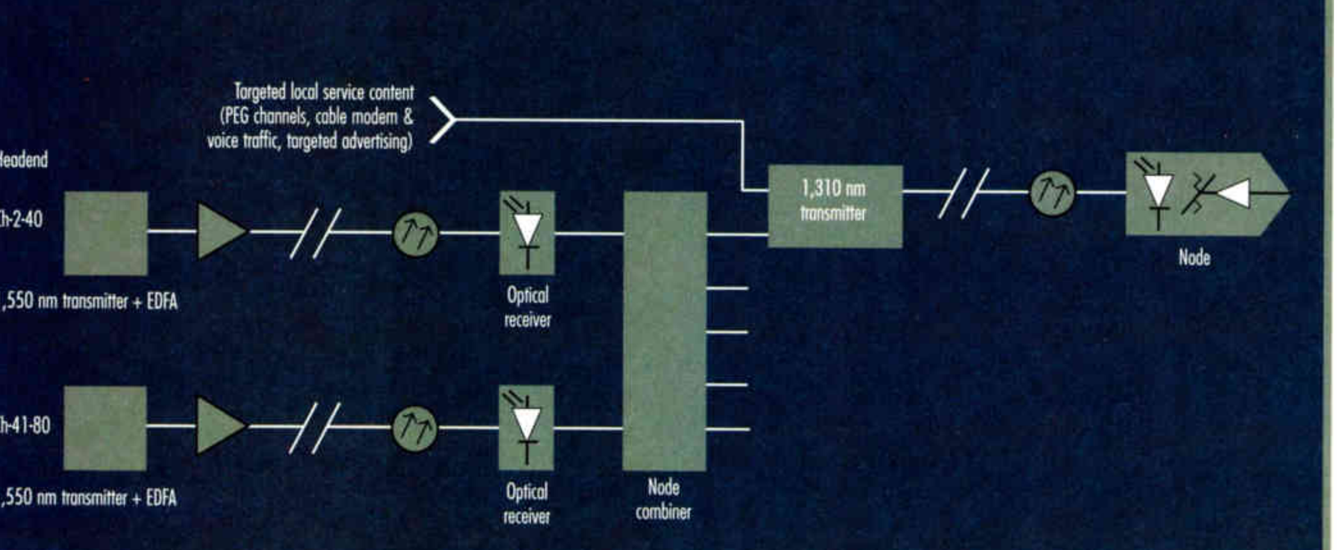
For networks where services target small to moderate groups of users, 1,550 nm transmission technology is used primarily for supertrunking. The targeted services are added at RF and then distributed by relasing with 1,310 nm distributed feedback (DFB) lasers.

When the targeted service payload is heavy with multiple analog and digital channels, this method of 1,550 nm supertrunking and 1,310 relasing is still the preferred method of transmission. However, when primarily digital information is targeted to small numbers of nodes, significant cost savings and increases in network flexibility can be realized through the use of an architecture that combines the low-cost, high-power 1,550 nm broadcast with the targeted service directivity of 1,310 nm DFB lasers through the use of WDM overlays.

This WDM overlay architecture is compared with the traditional 1,550 nm supertrunking and 1,310 nm relasing system in Figure 1A (this page) and Figure 1B (page 48). In traditional 1,310 nm distribution networks, targeted services are added at RF at the secondary hubsite. In the 1,310 nm overlay network, content broadcast over an area covered by a secondary hubsite, such as advertising and near-video-on-demand (NVOD), is combined with the broadcast analog channels at the headend.

This payload is transmitted via a single 1,550 nm transmitter with optical amplifier to the secondary hubsite, where a high-power optical amplifier (+19 dBm to +25

Figure 1A: Traditional 1,550 nm supertrunk with 1310 relase



dBm output power) boosts the signal. A high-count optical splitter network then divides the signal to provide the appropriate node count, link loss budget and received power at the node.

The content inserted at the secondary hubsite—namely voice, interactive video and modem traffic—is delivered via a low-cost, low-power, 1,310 nm transmitter optimized for WDM overlay applications. An optical -20 dB tap coupler provides a convenient test point for RF signal balancing and compensation for the differential optical loss. Both wavelengths are transmitted over the same fiber and combined on the same detector at the node.

A traditional CATV RF plant then delivers the forward traffic to residential users. An immediate impact of transmitting analog channels at 1,550 nm directly to the node is the gain in carrier-to-noise ratio and distortion performance that is normally lost in the 1,550 nm to 1,310 nm relasing process.This performance improvement allows and provides for:

- The use of a single 1,550 nm transmission link for the interconnect between the headend and the secondary hubsite.
- Additional savings in cost and network complexity.
- The use of the 1,550 nm broadcast/1,310 nm WDM overlay.

Matching capital outlays with demand

Most operators face a dilemma when trying to time their investments in new plant and upgrades to coincide with the availability of new services. This dilemma is depicted in Figure 2 on page 48. The curve represents the rise in demand as new services become available. This time/demand curve has a great deal of uncertainty because of the inherent uncertainties in the availability of new technologies, new content availability and the ever-changing legal, regulatory and competitive landscape.

The 1,550/1,310 WDM overlay concept provides for a separation between the broadcast analog part of the spectrum and the digital new media portion. In this architecture, the operator gets the benefit of using the lowest-cost method for delivering the broadcast portion of the CATV spectra. While the demand for the broadcast portion of the spectrum is fairly uniform, it is expected that demand for interactive services, such as Internet access, will be highly nonuniform. The 1,550 nm broadcast/1,310 nm WDM overlay architecture can allow system investment to be more directly tailored to local demographics and their consequent demand for additional services.

Making WDM competitive

While the 1,550 nm broadcast/1,310 nm WDM overlay architecture has been hypothesized for several years, the components only recently have become available to make this architecture competitive with more traditional architectures. There are three primary components of this architecture:

- The high-power, fiber optic amplifier,
- The low-cost overlay transmitter, and
- The splitter/WDM network.

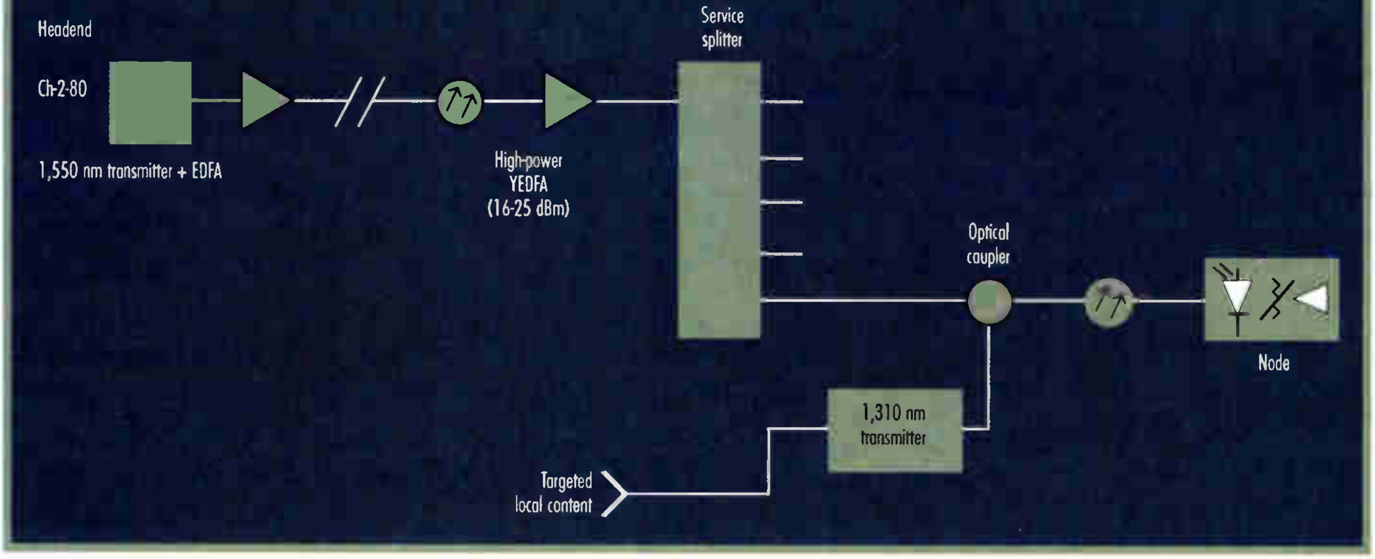
The development of high-power fiber-optic amplifiers and their continued refinement have allowed for substantial improvements in the performance and reach of HFC networks. This is due to the nearly distortion-free, low-noise properties of these amplifiers.

Traditionally, erbium-doped fiber amplifiers (EDFAs) have been pumped by either 980 nm or 1,480 nm laser diodes. High-power operation for low-cost broadcast architectures has been limited by the high cost and limited output power of the available pump lasers. But today, the co-doped ytterbium-erbium doped fiber amplifier (YEDFA) pumped by diode-pumped solid state lasers (DPSSLs) can extend the output power of fiber-optic amplifiers to over +27 dBm—for prices similar to existing 980 nm pumped fiber amplifier technology. This substantially lowers the dollar per milliwatt cost of generating 1,550 nm light.

The YEDFA optical amplifier system achieves this high power through the use of high-power DPSSLs. The pump source for the DPSSL is a high-power broad area AlGaAs (aluminum gallium arsenide) laser diode operating around 792 nm and emitting over 2 W of optical power from a 200 micron aperture. The high power from the laser diode is focused into a Nd:YLF (neodymium:yttrium lithium fluoride) crystalline laser and converted to 1047 nm with high efficiency, excellent spectral purity and with nearly diffraction-limited beam quality.

The output beam quality of the DPSSL is so good, in fact, more than 90% of the DPSSL light is focused into the fiber, compared to less than 60% for a 980 nm

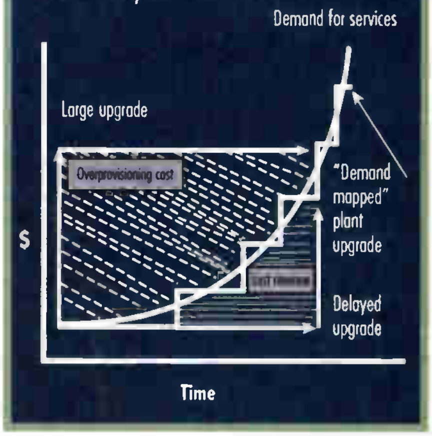
Figure 1B: 1,550 nm broadcast with 1,310 nm WDM overlay



pump. Using the DPSSL source, almost 700 mW is available for pumping a fiber amplifier, as compared to less than 150 mW for a 980 nm pump of similar cost.

The 1,047 nm output is converted to 1,550 nm gain through a phosphosilicate

Figure 2: Timing investments and availability of new services



glass fiber containing both erbium and ytterbium as a sensitizer. High-power operation has been obtained through the use of cascaded 980 nm pumped EDFA gain stages, though at a much higher noise penalty than a single-stage YEDFA.

The lower carrier-to-noise and distortion requirements of a purely digital tier of channels allow for significant savings in terms of the 1,310 nm WDM overlay transmitter. A 1,310 nm transmitter used in standard HFC networks must, along with the narrowcast tier of digital channels, carry the full analog and digital broadcast spectrum. This requirement places large demands on both the 1,310 nm DFB and the electronics used to drive the laser. ➤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The 1,310 nm DFB used in traditional HFC networks is selected for high power, low noise and high linearity. It must be both temperature controlled and optically isolated. The WDM overlay laser, on the other hand, has much lower requirements for power, noise and linearity. DFB lasers, such as those used in return-path applications, are suitable for this purpose. Sophisticated predistortion-type linearization electronics are employed in HFC 1,310 nm transmitters, although they are not required for the WDM overlay transmitter. The relaxation of these requirements allows substantial savings in both transmitter cost and complexity.

Deployment costs are falling

The explosive worldwide growth of fiber optic transmission networks for both digital and analog applications has caused dramatic price reductions in the WDMs and other passive optical components used in these systems. Likewise, the high-count splitters and WDMs used in the 1,550 nm broadcast/1,310 nm WDM overlay architecture have also experienced recent large price reductions. The lower cost of these items enables optical WDM-based insertion of local content at various points in the network.

As 1,550 technologies continue to mature, broadcast network costs are expected to decrease even further and drive fiber deeper into the network. In addition, the use of local 1,310 nm optical insertion via WDM will help MSOs deploy targeted services to more efficiently generate new revenues. CT

Jason Shreeram is a staff applications engineer and Donald Sipes is director of engineering for ATx Telecom Systems Inc., a subsidiary of Scientific-Atlanta Inc. Shreeram may be e-mailed at jason.shreeram@sciatl.com, and Sipes may be e-mailed at don.sipes@sciatl.com. They may both be reached at (630)778-2900.

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BOTTOM LINE

Save Money with WDM Overlay Narrowcasting

Recent advances in wave division multiplexing (WDM) technologies—as well as the availability of low-cost 1,310 nm overlay transmitters—are enabling network operators to more cost-effectively deliver narrowcast services to targeted serving areas.

Traditional vs. overlay: How does it work? In traditional 1,310 nm distribution networks, targeted services are added at RF at the secondary hubsite. In the 1,310 nm overlay network, content broadcast over an area covered by a secondary hubsite, such as advertising and near-video-on-demand (NVOD), is combined with the broadcast analog channels at the headend.

DTV or Not DTV? That Is the Question

By Ron Hranac

So what's the big deal about digital TV? Well, quite a lot, now that you ask. Not exactly a new phenomenon, digital has been around the TV industry for several years. Broadcasters and studios have used variations of digital video in recording and production environments, and various video transportation methods have taken advantage of digital technology.

In a so-called baseband form, however, most of these digital video formats have been at data rates well in excess of 100 Mbps for a single video signal. It's only been in recent years that we've seen digital modulation schemes use compression technology to provide transmission efficiencies for these otherwise unwieldy digital signals.

DirecTV and USSB, direct broadcast service providers, have been transmitting digitally modulated signals via satellite to U.S. homeowners for more than three years. Primestar and EchoStar have been at it nearly as long. In the same satellite transponder bandwidth usually occupied by one analog video signal, DirecTV and others can transmit six or more video signals. TCI's Headend In The Sky, or HITS, carries up to 12 digital video signals in the same bandwidth as one analog video signal!

Now we're hearing about digital transmission in the over-the-air broadcast environment, and how it will allow broadcasters to provide high definition TV (HDTV) or maybe a handful of standard definition TV (SDTV) "channels" in the same bandwidth used for one analog TV channel.

In the good ol' days

Today's North American analog TV uses the NTSC standard. The acronym NTSC stands for National Television Systems Committee, the group that originally gave us this format. NTSC video started out as a black and white standard, finalized in the 1940s. Back then, NTSC meant video had 525 interlaced lines, a horizontal frequency of 15,750 Hz, a vertical (field) rate of 60 Hz, and an aspect ratio (picture shape) of 4:3. That is, the picture is four units wide by three units high.

Interlaced scanning was used to help conserve transmission bandwidth. Further bandwidth efficiencies were achieved by using a form of amplitude modulation known as vestigial sideband (VSB) transmission. With VSB, all of the channel's upper sideband is transmitted, along with a small part, or vestige, of the lower sideband. Out of that we got 6 MHz-wide TV channels.

In the early 1950s we got color, and to maintain compatibility with the installed base of black and white TV sets, things couldn't change too much. The total number of lines making up the image stayed the same, but the horizontal rate was tweaked a bit to 15,734.26 Hz, and the field rate became 59.94 Hz. (A side note here: The reason hum bars move upward through the picture is because of the frequency difference between the video's field rate and the hum's 60 or 120 Hz rate.) A color subcarrier was added 3.579545 MHz above the visual carrier frequency to convey chrominance information to the TV set. The color subcarrier's sidebands are interleaved in between the luminance sidebands. Do a little math, and you'll find all of these things are related.

Pros and cons

NTSC has been around a long time, and it does have advantages. It's a proven technology; it's reasonably bandwidth-efficient considering the amount of information that's being transmitted; there is a large base of compatible programming; and there is a large installed base of compatible equipment such as TV sets and VCRs.

On the negative side, NTSC has limited resolution and picture quality. It produces color artifacts—like the moiré pattern you

BOTTOM LINE

Jumping Digital TV's Hurdles

Digital TV is a reality. Unfortunately, both broadcasters and the cable industry face a formidable number of challenges to implement it.

The challenges facing broadcasters implementing the technology are:

- Format issues,
- Upgrade costs,
- Short timeframe for deployment, and
- Uncertain markets.

The cable industry faces a few hurdles, as well:

- Cable digital TV will be 64-QAM while broadcasters will be using 8 VSB,
- There are a number of must-carry issues to be resolved, and
- Digital TV deployment.

see on the TV weatherman's plaid jacket. The 4:3 aspect ratio doesn't match the image shape of most motion pictures. Analog NTSC technology is subject to numerous transmission impairments: multipath (ghosting); electrical interference; CATV network distortions such as composite triple beat (CTB) and composite second order (CSO); and grainy or snowy pictures when the video signal-to-noise ratio (S/N) is low.

In fact, a minimum S/N of 40 dB is required for generally acceptable picture quality, although most cable subscribers wouldn't be too keen about paying for anything less than about 45 dB. This means the carrier-to-noise ratio (C/N) has to be that or better. Finally, there are compatibility problems with overseas analog TV formats such as PAL and SECAM.

Several years ago the TV industry set a goal to create a worldwide HDTV production format to provide picture quality comparable to projected 35mm motion pictures, an aspect ratio similar to what you see in a widescreen theater, and CD-quality audio. Interestingly, HDTV originally was intended to be a worldwide analog standard.

Disagreements arose regarding 50 Hz versus 60 Hz field rates, along with other issues, resulting in little chance to develop a worldwide HDTV production and transmission standard. In North America several analog formats were proposed and a lengthy evaluation process was started.

Somewhere along the line a monkey wrench was tossed into the advanced TV (ATV) works. In retrospect, this was a good wrench! General Instrument proposed a *digital* transmission format! Most of the analog proposals went by the wayside, and the Advanced Television Technology Center evaluated a handful of digital proposals plus one lone analog proposal from Japan. Ultimately the analog proposal was dismissed; of the remaining digital proposals, none was found to be ideal. The marching orders then were to combine the best attributes of each one, and we wound up with a Grand Alliance recommended HDTV specification. The Grand Alliance, by the way, included AT&T, General Instrument, Philips, Sarnoff, Thomson and Zenith.

The original Grand Alliance recommendation was to use 8-VSB digital modulation for terrestrial HDTV broadcasting, and 16-VSB for cable. The display format would have a 16:9 aspect ratio (close to widescreen in shape) and interlaced scanning, along with the requisite CD-quality sound. This proposed standard was submitted to the Federal Communications Commission for approval.

The computer and motion picture industries lobbied for changes to the proposed HDTV standard. The computer industry argued for progressive scanning; they said it's better for displaying text and graphics, and is compatible with computer technology. The broadcast industry argued for interlaced scanning, because of that format's lower bandwidth requirements, lower cost, and supposedly better spatial resolution. The motion picture industry went for the artist's perspective, and argued for preservation of the original motion picture aspect ratio, which meant variable aspect ratios. Broadcasters argued for a fixed 16:9 aspect ratio.

The FCC implemented compromise technical specifications for *digital broadcasting* at the end of 1996. This is now known as digital TV, or DTV. By the way, don't confuse DTV with HDTV, which is high definition TV. HDTV can be analog (as it is in Japan), or it can be digital. DTV is digital TV, high definition or otherwise. There is another acronym in all of this: ATSC, or Advanced Television Systems Committee. The FCC refused to mandate a picture standard, saying this was done so the marketplace could decide among different versions of DTV. The ATSC video format—there are about 18 of them—is part of a so-called "voluntary standard."

This confusion means any manufacturer can market computer monitors or TV receivers with either interlaced or progressive scan displays, or both. Broadcasters have the option of transmitting their digital signal in a wide range of transmission standards using 8-VSB, but they must use MPEG-2 for compression and the Dolby Digital six-channel audio format.

The FCC has created frequency assignments for DTV, most of which are in the UHF broadcast spectrum above 470 MHz. Ideally, existing stations will simulcast a 6 MHz wide DTV channel (which can be either a single HDTV "channel" or a multiplex of standard definition "channels") on the new frequency and regular analog NTSC programming on their original channels. The original frequency will be abandoned by the broadcaster and turned over to the government, probably to be


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Figure 1: 8-VSB signal in the frequency domain

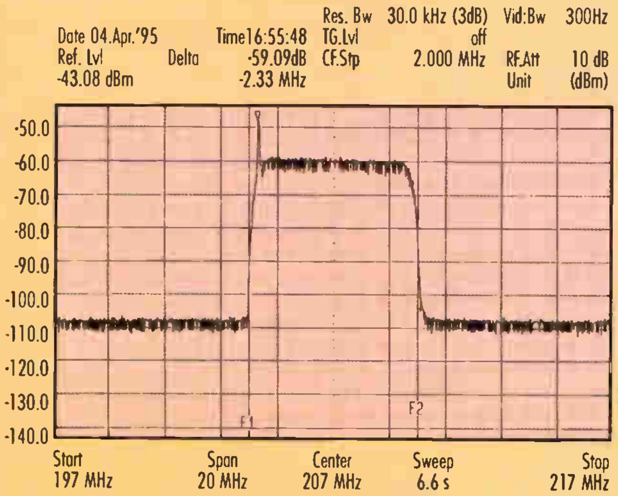
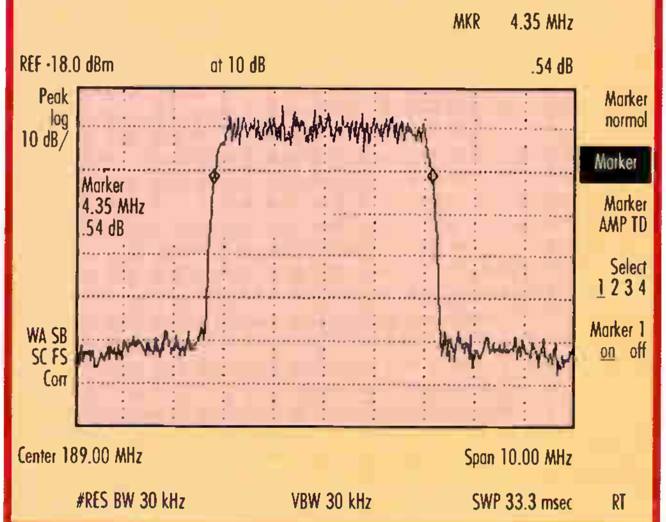


Figure 2: 64-QAM signal in the frequency domain



auctioned to telecommunications industries.

At this time, the FCC has accepted a commitment from broadcasters to put at least 24 DTV stations on the air within 18 months. This includes 22 stations in the 10 largest markets: New York, Los Angeles, Chicago, Philadelphia, San Francisco, Boston, Washington, Dallas, Detroit, and Atlanta. After 24 months, all network-affiliated stations in the 10 largest markets not already broadcasting on their new DTV frequencies will be required to do so. After five years (no later than April 2002), all small-market commercial stations must begin digital broadcasting or risk losing their DTV license. Public stations must begin DTV operation a year later. Some temporary extended waiver periods may be granted by the FCC, but all United

States NTSC broadcasts are to cease by 2006.

What *is* DTV?

From a broadcaster's perspective, DTV is really not much more than better pictures and sound, with the potential for some additional data services. The computer industry looks at DTV as a combination of video, audio and Web data, allowing the TV set to be a "gateway to the Internet." Both perspectives are correct. After all, the consumer data market is unquestionably growing, and there is no reason why a TV channel's 6 MHz bandwidth can't be used effectively for both TV and data. DTV is certainly one solution, and when viewed from the broadcast and computer industry perspectives, can serve both platforms: the TV and PC.

From an engineering perspective, DTV can really be thought of as data multiplexing. Under the "no standard" standard, a broadcaster can transmit a single HDTV signal or multiple standard definition TV signals, along with audio in the Dolby Digital six-channel audio format (formerly Dolby AC-3). Additional data can be transmitted for Web access and even some sort of telephony. The point is the potential for incremental revenue for broadcasters. What does all this have to do with cable? Bear with me.

8-VSB

The broadcast DTV signal is transmitted at up to 19.39 Mbps in a 6 MHz bandwidth. The 8-VSB signal includes video, audio, and an auxiliary data channel. The 8-VSB digital modulation format will be used for terrestrial (over-the-air) broadcasting. The digital modulation scheme is in modem hardware built by Zenith for the Grand Alliance, and includes a pilot carrier used to lock the demodulator and improve robustness of the data system. The C/N threshold is 14.9 dB. Figure 1 on page 58 shows an 8-VSB signal on a spectrum analyzer.

8-VSB has a peak-to-average power ratio of 7.5 to 8 dB. For a broadcaster, this means that a DTV transmitter rated at an average power of, say, 10,000 watts will have a transient peak power of about 63,000 watts. Transmitter linearity and intermodulation performance will be very important. This might be important to cable operators, too. If DTV falls under the must-carry rules, and we carry an 8-VSB signal in its original format, this peak-to-average ratio could be a consideration in headend processing equipment and fiber-optic links.

Broadcast industry concerns

At the risk of losing their license, broadcasters will have to convert to DTV transmission. A TV station can opt for digital pass-through at an estimated cost of $1 to $3 million. This will buy new satellite receiving equipment to receive the TV network's digital feed; a new digital-capable transmitter; and a new antenna, feedline and hardware. In some cases a new tower may be required. Can you imagine spending this much per channel for digital pass-through in your headend?

If a broadcaster wants to upgrade to full digital production capability, cost estimates are in the $9 to $12 million range *per TV station*. This covers the cost of new digital cameras and lenses, a new digital-capable studio, switching and production equipment, new digital electronic news gathering (ENG) equipment, along with the equipment for digital pass-through.

Broadcasters are asking if there is a real market for DTV. How can small-market stations afford to upgrade? What about rural area TV translators? Even the availability of personnel to upgrade or replace towers, install new antennas and so on, is in question. Many broadcasters are trying to decide between interlaced and progressive scan formats, although Philips and Zenith plan to introduce DTV receivers by the end of 1998 that will include the ability to display all 18 formats of the ATSC standard.

At 1997's NAB convention, the computer industry's "DTV team"—Microsoft, Intel and Compaq—proposed that DTV broadcasts initially use a 720 x 1,280 progressive scan format for film-based materials, as well as standard definition formats in both interlaced and progressive scan modes. They believe this approach will allow DTV to serve PCs, hybrid PC/Tv sets, and digital TV sets. Microsoft has been working since 1995 on a project originally called The Broadcast PC, later changed to the Broadcast Architecture for Windows. Upcoming releases of Windows NT v5.0 and "Memphis" are supposed to include Broadcast Architecture for Windows capabilities. This is intended to support a variety of film and video resolutions, and will allow future consumer technology to have full PC and TV capabilities.

DTV and cable

Here is where it gets confusing for us. The CATV industry has adopted 64-QAM for most cable system digital video transmission. Like 8-VSB, it occupies a 6 MHz bandwidth. Unlike 8-VSB, we get more data down the pipe in that bandwidth, on the order of 27 Mbps for 64-QAM (quadrature amplitude modulation). And did I mention that 8-VSB and 64-QAM aren't exactly compatible? (See Figure 2 for a peek at a 64-QAM signal on a spectrum analyzer.)

It's not clear whether broadcasters' DTV signals will fall under must-carry rules. We now have to carry most broadcasters' NTSC analog channels. But things get a little fuzzy when you start to think about also having to carry a DTV signal that might be HDTV, or maybe it will be three or four SDTV "channels," along with revenue-producing ancillary data services. I imagine DTV will eventually fall under must-carry rules.

Let's assume that will be the case. One way to comply will be to simply carry the 8-VSB format signal the way you receive it at the headend, and pass it through to the subscriber unaltered. Assuming the previously mentioned 7.5 to 8 dB peak-to-average power ratio of 8-VSB is dealt with, at least for the next few years—until broadcasters are forced to shut down their NTSC transmissions—you could be forced to carry a given TV station's analog NTSC channel and its DTV channel. Can you say channel capacity problems? This will go away once the NTSC transmitter is unplugged.

Continued on page 80

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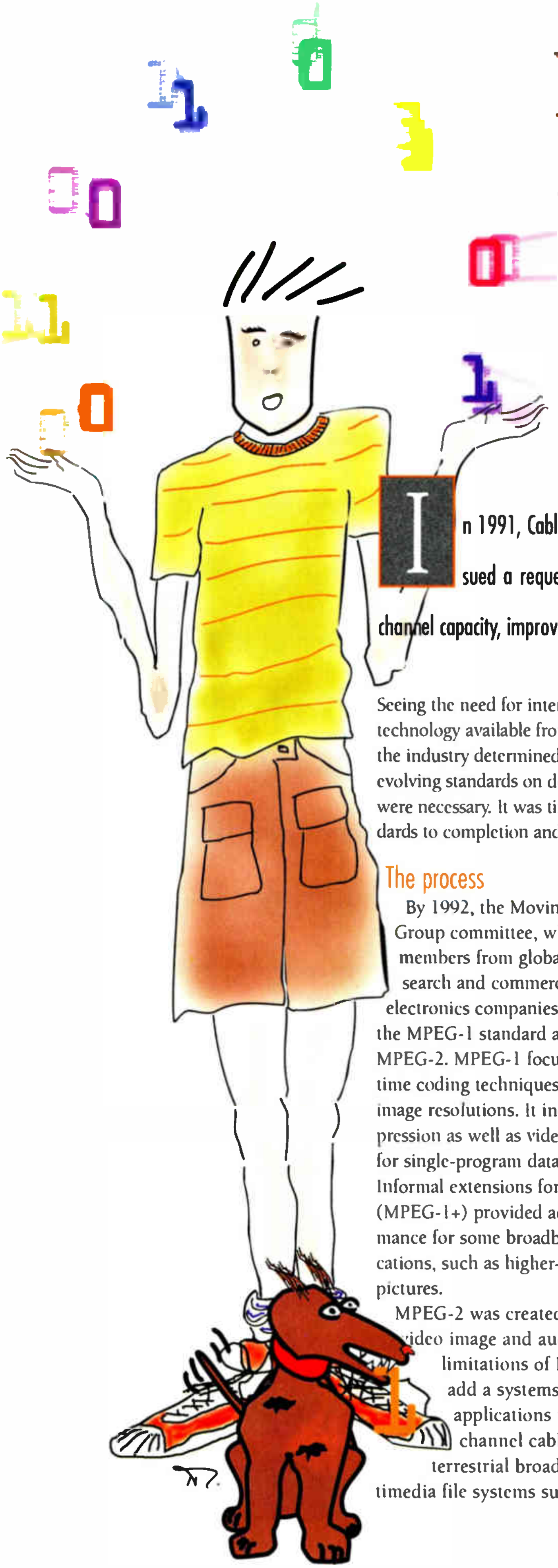


From Digital Standards to Commercial Reality

By Carl J. McGrath

In 1991, CableLabs posed a challenge to the worldwide broadband industry when it issued a request for proposal (RFP) for digital system technology that would expand channel capacity, improve image quality, and enable interactive services.

Seeing the need for interoperable systems technology available from multiple vendors, the industry determined that existing and evolving standards on deployed products were necessary. It was time to move standards to completion and into products.

The process

By 1992, the Moving Pictures Experts Group committee, which included members from global academia, research and commercial and consumer electronics companies, had completed the MPEG-1 standard and was developing MPEG-2. MPEG-1 focused on frame-at-a-time coding techniques and moderate image resolutions. It included audio compression as well as video/audio linkages for single-program data streams support. Informal extensions for higher resolutions (MPEG-1+) provided adequate performance for some broadband delivery applications, such as higher-resolution pictures.

MPEG-2 was created to address the video image and audio performance limitations of MPEG-1 and to add a systems layer. Targeted applications included multichannel cable, satellite and terrestrial broadcasters, and multimedia file systems such as CD-ROM, video file servers and video and audio on the World Wide Web.

MPEG-2 for North America

The MPEG-2 video standard focuses on the reception, decoding and decompression process. It clearly defines the syntax of the command and data messages that are "legal" in an MPEG bitstream and how the decoder must process them. The only specification for the encoding process (conversion of video images into MPEG-compliant bitstreams) is that the stream syntax must conform to the standard. Encoder developers can choose: Which commands to issue to the decoder; which bit rates to use; and what data elements best describe the images.

As a result, different encoders driven by the same video source generate different MPEG-compliant data streams. While their decoded and reconstructed pictures may not appear identical upon close examination, a unique stream generated by one encoder must be identically decoded by all compliant decoders. Standards-based systems are employed to ensure that compliant products from various vendors and decoder manufacturers display predictable results.

The MPEG-2 standard supports higher resolution images and encoding techniques that recognize frame-to-frame redundancy due to motion (motion compensation). MPEG-2 also creates a set of encoding "rules" that support end-user applications and future higher-quality delivery systems for production or distribution.

MPEG-2 supports images up to 720 x 480 pixels in size (for NTSC systems) with aspect ratios of 4:3 and 16:9 and bit rates as high as 15 Mbps. It also supports images originating as frames that must be decoded and displayed as interlaced fields, such as film and video.

In digital video compression, a full-bandwidth NTSC signal is demodulated into its luminance and chrominance components and then digitized with 8-bit analog-to-digital (A/D) converters to yield a digital image 720 pixels wide and 480 rows high. D1, an industry-standard format used in production studios for several years, is an uncompressed signal at 212 Mbps. Unfortunately, the data rates inherent to D1 are impractical for broadcast and consumer applications.

A more appropriate target rate is approximately 2 Mbps. Simple data compression techniques, such as those used on computer files, are rarely more effective than 2:1 or 4:1 and are unpredictable. Therefore, they are inadequate for digital video compression.

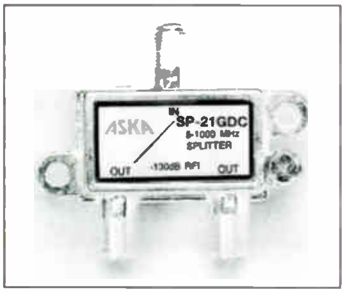
MPEG treats images as collections of macro blocks, 16 x 16 pixel regions of the image. This size optimizes the mathematical manipulations on the macro-block properties while maintaining adequate accuracy with reasonable data-element sizes. Compression of the image (reduction of data that must be delivered to the receiver/decoder for image reconstruction) is achieved through a series of filter and comparison functions operating on these macro blocks. These functions recognize repetition in the data, eliminate detail unrecognizable to the human eye, and use frame-to-frame redundancy to minimize the amount of updating required at the receiver.

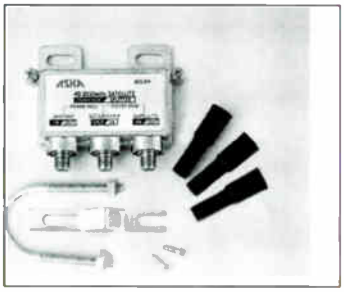
MPEG-2 adds significant sophistication to the process by keeping whole or partial images in the decoder memory, which allows detailed information to be reused (redisplayed) rather than re-transmitted for each frame. Since one encoder can feed millions of decoders on a broadcast network, MPEG-2 optimizes the complexity of the process so that the decoder-resource requirements (computation power and memory size) are small relative to the encoder.

Typical video bitstream rates are in the 2-3 Mbps range for current MPEG encoders, slightly more for content with significant action like sporting events.

Audio

MPEG-2 audio for North American applications represents a compromise to the general MPEG-standards philosophy of backward compatibility. Although a stereo (two-channel) audio compression system was in place for MPEG-1 (Layer 1), Dolby Digital, a competing but incompatible technology, had gained initial approval in the Federal Communications Commission high definition TV (HDTV) process. With strong input from the broadband operators, the new optional





non-backward-compatible mode for audio-stream delivery was added to the standard. As a result, MPEG-2 programs are fully standards-compliant with either Dolby Digital or MPEG Layer II audio encoding.

With the emphasis on delivering only the perceivable content of the audio stream, initial audio compression schemes center on the ability to hear certain frequency bands or perceive low-level signals in the presence of high-level signals at different frequencies.

Further data reduction comes from the ability to detect spatial differences (stereo and surround encoding). Because hearing is more sensitive than vision, achievable bit rate reductions for high-quality audio are between 6 and 9, as compared to video rate reductions of 50 to 100. Typical audio bitstream rates are 192 kbps for a stereo pair, up to 256 kbps for some content.

Systems

Significant modifications and enhancements to the existing MPEG-1 standard were required for such MPEG-2 targeted applications as cable TV and satellite multichannel systems. The goals were:

- Rules for combining multiple element streams (i.e., audio and video streams) into a single multiplex.
- Rules for adding additional streams of unknown type (i.e., data and program-related information) to the multiplex.
- Definition of a stream navigation data set that enables any MPEG-compliant receiver to determine stream content to form relationships among the streams.
- Rules for communicating time references to the decoder, and recognizing and preserving the real-time nature of the content. For NTSC video, a new field must be ready for display at precisely a 59.94 per second rate.
- Generic support for access control and encryption of the streams.
- Transparency of the stream format to the actual delivery mechanism, with support for any bit rate over any medium capable of supporting the minimum applicable rates for system program elements.
- Minimization of the transport-decoder complexity and the amount of memory that must be dedicated to the decoding process.

The decoder must be simple and efficient so that a high percentage of the overall bits in the stream are dedicated to content, not control (system overhead). Therefore, a packet-based system similar to asynchronous transfer mode (ATM), the evolving data communications standard, was selected. MPEG-2 does not include an error-correction mechanism, but it provides simple structures that make the receiver aware of possibly corrupted packet contents in the delivery process. The standard does not specify error-recovery mechanisms/rules.

Completing a delivery system

MPEG-2 provides an essential definition of the encoding and decoding process for video and audio and an open framework for delivering them over a system. However, many details required for interoperability at the implementation level are still open. Standards for the generation and delivery of information defining the services (system information), and standards for the communication of the data stream over physical channels applicable to cable, are still required to complete a basic system.

System information

The Advanced Television Systems Committee created by the FCC to oversee the HDTV process, was responsible for establishing definitions of data streams and descriptive information accessible to all receivers in a well-defined format.

The ATSC SI standard, Document A/56, facilitates acquisition and navigation among analog and digital services available to a particular decoder. SI also serves as a support platform for applications like interactive program guides (IPGs) and near-video-on-demand (NVOD). SI comprises a database describing various network aspects. Its tables include:

- Carrier definition table (CDT)—defines each frequency used in the cable plant.
- Modulation mode table (MMT)—defines the method for modulating the network's digital carriers.
- Virtual channel table (VCT)—defines the collection of available analog and digital services and assigns each service a user-channel number. It supports downloaded and resident applications like IPGs and NVOD.
- Source name table (SNT)—Provides an informative definition for each unique program provider identified in the VCT.

The data base also includes a system time message, which is used to time-synchronize all system components, from equipment at the satellite uplink to the cable decoder. Using a system time reference, operators can specify changes to VCT entries before they become effective.

The SI database is unique. It defines the services available only within the bounds of the system delivering the table. In broadband system applications, it is typically constructed by the access control system and delivered to the set tops as an out-of-band (OOB) data stream. OOB delivery reduces the total system overhead in multichannel systems and ensures that the data stream is constantly available to the set-top. Alternatively, SI can be delivered as part of the in-band MPEG transport stream as a private data service. If delivered in-band, the system must use a "home channel" concept or replicate the SI stream on each channel.

Transmission

The final major delivery system component is the set of interface rules for the physical medium. While the ATSC developed similar specifications for over-the-air broadcast channels, CableLabs and the broadband industry decided to work with the International Telecommunications Union to establish and document standards. The ITU oversees communications standards on a global basis for both wired and wireless communication.

After extensive evaluation of typical cable TV systems, ITU proposed and accepted a transmission standard based on quadrature amplitude modulation (QAM) with 8-level signaling on each of the quadrature carriers (64-QAM) with an appropriate layered error-correction coding scheme. ITU later extended the QAM standard to include 16-level-per-carrier signaling (256-QAM).

Put it all together

Since 1991, broadband system operators have focused on successful deployments of commercially viable systems based on these standards and standard interfaces. Following the initial 1996 digital deployment, several MSOs have aggressively installed headend facilities. Digital video services were projected to be available to over 22 million North American households by the end of last year. Interoperability among system components implementing the standards has been demonstrated not only in the laboratory but also in these operating networks. Systems combining locally encoded and satellite-delivered programming are currently in operation.

Next steps

CableLabs is now seeking proposals for extensions to its digital video delivery platform through the OpenCable process. Building on these existing standards, data communications industry standards, and new committee efforts, the broadband industry continues to drive advanced convergence-focused systems into the commercial marketplace.

Carl McGrath is vice president of engineering for Digital Network Systems of NextLevel Systems Inc. He may be reached at (215) 674-4800.

BOTTOM LINE

The Digital Reality

CableLabs' 1991 request for proposal (RFP) for digital-signal technology that would expand channel capacity, improve image quality and enable interactive services signified that it was time to move Moving Pictures Experts Groups to completion and into products.

Key components of the North American MPEG-2 standard include:

- Video and audio: MPEG-2 provides an essential definition of the encoding and decoding process for video and audio and an open framework for delivering them over a system.
- ATSC system information: The Advanced Television Systems Committee SI standard, Document A/56, facilitates acquisition and navigation among analog and digital services available to a particular decoder.
- ITU-B QAM: The International Telecommunications Union transmission standard is based on quadrature amplitude modulation (QAM) with 8-level (64-QAM) or 16-level (256-QAM) per-carrier signaling and an appropriate layered error-correction coding scheme.

COMPRESSION

Are You Fooled By MPEG?

How Compression Works, in Plain Language

By Robin Wilson

The Moving Pictures Experts Group (MPEG-2) video compression standard is carefully designed to fool your eyes and brain. How else could a source signal that has over 150 Mbits of raw video information look pleasing at 3 Mbps? This article exposes the many tricks used in MPEG-2 compression. Most articles on the operation of MPEG rely on complex descriptions of the mathematical algorithms used to manipulate and remove information. While this may be an accurate way of looking at compression, it is often counter-intuitive. We'll address this problem by describing MPEG from a more intuitive point of view of the psycho-visual interpretation of the human eye and brain. In other words, how we see the picture rather than how the math works.

MPEG compression relies on hiding the inevitable artifacts or signal degradations caused by removing well over 95% of the original picture. These sometimes very significant artifacts are placed or hidden "behind" parts of the picture so that the eye does not see what may actually be there. This is very similar to the masking concept used in audio compression where "quiet" components of an audio signal are removed when they occur at the same time as other "loud" signals. A very easy way to prove how good MPEG is at fooling the mind is to look at still frames of a video sequence that may look relatively artifact-free when viewed at normal speed. The individual still frames frequently have very visible artifacts that simply are not visible when played at normal speed. An offshoot of this analysis is the discovery that some of the techniques used by MPEG to hide artifacts are fooled by certain types of picture material.

MPEG also makes use of some very intuitive techniques like recycling to reduce bit or data consumption.

Color doesn't need so much detail

Reducing color resolution is a data reduction technique by no means exclusive to MPEG. It's well known that the eye has significantly less acuity for fine detail of color changes than brightness changes. This phenomenon is put to good use in most forms of video signals, including color information. For example, NTSC has less than a third of the horizontal color detail than the corresponding brightness or luminance signal.

MPEG in the form used to carry signals to the home takes advantage of this aspect of the eyes' lack of color resolution acuity one step further: Color resolution in the vertical direction is halved, and therefore reduced to a similar extent to the horizontal direction—which usually already had the excess color detail removed.

Pollution and recycling

Video is a major pollutant. Video wastes huge amounts of data describing in excruciating detail the same aspects of a picture or a series of pictures over and over again. MPEG attempts to reduce this data pollution by recycling parts of the picture; in some cases, even complete pictures are recycled. A standard definition video signal requires continuous data rates that can exceed 150 million bits per second. Due to the incessant need to update the uncompressed displayed picture, this data rate remains constant regardless of the simplicity or complexity of the picture. Sending uncompressed digital video is analogous to and as wasteful as running a high-powered sports car at maximum throttle continuously even when parked overnight by using the brakes.

MPEG Rule 1: Never send the picture

Because uncompressed video is such an inefficient way to describe moving pictures, almost anything other than uncompressed video can do a better job. Sending an uncompressed picture is therefore the worst possible strategy. A much better strategy is to send efficient short (compressed) mathematical descriptions of the picture, including descriptions on how to re-use or recycle parts of previous pictures.

How pictures are recycled

MPEG's main technique for recycling involves identifying parts of the picture that are repeated in subsequent pictures. Repetition of aspects of a picture is very common in most video sequences. To make this technique practical and economical to implement, MPEG dissects pictures into small manageable rectangles often of 16 x 16 pixels. This is like dividing a typical TV-sized picture into postage stamp-sized rectangles. MPEG then calculates where each of these postage stamp blocks of the picture moves to.

Thus, an MPEG compressed picture actually may be made up of a mosaic of recycled parts of previous and even future pictures. (MPEG temporarily stores future pictures to allow this apparent future prediction to succeed.) MPEG sends a few

BOTTOM LINE

MPEG: Less Than Meets the Eye

MPEG compression relies on hiding the inevitable artifacts or signal degradations caused by removing well over 95% of the original picture. These sometimes very significant artifacts are placed or hidden "behind" parts of the picture so that the eye does not see what may actually be there.

MPEG's main technique for recycling: MPEG identifies parts of the picture that are repeated in subsequent pictures, then dissects the pictures into small manageable rectangles, often of 16 x 16 pixels. This is like dividing a typical TV-sized picture into postage stamp-sized rectangles.

A visual mosaic: MPEG sends a few very efficient commands to the decompressor (decoder) that describe how each of these little stamp-sized blocks moves in a horizontal and vertical direction between successive pictures. The raw result may actually look like a mosaic where the postage stamp squares of recycled picture parts crudely form a new picture.

Almost no bandwidth is wasted in sending these very simple movement instructions (known as motion vectors). The remaining bandwidth can be used to send relatively small amounts of data to "patch up" the disjointed parts of the mosaic.

Fooling the eye by removing bits from parts of the picture is not just limited to parts of the same picture. MPEG employs a relatively long-term storage "buffer" where parts of the compressed pictures are stored. By using this buffer it is possible to "borrow" and "pay back" bits from current and future pictures.

very efficient commands to the decompressor (decoder) that describe how each of these little stamp-sized blocks moves in a horizontal and vertical direction between successive pictures. The raw result may actually look like a mosaic where the postage stamp squares of recycled picture parts crudely form a new picture.

The reason that MPEG succeeds in this subterfuge is that almost no bandwidth is wasted in sending these very simple movement instructions (known as motion vectors). The remaining bandwidth can be used to send relatively small amounts of data to "patch up" the disjointed parts of the mosaic.

A second recycling technique comes into play mainly with film originated material. With the NTSC video system, pictures are sent 30 times a second. When film is converted to NTSC-based video, 24 pictures per second (standard to film) are still sent at 30 pictures per second by a complex and wasteful process of repeating some of the film pictures in a brute force attempt to fill the empty picture slots as unobjectionably as possible. This has always been a problem with NTSC TV systems.

MPEG recognizes this problem and instead of brute force duplication in the transmission path, sends a very succinct command to tell the decoder to replicate some of the redundant or "fill" pictures. Unlike the postage stamp-based system described above, these picture are precisely the same, so there's no need to describe individual parts of the picture.

The MPEG/Las Vegas connection

MPEG succeeds *most* of the time. Video is a three-dimensional medium; shapes have horizontal, vertical and temporal (time-based) dimensions. Much of the success of MPEG relies on a gamble. It's counting on the odds that when the activity in a picture has relatively low horizontal, vertical or temporal components, or when lots of activity occurs in one of these dimensions, there's little or none in the others.

Luckily, that holds true with most types of pictures, most of the time, and MPEG compression works. Unfortunately that gamble isn't a guarantee. One example of pictures that lose the MPEG gamble are basketball games. In your basic game of hoops, there's lots of complex detail from the court and spectators (horizontal and vertical), and there's lots of fast motion from the players and fast panning cameras. Horse racing is another example. For these types of programming, MPEG needs some help. Typically the "help" can be using a higher data rate.

What do you do when there are no bits left in the pipe? When all of the recycling and mathematical description techniques have yielded their last bit, yet there's still too few bits left to portray a complex video sequence, something has to go. This is when the gamble doesn't quite pay off. The trick is to throw away even more bits from the picture in a way that is not too objectionable.

Hiding the artifacts

An important tool used by MPEG is to reduce how accurately the brightness of an object or parts of an object is described. The eye is less acute at seeing

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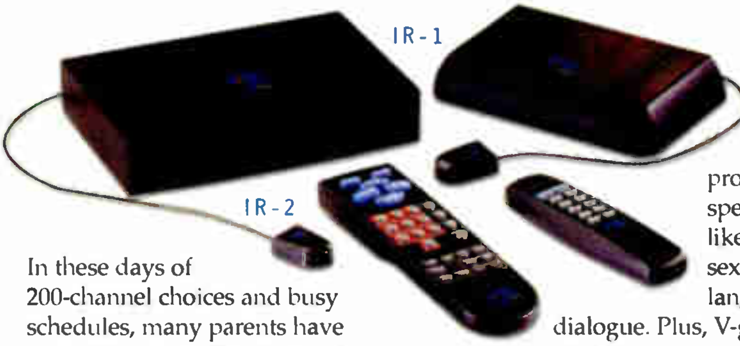

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small differences in brightness, especially as the size of an object goes down.

For example, a large "flat" object needs to be described relatively accurately in terms of brightness, otherwise noise or contourlines may be seen in the object. If the object or part of the picture contains lots of fine detail, then it's often possible to describe the brightness of the object in much less detail, as the noise or contour lines are hidden or masked by the fine detail. In addition, the level of acuity used to convey the fine detail often can be even further reduced to save precious transmission bits. In extreme cases the very high frequency detail may be "rounded to zero" (in other words, not sent at all).

Obviously all of this reduction of information ultimately becomes apparent even to noncritical viewers. This is especially true at lower bit rates including the 3 Mbps mentioned earlier. This also is when compression is transformed from a science to an art form. The art is to determine which parts of the picture can best afford to lose precious bits, and if bits have to be lost, what aspect of the picture must suffer. Fine detail can, at best, be described more approximately, and at worst, be removed altogether. The real art is to adjust this data reduction to remove more bits from the less important areas to the viewer, a task very difficult even through complex calculation.

Fooling the eye by removing bits from parts of the picture is not just limited to parts of the same picture. MPEG employs a relatively long term storage "buffer" where parts of the compressed pictures are stored. By using this buffer it is possible to "borrow" and "pay back" bits from current and future pictures. The determination of the best strategy is based on analyzing sudden changes in picture content. A major change in picture content as occurs at a cut in a video sequence requires more bits to compress. In that case, the recycling techniques discussed earlier fail and a complete and less efficient refresh may be required. Counter to this, the eye is less able to detect artifacts when pictures change rapidly in content. For this reason, MTV-like fast cutting videos often are much easier to compress than otherwise might be thought. CT

Robin Wilson is director of marketing for DiviCom. He can be reached at (408) 944-6700.

What is a Digital Set-Top?

Consumer Electronics or Serving Company's Interface?

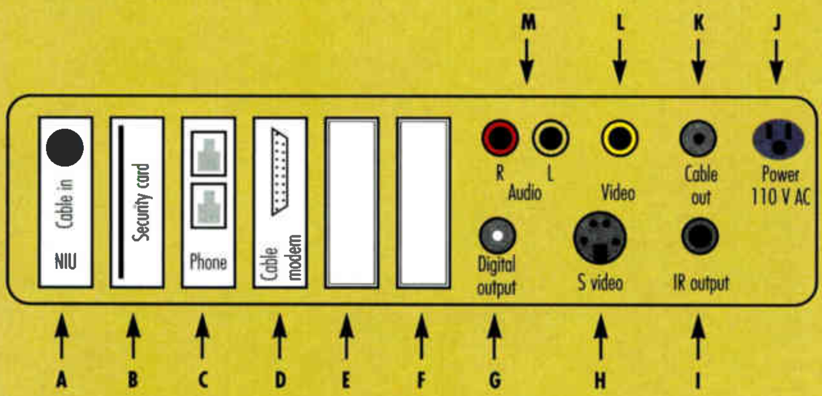
By Michael Sawyer

Direct broadcast satellite (DBS) is gobbling up market share. The wireline cable companies are responding with digital services. The telephone companies announce that they are going to provide digital cable TV offerings.

Digital is the direction this industry is moving. Digital provides superior picture and sound quality, compression, and encryption capabilities. Digital provides control, management and protection of the signal in ways that were unimaginable a decade ago.

How does the customer interface with this digital signal? There is no cable-compatible TV set for digital services today. Wireline digital service providers furnish the digital converter (DC). DBS operators offer their services through retail outlets.

Figure 1: Generic DC (rear view)



A—the NIU for the service provider; it includes the cable input jack
B—the security card for the service provider to use to authorize services to the box
C—the telephone module for the service provider
D—the optional cable modem interface
E & F—These are growth ports
G—the digital audio output
H—the S-video output
I—the output for the IR device that could be used to control other equipment from the box
J—the power input for the box
K—the cable out jack where the customer picks up the RF signal from the box
L—the baseband video output
M—the baseband audio outputs

Consider the telephone industry model. Once upon a time only the operator's equipment was on the line. Today, consumers buy their own. The telephone company provides a network interface unit (NIU). That is where their ownership ends. The consumer owns everything inside the home.

Standards

Organizations, such as CableLabs, are developing specifications that will make it possible to sell DCs at a retail outlet. The purpose of this article is to discuss what might be seen in the future that makes the DC a consumer article while providing each service provider an opportunity to offer differentiated services.

Standards are the issue. You can go out and buy a telephone and plug it into the telephone outlet and it works. These phones can be anything from a simple dial telephone to a fancy cordless phone with touch-tone, caller ID, and a built-in answering machine.

Plug-in ports

Is it possible to do this with a DC? What user interface standards would be needed? Using the concept of plug-in ports, there are four basic interfaces that must be provided. In Figure 1, the DC rear view shows six plug-in ports with four "mandatory" ports:

- NIU A: The service provider's specified NIU card properly terminates the cable service being provided. By using a plug-in NIU, the same basic DC could be used to terminate any type of service offered.
- Security Card B: Allows the service provider to authorize services, such

as pay-per-view (PPV). A separate plug-in module and security card would allow each service provider to maximize the security over their programming, thereby protecting revenue dollars.

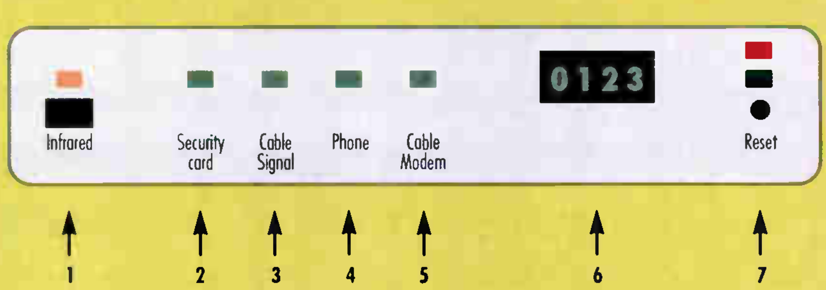
- Telephone Card C: On two-way systems, there would be a card to interface with the consumer's telephone system and provide full telephony service to the consumer over the cable plant. On one-way systems, this plug-in would provide a means of communication with the headend via the local telephone service provider.
- CableModem Card D: This card would be provided in systems where the operator is offering high-speed Internet or other data access to the consumer.
- Expansion Port(s) E&F: These slots are for other services.

Figure 1 shows the output jacks from the DC that the customer uses to obtain video and audio signals. The standard baseband jacks for A/V are represented at "M" and "L." The standard RF output of the DC to the consumer's VCR or TV set is "K." "J" is the power input. Digital quality sound that is encoded on the digital signal is available at "G." The high quality S-Video is received at "H." Finally, the IR output is at "I"; it is used to give the DC control over the VCR.

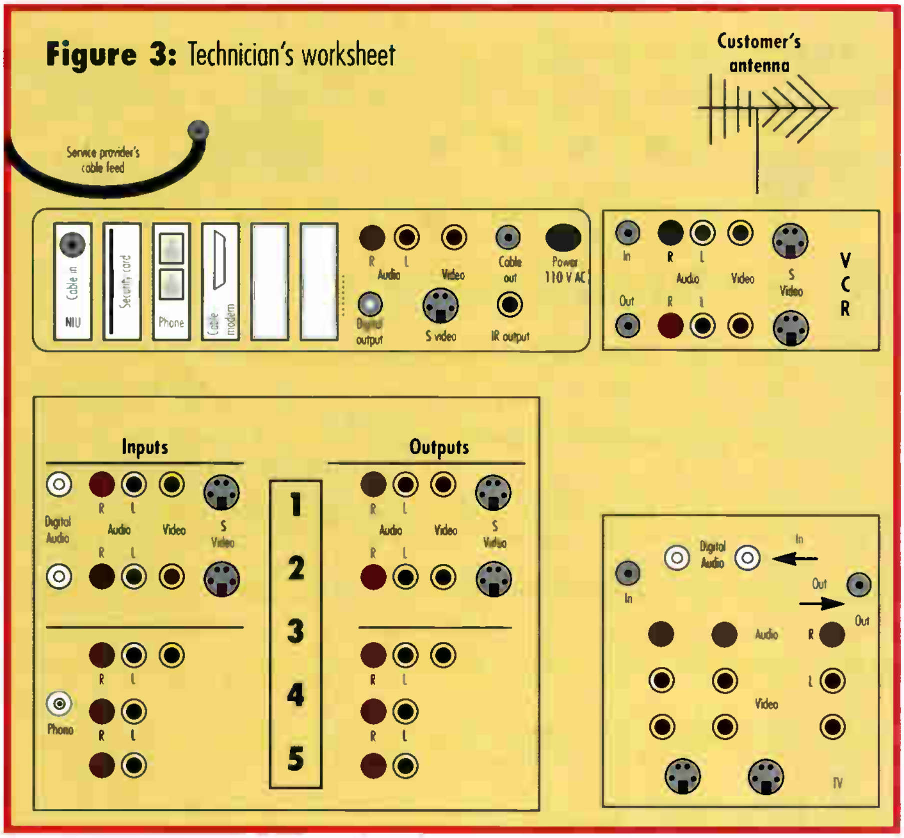
In Figure 2, the DC front, is a view of what the front of this equipment could look like. There are controls here. It also is expected that the DC would come with a remote control.

The removable plug-ins specified by

Figure 2: Generic DC (front view)



1–Infrared window with red LED that flashes when remote control signals with box
2–Green LED on to indicate that the security card is installed and working
3–Green LED on to indicate that the provider's cable signal is present
4–Green LED on to indicate that the telephone connection or modem is installed and functioning
5–Green LED on to indicate that the cable modem is installed and functioning
6–Four sets of LEDs to provide digital readout from the box; in normal use this would be the channel to which the box was tuned
7–The reset switch has two LEDs associated with it; the green LED indicates the box is on; the red LED indicates that the box has lost power



the service provider are relatively complex pieces of electronic equipment. At the same time, they are simple to install and operate. The output jacks for the consumer's use are very simple; however, the combinations and permutations of connections are not. There are consumers who are "techies" and do not want anyone touching "their stuff." There also are many VCRs that always blink "12:00." In fact, this has been a comedians' standard for years.

The point is, many consumers are afraid to touch their equipment. The service provider wants the consumer to enjoy the service, and spend additional dollars ordering premium channels. To maximize their satisfaction, and the revenue dollars, the consumer needs to get the best pictures and sounds from their equipment. They need to be satisfied.

An exercise

Connecting the new DC equipment to the consumers' electronic equipment is not rocket science. And most people

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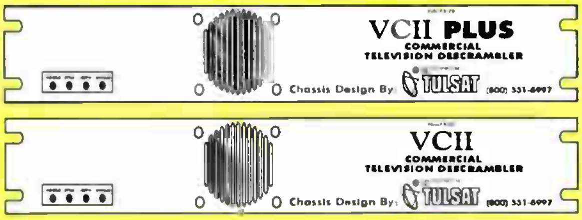

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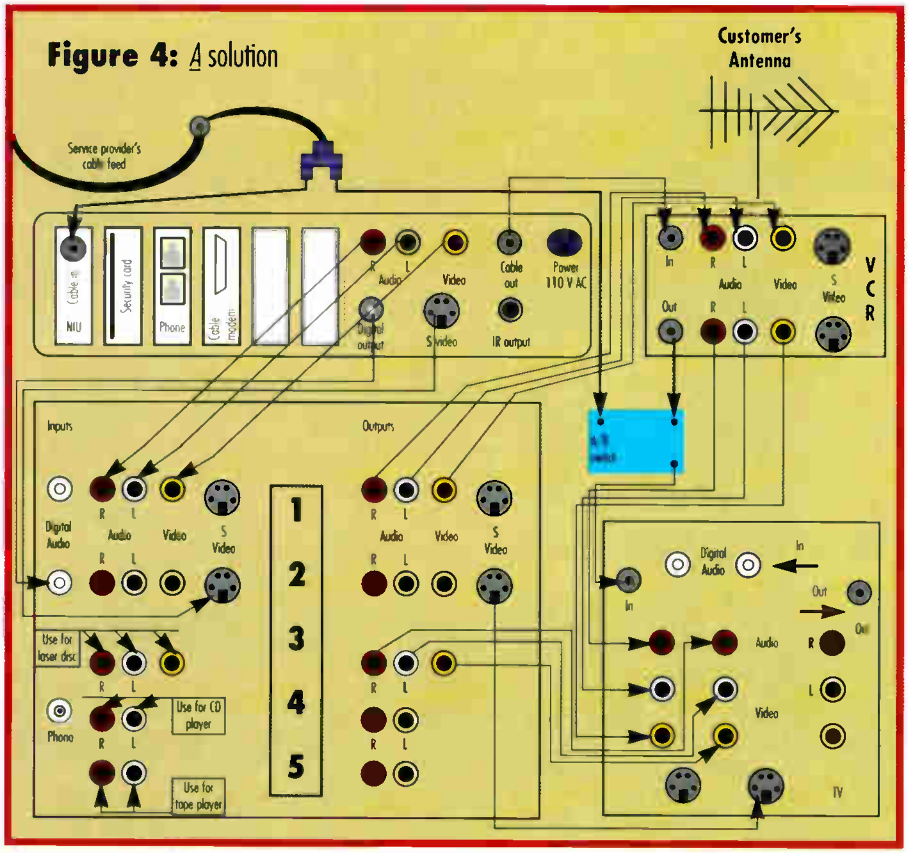

Figure 4: A solution

are not rocket scientists. In fact, many are technologically challenged. Many of us in the industry think that hooking the equipment up is a piece of cake. So, here is your exercise:

You are at the customer's site. The service is provided via coaxial cable into

BOTTOM LINE

Digital Converters: A Money Machine?

The digital set-top converter is a money machine. But will it bring money in or drain money from the service provider's coffers? Prices for the devices have dropped dramatically from prototype estimates. Still, 10,000 devices each at $300 is $3 million plus the life cycle costs. Transferring these costs to the customer would save an operator money and boxes you do not own are not "walk-away" problems.

So, how could the industry provide a consumer electronic device sold in retail stores that would allow each service provider to protect its programming, authorize the sale of high-margin premium services, and have the option to provide both telephony and/or high speed data service? This could be a dream machine for the industry. Of course, the customer would have to have it installed correctly to maximize satisfaction for the user and profitability for the service provider.

If this does not sound plausible in your service area, consider the profits enjoyed by the telephone companies in providing local and long distance services. Those companies do not provide the equipment; those companies charge for work inside the consumer's home. Those companies are entering the cable TV market. The old ways of doing business are obviously behind us. New ways are being tried. The question remains as to how the equipment vendors and service providers will shape the future.

the home, has 30 channels that can be received and decoded by a standard cable-compatible TV set, and 100 premium channels that can only be accessed via the DC. The DC has been installed in accordance with your company's procedures and methods. The diagnostics have shown that the signal is good, the DC and customer are registered, and the DC is working correctly. The person who let you into the home handed you the following request, which you are now looking at:

> "How does the customer interface with this digital signal?"

Please install my cable service so that I can record premium channels while watching nonpremium channels. I want to use my new, fancy surround sound video stereo receiver to switch video channels as well as listen to audio from the cable service. I want to be able to listen to my CD player and cassette tape player from the stereo while watching the TV and using the VCR. I have a laser disk too. Do not forget to have the digital music put into my system too. I will take care of the wiring for the speakers, you do the rest of this stuff. Thank you.

Figure 3 shows the equipment less the speakers. Please take 5-10 minutes to sketch out how to meet the customer's request. A truck outside has all sorts of stuff in it, like A/B switches, splitters, etc. Take 10 minutes to do this. The quality assurance (QA) staff will be out later to critique the work (See Figure 4.)

Figure 4 is a solution. It is not the only solution, but it meets the customer's request.

A two-way splitter was inserted before the DC so that channels in the clear could be viewed on cable-compatible TV sets. One lead then went to the

DC and the other to an A/B switch.

The RF signals from the DC "Cable Out" went to the VCR. The VCR RF Out went to the A/B switch. The customer can now watch all channels and tapes via the VCR to the TV's RF input.

The baseband jacks on the DC box are directed to the receiver's "1" section. The outputs of these baseband jacks go to the VCR for recording.

VCR baseband jacks are connected to the TV baseband jacks. The customer could now watch a VCR tape while having the DC box tuned to an audio-only feed playing through the receiver.

The DC digital audio and S-Video output are directed to the receiver's "2" section. Only the S-Video is output here; it goes to the TV's S-Video input. The audio would be played from the stereo.

The laser disk is connected to the input baseband jacks in the receiver's "3" section; the output is sent to the second set of baseband jacks on the TV set. This allows the customer to watch laser disks.

The CD player is input at the receiver's "4" section. The cassette player is at the receiver's "5" section.

Note that the receiver can be set to only one of these sections at a time. Thus, if the laser disk (or CD or cassette players) is in use, the other "sections" are inactive.

"Organizations, such as CableLabs, are developing specifications that will make it possible to sell DCs at a retail outlet."

The customer's antenna is not connected. If the service provider had copy protection1 on some programs, this customer could still watch a high-quality program via the digital audio and S-Video outputs of the DC via the receiver. If there was no digital audio, the customer would have to use the RF input to watch protected programs.

Was this a 10-minute task? How long are field technicians being given to solve this problem? These are not trivial questions. Someone is going to do this work. Perhaps the customer should do it. Perhaps the store that sold them the equipment. Or, perhaps, your competitor will do it. A conscious decision must be made concerning what your company does. Service and revenue are dependent on the DC functioning in a way that maximizes the customer's experience. CT

Michael Sawyer is a principal in KnowledgeLink Inc. He can be reached via e-mail at JAMBRY1@aol.com.

Cable Acronyms

The Long and Short of It

By Ted Woo

More and more, our daily lives are filled with acronyms. Even acronyms have acronyms! For instance, did you know that TLA means "three-letter acronym"?

If you think GOP is shorthand for the Republican Party, DDS is the person who fixes your teeth and CAC is what you use to keep your house cool in the summer, save what follows for future reference. This article is a collection of common industry acronyms and their translations. While a truly comprehensive listing would be the size of an encyclopedia, this listing should help you with a lot of acronyms we use today.

AAL: ATM (asynchronous transfer mode) adaptation layer
AC: Access conditions or alternating current
AC-3: Dolby Labs' compression system for digital audio
ACP: Adjacent channel power
ADSI: Analog display service interface
ADSL: Asymmetric digital subscriber line
A/D: Analog-to-digital converter
AEL: Audio Engineering Laboratory
AFC: Antenna for communications, or automatic frequency control
AFT: Automatic fine tuning
AGC: Automatic gain control
AID: Application identifier
ALC: Automatic level control
AM: Amplitude modulation
ANSI: American National Standards Institute
APDU: Application protocol data unit
API: Applications programming interface
ASN.1: Abstract syntax notation 1
AT: Automatic tandem
ATEL: Advanced Television Evaluation Laboratory
ATM: Asynchronous transfer mode
ATR: Answer-to-reset
ATSC: Advanced Television Systems Committee
ATTC: Advanced Television Test Center
ATV: The U.S. advanced TV system, or advanced TV
BCD: Binary code decimal
BER: Basic encoding rules, or bit error rates
BIP-8: Bit interleaved parity-8
BSLBF: bit string (serial)-leftmost bit first
BSS: Business support system
CA: Conditional access
CAC: Carrier access code
CAS: Conditional access (sub) system
CAT: Conditional access table
CATV: Community antenna TV, or cable TV
CBC: Cipher block chaining
CD: Committee draft, or compact disc
CDT: Carrier definition table
CDTV: Conventional definition TV
CE: Consumer Electronics
CEBus: Consumer electronic bus
CP: Content provider
CPE: Customer premises equipment
CRC: Cyclic redundancy check
CNR or C/N: Carrier-to-noise ratio
CW: Control word
D/A: Digital-to-analog converter
DAVIC: Digital Audio-Visual Council
dB: Decibel
DBS: Direct broadcast satellite
DCC: Data communications channel
DCE: Data communications equipment
DCS: Digital cross-connection
DDS: Digital data service
DCT: Discrete cosine transform
DE: Data element
DES: Data encryption standard
DF: Dedicated file
DFB: Distributed feedback
DHCP: Dynamic host configuration protocol
DIR: Directory file
DLC: Digital loop carrier
DMS: Digital multiplex systems
DO: Data object
DRAM: Digital recorded announcement machine, or dynamic random access memory
DS: Digital signal
DSI: Digital speech interpolation
DSL: Digital subscriber line
DS0: Digital service, level 0
DSM: Digital storage media
DSM-CC: Digital storage media command and control
DSP: Digital signal processing
DTS: Decoding time stamp
DVB: Digital video broadcast
DVB SI: Digital video broadcast service information
DVCR: Digital video cassette recorder
DVD: Digital versatile disk, or digital video disk
DVR: Digital video recorder, or digital video recording
ECM: Entitlement control message
EAS: Emergency Alert System, or extended area service
EF: Elementary file
EIA: Electronic Industries Association
EMM: Entitlement management message
EPG: Electronic program guide
ES: Elementary stream
ESP: Encapsulated security protocol
ETU: Elementary time unit
FDDI: Fiber distributed data interface
FM: Frequency modulation
FP: Filter program
FPLL: Frequency and phase-locked loop
FS: Filter set
FTP: File transfer protocol
FTTC: Fiber-to-the-curb
FTTF: Fiber-to-the-feeder
FTTH: Fiber-to-the-home
GA: Grand Alliance
GB: Gigabyte; one billion bytes
GMT: Greenwich Mean Time
GPS: Global positioning system ➤

GOP: Group of pictures
HDSL: High-speed digital subscriber line
HDTV: High definition TV
HFC: Hybrid fiber/coax
Hi8: High-band 8 mm video system
HTML: Hypertext markup language
HTTP: Hypertext transfer protocol
IDL: Interface definition language
IDO: Inter-industry data object
IEC: International Electrotechnical Commission
IEEE: Institute of Electrical and Electronics Engineers
IETF: Internet Engineering Task Force
IGP: Interior gateway protocol
IRD: Integrated receiver/decoder
IP: Internet protocol; intelligent peripherals
IPPV: Impulse pay-per-view
IPR: Intellectual property rights
IPv4: Internet protocol version 4

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06.❑ Cable TV Program Networks
07.❑ SMATV, DBS Operator
08.❑ MMDS, STV or LPTV Operations
9A.❑ Microwave
9B.❑ Telecommunications Carrier
9C.❑ Electric Utility
9D.❑ Satellite Manufacturer
9E.❑ Satellite Distributor/Dealer
9F.❑ Fiber-Optic Manufacturer
10.❑ Commercial TV Broadcasters
11.❑ Cable TV Component Manufacturers
12.❑ Cable TV Investors
13.❑ Financial Institutions, Brokers & Consultants
14.❑ Law Firm or Govt. Agencies
15.❑ Program Producers, Distributors and Syndicators
16.❑ Advertising Agencies
17.❑ Educational TV Stations, Schools and Libraries
18.❑ Other (please specify) ________

C. Please check the category that best describes your job title: (check only one)
19.❑ Corporate Management
20.❑ Management
21.❑ Programming

Technical/Engineering
22.❑ Vice President
23.❑ Director
24.❑ Manager
25.❑ Engineer
26.❑ Technician
27.❑ Installer
28.❑ Sales
29.❑ Marketing
30.❑ Other (please specify) ________

D. Which one of the following best describes your involvement in the decision to purchase a product/service? (check only one)
31.❑ Recommend
32.❑ Specify
33.❑ Evaluate
34.❑ Approve
35.❑ Not involved

ISA: Interactive Services Association
ISDN: Integrated services digital network
ISO: International Standards Organization
ITU: International Telecommunication Union
JEC: Joint Engineering Council of Electronic Industries Association and National Cable Television Association
JEDEC: Joint Electron Device Engineering Council
lsb: Least significant bit
lsB: least significant byte
LFE: Low frequency effect, <120 Hz
Mb: Megabit, one million bits
MB: Megabyte, one million bytes
Mbps: Million bits per second, or megabits per second
MCNS: Multimedia Cable Network System
MCPT: Multiple carriers per transponder
MD: Mini-disc (a digital video format)
MF: Master file
MIPS: Million instructions per second
MJD: Modified Julian data
MMDS: Multichannel multipoint distribution service
MMI: Man machine interface
MMT: Modulation mode table
Modem: Modulator/demodulator
MPEG: Moving Pictures Experts Group
MP@HL: Main profile at high level
MP@ML: Main profile at main level
msb: Most significant bit
msB: Most significant byte
NCTA: National Cable Television Association
NID: Network interface device
NIM: Network interface module
NIU: Network interface unit
NML: Network management layer
NP: Network provider
NVM: Nonvolatile memory
NVOD: Near-video-on-demand
OMG: Object management group
OQPSK: Offset quadrature phase shift keying
OS: Operating system
PAT: Program association table
P-1394: A fire wire specification of the Institute of Electrical and Electronics Engineers
PCM: Pulse code modulation
PC-MCIA: Personal Computer-Memory Card International Association
PCN: Personal communications network
PCR: Program clock reference
PCS: Personal communications service
PDU: Protocol data unit
PES: Packetized elementary stream
PID: Packet identifier
PIN: Personal identification number

PIX: Proprietary application identifier extension
PMT: Program map table
POTS: Plain old telephone service
PPP: Point-to-point protocol
PPV: Pay-per-view
PS: Power supply
PTS: Protocol type selection
PU: Presentation unit
PSI: Program-specific information
QAM: Quadrature amplitude modulation
QPSK: Quadrature phase shift keying
RPCHOF: Remainder polynomial coefficients, highest order first
RAM: Random access memory
RFU: Reserved for future use
RID: Registered application provider identifier
RISC: Reduced instruction-set computer
ROM: Read-only memory
RP: Record pointer
RPC: Remote procedure call
SCR: System clock reference
SCTE: Society of Cable Telecommunications Engineers
SD: Super density digital compact disc
SDSL: Single-line digital subscriber line
SDTV: Standard definition TV
SECAM: Sequential couleur avec memoire
SIM-ME: Subscriber identity module-mobile equipment
SIT: Satellite information table
SLIP: Serial line Internet protocol
SMATV: Satellite master antenna TV
SMPTE: Society of Motion Picture and Television Engineers
SNA: System network architecture
SNMP: Simple network management protocol
SONET: Synchronous optical network
SP: Service provider
SPI: Security parameter index
STB: Set-top box
STD: System target decoder
STU: Set-top unit
SVB: Switched video broadcast
TAI: International Atomic Time
TCP: Transmission control protocol
TDMA: Time division multiple access
TDR: Time domain reflectometer
TDT: Transponder data table
TLV: Tag length value
TNT: Transponder name table
TOV: Threshold of visibility
TS: Transport stream
TSI: Time slot interchange
UDP: User datagram protocol
UIMSBF: Unsigned integer, most significant bit first
URL: Uniform resource locator
UTC: Universal coordinated time
VBI: Vertical blanking interval
VBV: Video buffering verifier
VCN: Virtual channel number
VCT: Virtual channel table
VDSL: Very-high-speed digital subscriber line
VDT: Video dialtone, video display terminal
VLSI: Very large scale integration
VOD: Video-on-demand
WDM: Wavelength division multiplexing
WWW: World Wide Web
XDS: Extended data system
xDSL: Any variant of the digital subscriber line technology CT

Ted Woo, Ph.D., is director of standards for the Society of Cable Telecommunications Engineers. He may be reached by e-mail at twoo@scte.org.

Continued from page 58

Let's say you do have the channel capacity. Let's also assume that you are carrying several 64-QAM digital channels from a service such as HITS. What happens when the subscriber tunes his 64-QAM set-top box to the 8-VSB broadcast channel? Will the set-top pass it through to the set? What about the subscriber's new digital TV that won't work as a cable-ready set because its tuner does fine with all 18 ATSC formats but not with our 64-QAM signals?

Instead of carrying the 8-VSB signal, why not change it to 64-QAM? You'll have to buy some low-cost headend transcoders that will convert it from one data format to the other. Just to muddy the waters, let's say the broadcaster is transmitting one HDTV signal. Once transcoded to 64-QAM, there will likely be a little room to perhaps multiplex one or more of our own signals into the 6 MHz bandwidth (remember, broadcasters get a little less than 20 Mbps in a fully "loaded" 8-VSB signal, while we can stuff 27 Mbps down the same bandwidth with 64-QAM). So why not use the remaining 7-plus Mbps equivalent for, say, CNN and a couple other channels?

The problem with this is that the broadcaster might transmit three or four standard definition signals during the day, and switch to HDTV during prime time. The transmitted data rate might be one that changes, depending on the time of day. This could be a bit tricky to manage in the headend if you were trying to get maximum usage out of each 6 MHz slot. For instance, you might be using 10:1 compression, and local broadcasters might use only 4:1 compression. You can bet there will be a slight loss of quality when you change the broadcaster's 4:1 signals to 10:1. How will broadcasters feel about that? Oh, yes, did I mention that the current generation of set-tops doesn't do 8-VSB? I don't think they do HDTV, either. This may change, but for now it's my understanding that most are designed for 64- and 256-QAM standard definition signals. The output of the box is good ol' NTSC. Unfortunately there are no easy answers to most of these questions, only more questions.

Doing it yourself

Broadcast DTV problems aside, what if you want to carry digital TV? There are a couple ways to do this: originate it locally, or pass-through from a satellite or other source. Locally originated digital TV requires expensive studio and playback facilities, and expensive headend digital compression equipment. Last time I priced compression equipment, it was going for about $50,000 per channel (40 channels would cost around $2 million, and this doesn't include studio and playback equipment), plus about $100,000 for a basic conditional access control system. While digital set-top box prices will come down, as of this writing they were in the $400 to $500 range.

Pass-through from satellite is probably the most cost-effective way for us to do digital TV, and will be for the foreseeable future. You'll receive already-compressed digital programming from a service such as HITS. You need to install headend transcoders to convert the satellite's QPSK digital signals to 64-QAM signals for carriage on the system. Expect to pay around $80,000 for the headend equipment to receive and convert 30 to 40 channels from a half-dozen transponders. That's a reasonable couple thousand per channel, comparable to the cost of many modulators or processors.

What next?

The DTV picture format is a little uncertain at this time, but I'll bet a progressive scan technique will win this battle. In some ways I pity the broadcast industry. They are being told by the government to change from NTSC to DTV, at an upgrade cost that will be exorbitant in many cases. I think the format differences will go away, because digital technology will easily allow TV sets, VCRs, and set-top boxes to handle just about anything we or broadcasters send down the pipe. There will be a lot of confusion in the interim, confusion that we hopefully will be able to deal with better than we did the cable-compatible/cable-ready TV and VCR problems of years past. CT

Ron Hranac is senior vice president, engineering for Coaxial International Inc. He is also senior technical editor for "Communications Technology" magazine. He can be reached via e-mail at rhranac@aol.com.

Laser Products

Ortel Corp. has unveiled two new items in its line of laser products for hybrid fiber/coax (HFC) networks: the 3640A/B/C Platinum Plus distributed feedback (DFB) transmitter board and the 1611A/B DFB Platinum laser module. The transmitter board allows drop-in upgrading and future customization in OEM product designs. It is available worldwide, in all standard frequency plans and channel holdings.

The 1611A/B DFB Platinum laser module can perform both broadcast and narrowcast applications with power output up to 16 mW. It is an OC-48 compatible pin out and highly linear laser.

Reader service #305

Text-Messaging System

Video Data Systems has introduced its MCM-96, a modular text-based messaging system capable of providing keyed text or billboard displays for up to 96 channels simultaneously. Designed specifically for the multichannel environments of the cable TV industry, this system is a cost-effective solution for a wide range of applications.

The company also has launched two new digital disk recorders (DDR). The VidDISC-100 and VidDISC-200 are designed as affordable VTR replacements while offering the full functionality and advanced capabilities of digital disk technology.

Also new from Video Data is a low-cost photo insertion system that allows users to create and automate playback of local commercials in small cable system operations, and its new VidSTAR Photo Imaging System, a low-cost photo imaging system based on the Video Data's VidSTAR text and graphics system.

Reader service #310

870 Mhz Pedestal Amplifier/Node

ANTEC Network Technologies, the manufacturing division of ANTEC Corp., has just introduced its pedestal amplifier/node, the latest product in ANTEC's family of headend to the home products. The amplifier/node product is designed for flexible mounting in otudoor enclosures where space is at a premium. It allows operators to meet their space limitations and reduce their installation costs. Features of the pedestal amplifier/node product include: multiple gain stages for high RF output, 870 Mhz bandwidth with programmable reverse switching, modular design allows for various product configurations, and simplified upgrade from RF amplifier to optical node.

Reader service #312

Video Server System

SeaChange International announced SPOT Pro, a low-priced video server system providing small- to medium-sized TV operators with the control and reliability of digitally encoded MPEG-2 (Moving Pictures Experts Group) programs and commercials. The software-based system outperforms tape decks and cart machines because it automatically records, stores and plays video material without expensive maintenance, labor-intensive operation, cumbersome tape libraries and degeneration of video quality. In addition, the company's movie system was selected by Four Media Co. for the delivery of multiple pay-per-view (PPV) movie channels via satellite. SeaChange also announced it has won Frost & Sullivan's "1997 Market Engineering Entrepreneurial Company Award" for world-class leadership and positive contributions to the U.S. video server market.

Reader service #306

750 MHz Decoder

Offering cable operators a set-top box that enables them to compete more effectively with direct broadcast satellite (DBS) competition, Zenith Electronics has announced its new 750 MHz "PM" analog set-top box. The new 750 MHz version of the company's phase modulation box is designed to increase the number of available channels that a cable operator can deliver to the home—from the current 84 channels to 116.

The increased bandwidth not only delivers added channel capacity, but also offers the Zenith PM systems its first audio scrambling option.

Reader service #309

Power Supply Management Agent

A power supply management agent (PSMA) has been developed by C-COR to assist cable operators who want to supplement their standby power supplies with an inexpensive and reliable management agent.

The PSMA allows operators to remotely cycle the batteries in a standby power supply and detect problems before they lead to an outage. The agent automatically alerts the C-COR cable network manager software to any problems without waiting to be polled.

Reader service #305

Integration Services

Toshiba America Information Systems' Multimedia Systems Division is providing complete integration services to cable and communication companies and large enterprises that need to deliver high-speed data/Internet access.

As an integrator, Toshiba brings to the market its Multimedia Cable Network System-based cable modems and termination systems coupled with complete headend systems that include reliable and powerful hardware and software from the industry's premier suppliers.

Reader service #308

Headend Monitoring Products

AM Communications has released three new monitoring products that support a wide range of cable TV headend and central office rack-mounted equipment, which must be locally and remotely monitored. The products include the telemetry applications module (TAM), serial applications module (SAM) and the binary applications module (BAM). The TAM is a rack-mounted transponder that is modular and configurable to address monitoring functions. The TAM consists of a communications control unit (CCU) and up to eight SAMs.

The SAM modules plug into the TAM CCU rack frame. Each SAM is preprogrammed to communicate with a specific type of OEM equipment. Alarm information is extracted from the return data by the SAM, signaled back to the TAM CCU and the OmniMCU. The BAM provides a solution to collect the various alarms generated by equipment, provides a local visual alarm system, and provides a means to communicate with a centrally located status monitoring system or alarming system.

Reader service #311

Return Multiplex Unit Series

Triple Crown Electronics has developed the RMU series return multiplex unit. The RMU stacks up to four separate return paths in a 5-270 MHz band, which can be sent back to the headend on a single fiber, when used with a special fiber mode.

The use of a second RMU will add four return paths in a 270-600 MHz band allowing an 8:1 consolidation of the fiber used for the relatively small bandwidth return path. This will allow cable operators to make better use of the wide bandwidth that fiber is capable of and reduce the fiber count wasted on the return path.

Reader service #307

Meet The Digital Detectives

Video's First Serial Digital Analyzing System That Captures Signals, Injects Test Errors & Helps Bridge The Gap.

Whether you are testing SDI transport path, verifying digital video protocol or performing quality assurance checks on program material, Leader's new "Digital Detectives" are a dynamic solution for meeting SDI testing needs. Designed to operate in today's "transition" environment where analog and digital are present, these advanced design instruments provide superior flexibility and ease of use for quick, painless transition from analog to digital. Yes, each "Digital Detective" is a stand-alone product, but...the sum is greater than the parts!

For example, the LT 5910 SDI Analyzer delivers every capability for routing path and protocol analysis. What's more, it acts as a signal source to permit deliberate introduction of digital video errors into the data stream in order to test your system's ability to identify and deal with errors. Error capture and an extensive set of alarms facilitate 24 hour monitoring. Simultaneously, error capture permits detailed troubleshooting of intermittent faults.

Monitoring actual video signals is the job of the versatile LV 5100D. It has 2 serial and one analog (3-wire) inputs and works well in multi-format environments. Extensive cursors and data readouts facilitate quick, error-free analysis using familiar analog displays to ease the transistion to digital. The LT 425D generates all the signals and test patterns needed to become a precise master source for digital component reference and signal testing. Multiple SDI and analog black outputs simplify use with multi-formats. Compression test patterns include provisions for future test needs, while the built-in AES/EBU (separate and embedded) satisfies audio test requirements.

For a close-up look at the "Digital Detectives," or for further details, call Leader's system integration specialists...

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

- *BCT/E Certification: An Overview of Technical Certification and Related Category Examinations*—This presentation, featuring Marvin Nelson and Leslie Read, is geared toward candidates in the Broadband Communications Technician/Engineer Program and those entering the program. (70 min.) Order # T-1115, $45.
- *Customer Service: Doing the Job Right the First Time*—Connie Buffalo, Ralph Haimowitz and Willis Smith draw upon data from a nationwide survey to provide valuable insight into how customer-oriented training for technical personnel can greatly improve relations with your subscribers. (70 min.) Order #T-1116, $45.
- *EBS and the Cable Industry*—Frank Lucia, Helena Mitchell and Kenneth Wright provide an understanding of the current and future demands upon the Emergency Broadcast System, and why cable TV will become such a critical part of EBS. (60 min.) Order #T-1117, $35.
- *How Will the New NEC, NESC and OSHA Regulations Impact Your System?* Featuring James Kearney and Roger Keith, this tape covers NESC requirements such as clearances both on the pole and midspan. (75 min.) Order #T-1118, $45.
- *Outage Reduction Techniques*—Scott Bachman and Robert Moel provide point-by-point discussion of the findings of the CableLabs Outage Task Force. (65 min.) Order #T-1119, $45.
- *Standards Deviations*—The FCC's Michael Lance and John Wong provides a current update on the status of CLI filings and a paragraph-by-paragraph discussion of the new FCC regulations. (1 hr.) Order #T-1120, $35.
- *The Basics of Telephone*—Noted author Bill Grant provides an understanding of U.S. telephone technology. (80 min.) Order #T-1136, $18. CT

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

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

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CALENDAR

February

11: SCTE Delaware Valley Chapter technical seminar, "Competitive Access and Business Meeting," Horsham, PA. Contact Chuck Tolton, (215) 961-3882.

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

18: SCTE Central California Chapter technical seminar, "CLI" and "Fiber Optics Basics," Merced, CA. Contact Raul Esquivel, (209) 384-1316.

18: SCTE Ozark Mountain Chapter technical seminar, Springdale, AR. Contact Mike Franke, (918) 456-1102.

19: SCTE New England Chapter, testing session, BCT/E and Installer certification exams to be administered, Boxborough, MA. Contact (413) 562-9923.

26: SCTE Northern New England Chapter technical seminar, "Power, Grounding and Bonding," Portland, ME. Contact Bruce Bolger, (207) 967-5212.

March

1: Institute of Electrical and Electronic Engineers call for papers. Contact(609) 639-3116 or e-mail: heutmaker@lucent.com.

4-6: Global TMN Summit '98 and Vendor Showcase, sponsored by Vertel and HP OpenView Telecom, Orlando, FL. Contact www.vertel.com or www.hp.com/go/ovtelcom.

12: Society of Cable Telecommunications Engineers Satellite Tele-seminar Program, "Introduction to Digital Technology (Part Two) and "Preparing for Digital Deployment (Part One)," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

17: SCTE North Country Chapter Vendor Show and Cable-Tec Games, Minneapolis, MN. Contact Dan Shea, (612) 572-9290.

19: SCTE Dakota Territories Chapter, "Construction and OSHA," Jamestown, ND. Contact Tony Gauer, (605) 426-6140. CT

Planning Ahead

April 27-29: Internet & Electronic Commerce & Exposition, sponsored by the Gartner Group Inc. and Advanstar Communications Inc. Contact (203) 256-4700.

May 12-14: Pacific Equipment & Technology Expo, Orlando, FL. Contact Robert Morock, (800) 525-7383.

June 7-9: Consumer Electronics Manufacturers Association's CES Habitech '98, Atlanta, GA.

June 10-13: SCTE Cable-Tec Expo, Denver. Contact (610) 363-6888.

September 13-16: ICSPAT & DSP World Expo '98, Toronto, Ontario, Canada. Contact Liz Austin, (415) 538-3848.

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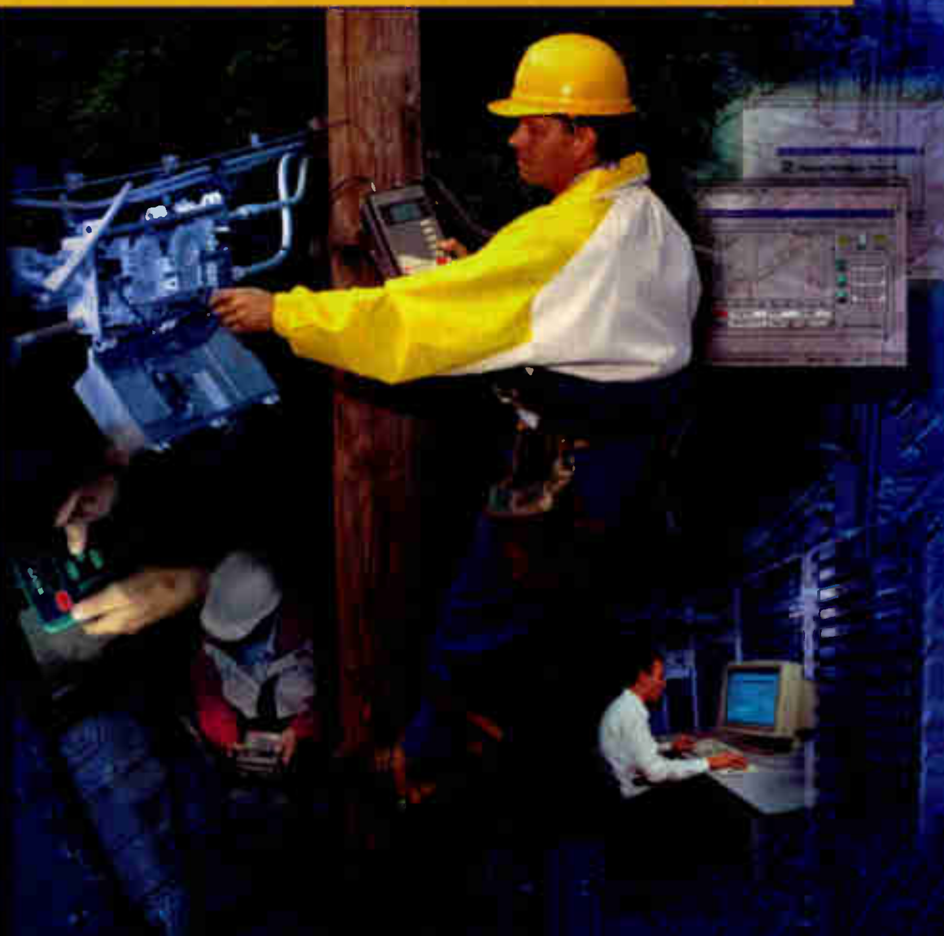

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VENDOR CONNECTION

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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26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Telecommunications Engineers)?

01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):

Cable TV Systems Operations

03. ___ Independent Cable TV Syst.
04. ___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MMDS, STV or LPTV Operator
09. ___ Microwave
10. ___ Telecommunications Carrier
11. ___ Electric Utility
12. ___ Satellite Manufacturer
13. ___ Satellite Distributor/Dealer
14. ___ Fiber Optic Manufacturer
15. ___ Data Network
16. ___ Commercial TV Broadcaster
17. ___ Cable TV Component Manufacturer
18. ___ Cable TV Investor
19. ___ Financial Institution, Broker, Consultant
20. ___ Law Firms or Gov't Agencies
21. ___ Program Producer or Distributor & Syndicators
22. ___ Advertising Agencies
23. ___ Educational TV Stations, Schools and Libraries
24. ___ Other (please specify)________

C. Please check the category that best describes your job title:

Technical/Engineering

25. ___ Vice President
26. ___ Director
27. ___ Manager
28. ___ Engineer
29. ___ Technician
30. ___ Installer
31. ___ Corporate Management (Chairman, Owners, Presidents, Partners, Executive/Senior Vice Presidents and Treasurers)
32. ___ Management (Vice Presidents, General Managers, Systems Managers & Directors)
33. ___ Programming (Vice Presidents & Directors and Managers & Producers)
34. ___ Sales (Vice Presidents, Directors & Managers and Sales Representatives)
35. ___ Marketing (Vice Presidents, Directors & Managers and Sales Representatives)
36. ___ Other (Company Copies & Other Titles & Non-Titled Personnel, please specify)________

D. In the next 12 months, what cable equipment do you plan to buy?

37. ___ Amplifiers
38. ___ Antennas
39. ___ CATV Passive Equipment including Coaxial Cable
40. ___ Cable Tools
41. ___ CAD Software, Mapping
42. ___ Commercial Insertion/Character Generator
43. ___ Compression/Digital Equip.
44. ___ Computer Equipment
45. ___ Connectors/Splitters
46. ___ Fleet Management
47. ___ Headend Equipment
48. ___ Transmission/Switching Equipment
49. ___ Networking Equipment
50. ___ Vaults/Pedestals
51. ___ MMDS Transmission Equipment
52. ___ Microwave Equipment
53. ___ Receivers and Modulators
54. ___ Cable Modems
55. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
56. ___ Telephone/PCS Equipment
57. ___ Power Suppls. (Batteries, etc.)
58. ___ Video Servers

E. What is your annual cable equipment expenditure?

59. ___ up to $50,000
60. ___ $50,001 to $100,000
61. ___ $100,001 to $250,000+

F. In the next 12 months, what fiber-optic equipment do you plan to buy?

62. ___ Fiber-Optic Amplifiers
63. ___ Fiber-Optic Connectors
64. ___ Fiber-Optic Couplers/Splitters
65. ___ Fiber-Optic Splicers
66. ___ Fiber-Optic Transmitter/Receiver
67. ___ Fiber-Optic Patchcords/Pigtails
68. ___ Fiber-Optic Components
69. ___ Fiber-Optic Cable
70. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditure?

71. ___ up to $50,000
72. ___ $50,001 to $100,000
73. ___ $100,001 to $250,000+

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?

74. ___ Audio Test Equipment
75. ___ Cable Fault Locators
76. ___ Fiber Optics Test Equipment
77. ___ Leakage Detection
78. ___ OTDRs
79. ___ Signal Level Meters
80. ___ Spectrum Analyzers
81. ___ Status Monitoring
82. ___ System Bench Sweep
83. ___ TDRs

I. What is your annual cable test and measurement equipment expenditure?

84. ___ up to $50,000
85. ___ $50,001 to $100,000
86. ___ $100,001 to $250,000
87. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?

88. ___ Contracting Services (Construction/Installation)
89. ___ Repair Services
90. ___ Technical Services/ Eng. Design

K. What is your annual cable services expenditure?

91. ___ up to $50,000
92. ___ $50,001 to $100,000
93. ___ $100,001 to $250,000
94. ___ over $250,000

L. Do you plan to rebuild/ upgrade your system in:

95. ___ 1 year
96. ___ more than 2 years

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

97. ___ up to10 miles
98. ___ 11-30 miles
99. ___ 31 miles or more

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CABLE TRIVIA

Our historical guru (aka Editor Rex Porter) has provided these trivia questions on the cable industry. Answers to the last set of questions appear first. (The last "Cable Trivia" ran on page 152 of the December issue.) The person supplying the most correct answers will be awarded a special Trivia T-shirt. You may only win once per calendar year.

To be in the running for a prize, your answers need to be postmarked or faxed to us by the 20th of the month of the issue date that the specific trivia test appears in. Good luck! Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 6565 E. Preston, Mesa, AZ 85215 or fax: (602) 807-8319.

Trivia #20 answers

1) A graduate of Iowa State University with a BSEE, he began his career in radar and radar countermeasures. His experience spanned years of broadcast with major stations across the nation. He was Society of Cable Telecommunications Engineer Member of the Year and received the National Cable Television Association Outstanding Achievement Award in 1979. An SCTE Fellow, and a member of the Institute of Electrical and Electronic Engineers and Society of Motion Picture and Television Engineers. Awarded U.S. patents #2,457,222 for an electron sawtooth oscillator and #2,449,801 for an oscillograph apparatus, his name: Frank Bias

2) Founder of her own company in 1980, she graduated magna cum laude from the University of Colorado with a B.S. in business. She was awarded the Women In Cable Award for Woman Entrepreneur in 1985, was elevated to senior member of the SCTE in 1981 and named Member of The Year in 1986. She is: Sally Kinsman

3) The author of a new book on satellites published by the NCTI, he is a regional director of the SCTE. Broadband Communications Technician/Engineer (BCT/E) certified, he holds a senior broadcast engineer-TV endorsement and is a senior certified electronics technician. He is listed in *Who's Who in Science & Engineering*. He is: Jim Kuhns

4) Although its name has been changed from the original, this was the first SCTE chapter. In fact, for a while, I had to belong to this Chapter as a charter member, since there was no chapter anywhere else. It is: The Appalachian Mid-Atlantic Chapter

5) The first issue of *DigiPoints* was printed in the SCTE newsletter, the *Interval*, in: December 1996

6) Scientific-Atlanta introduced its Model 6400 series broadband data modem as the first in a series of business products in: 1982

7) Jerrold's Ken Simmons designed the first 20-channel electromechanical prototype converter for the National Cable Television Association show in: 1967

8) ANTEC (then known as Anixter) introduced Raychem's unique F-connector, "EZF" at the National Cable Show in Las Vegas in: 1985

9) Riser-Bond's original name was: Avtek

10) The terms; "fairing jettison," "delta cutoff," "energize flywheel" and "operational" are: Various stages of a satellite launch from liftoff to orbit

11) The Drop Shop marketed a security device to prevent ladders from falling left or right due to weight shifts or strong wind. They called these: Gzontas

Triva #21

1) Today, we immediately recognize the acronym "EAS" to mean Emergency Alert System. In the early '80s, this company provided an addressable subscriber system, composed of three units; a microprocessor control (EAS-1024), a decode (EAS-64) and a multitap switch assembly (EAS-16):

A) Ameco
B) Sadelco
C) Electroline
D) Comsonics

2) Resigning his position as Federal Communications Commission Commissioner in January 1965, he became president of the National Cable Telecommunication Association. He was:

A) Jim Mooney
B) Fred Ford
C) Ken Cox
D) Dean Burch

3) A gin-pole is used to:

A) construct a tower
B) clean sections of a tuner
C) hang cable
D) check trench depths

4) A Canadian made antenna that found use in the U.S. for long distance, wide-azimuth VHF TV reception was called:

A) Sterba Curtain
B) Parabolic Torus
C) Terminated Rhombic
D) Beverage

5) Rack-mounted, plug-in modular headend equipment was introduced by:

A) Jerrold
B) S/A
C) CAS
D) Ameco

6) U.S. TV broadcasting was debuted by:

A) GE at Schenectady, NY in 1928
B) Farnsworth Corp. in 1936
C) CBS at New York City in 1946
D) RCA at the New York Worlds Fair in 1939

7) The man who was editor/publisher of *Cablecasting/Cable TV Engineering* directed the actions of the engineers who formed the SCTE. He is:

A) Robert Bilodeau
B) Ron Cotton
C) Charles Tepfer
D) Cliff Paul

8) Because there was no scholarship program available from the SCTE. He personally donated $2,500 in 1986 and the NCTI agreed to match his donation, dollar for dollar. He is:

A) Rex Porter
B) Earl Quam
C) Richard Ashpole
D) Dave Willis

And the winner is...

At press time, there was no winner for Cable Trivia #20 (which ran in the December issue). The winner will be announced in an upcoming issue. CT

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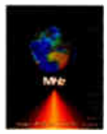

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Product and Data Showcase

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The Adjustable Sno-Shoe from Multilink Inc., eliminates the need for figure eighting and when used with the available extensions, larger amounts of fiber can be stored at one time. Also available in four different mounting styles, strand mount, wall mounts, and either vertical or horizontal on the pole. The plastic design of the Sno-Shoe allows for a non-conductive part and comes with a 20 year pro-rated warranty!

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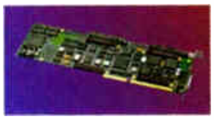

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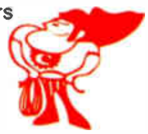

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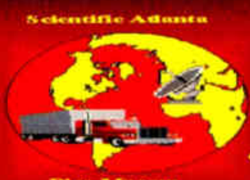

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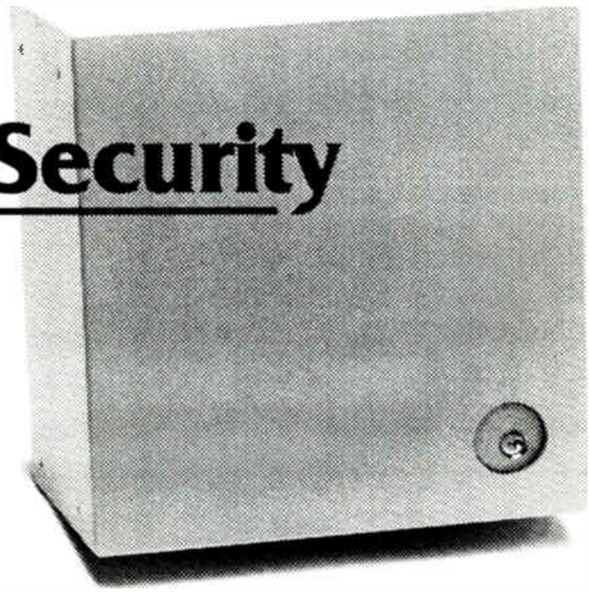

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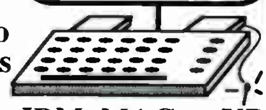

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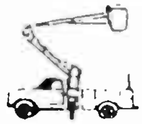

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Troubleshooting the Drop System: Part 6

This month's installment continues the series on troubleshooting directional couplers. The material is adapted from NCTI's Installer Technician Course, complemented by performance training suggestions to reinforce the material in a hands-on classroom setting. © NCTI.

In many cases, if only one of a customer's TV sets is affected, the trouble may be at the directional coupler that feeds that TV set. The DC may be installed backwards. Low or high RF signal levels at a particular TV set might indicate an incorrect directional coupler value or improper cable connections at the DC. Figure 1 shows normal signal levels for a properly cabled directional coupler. Figures 2 and 3 show two ways that a DC can be incorrectly installed and the corresponding effects on the RF levels.

Internal defects

A directional coupler with internal problems (e.g., from a manufacturing defect, corrosion, water migration or a lightning strike) can exhibit the same low RF signal levels as a DC that is hooked up incorrectly or even a total loss of RF signal.

To measure tap loss, disconnect the input cable from the directional coupler and connect it to the RF input of an SLM. Measure and record the RF signal level at a reference channel. Disconnect the input from the SLM and reconnect it to the input port of the DC. Disconnect the tap port cable and connect a coaxial jumper between the tap port and the SLM RF input (as shown in Figure 1). Measure and record the reference channel's signal level.

To calculate the tap loss, subtract the measured tap port level from the input level to determine the tap loss. If the calculated tap loss exceeds the manufacturer-specified tap loss, replace the directional coupler and then repeat the measurements and calculations to verify proper operation.

Next month's installment will continue this series on troubleshooting directional couplers.

Hands-on performance training

Proficiency objective: Troubleshoot directional couplers to determine if they are cabled correctly or have internal defects.

Ensure that you have enough work stations feeding broadband cable signals to pre-installed directional couplers that are used in your system. Use different value DCs and have some incorrectly cabled and/or with known internal defects. Provide students with the manufacturer specs for the DCs used.

Demonstrate performing measurements and calculations to determine if the DC is cabled correctly or has an internal defect.

Have students practice procedures at several/all of the work stations.

Verify that each student can correctly perform measurements and calculations to determine if a DC is cabled correctly or has an internal defect. CT

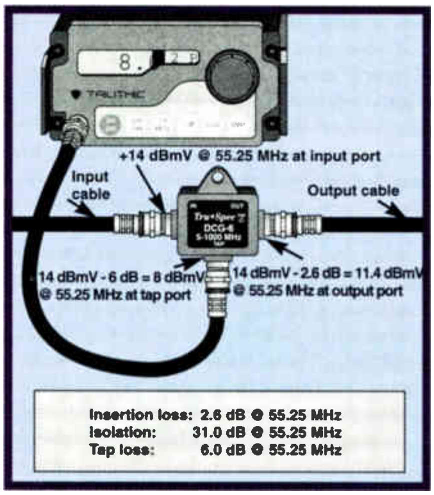

Fig. 1
Normal levels for DC-6 with correct cable connections

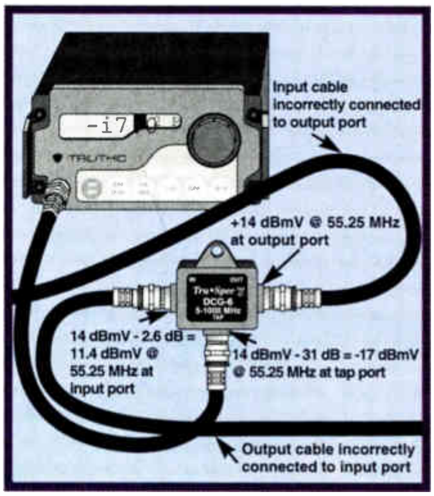

Fig. 2
Abnormal reading at tap leg because input cable is incorrectly connected to output port

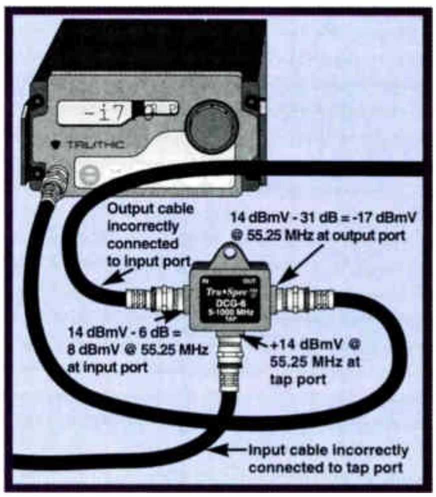

Fig. 3
Abnormal reading at output port because input cable is incorrectly connected to tap port

By Bill Riker

Taking Charge of Your Future

It's 1998: Do you know where your industry is headed? Even as you read these words, technological changes are happening faster than you can say "broadband." Turn on the TV or pick up a major newspaper — telecommunications is a very hot issue in the world today.

Now, the question on everyone's mind is, "What's next?" The Society of Cable Telecommunications Engineers, too, is changing with the times—from our technical training offerings to our ability to meet members' needs. You may have already heard about our latest in-house training program, "Cable 101," in which we offer nontechnical personnel a technical overview of the industry. This is an exciting project that we are looking forward to delivering across the United States this year.

But while this new offering will require financial and manpower investments by the Society in the next 12 months, we're also developing a lineup of other exciting new projects. Members can now look forward to leader guides and workbooks that will enhance our in-house training programs, continued progress in our standards development efforts and the addition of several valuable publications to our growing list of educational materials. And, of course, this year's Cable-Tec Expo in Denver will address some of the most progressive topics and challenges facing this industry.

Our members have the opportunity to make another major change in your Society and your industry as a whole. By now you all should have received your 1998 election packages in the mail. With the arrival of this package comes the responsibility to select new board members for one of the broadband industry's most significant organizations.

As you read through the biographies and comments from the 21 qualified individuals who are running for board positions, realize that the choices you make today can, and will, affect our future. We are especially pleased to have a wide variety of backgrounds represented by the 1998 election participants. From electronics to standards development to missile construction, this year's candidates are as diverse as the members they hope to represent.

"This year's Cable-Tec Expo in Denver will address some of the most progressive topics and challenges facing this industry."

If you haven't taken the time to look through the election package, set aside a few moments now to become better acquainted with the individuals who are running in your region and for the at-large director position. Read through the summary at the beginning of the election booklet to familiarize yourself with the Society's voting procedures. Then, ask yourself two questions: 1) Am I satisfied with the way SCTE represents me and my ideas in this changing technological environment?, and 2) How does SCTE affect me personally?

The election package offers two opportunities to possibly change the way you have just answered these questions. First, you have the chance to vote for an individual who stands for your own concerns and who will work to make SCTE your Society. For example, if one of your primary professional interests is data transmission, you may want to select a candidate who has been active in pursuing standards development in this area. Or, if you feel that your region needs to generate additional technical training opportunities through the establishment of more local Chapters, choose someone who will utilize their resources to make that happen. Quite simply, your vote is your voice.

I cannot stress enough the importance of making that voice heard. With the exception of our annual membership survey, these elections provide you with an exclusive opportunity to help keep the broadband industry in sync with these changing times. In the past, we have seen a decline in the number of members who take the time to vote. Although last year's return was up by 5%, those numbers still only represented less than one-fourth of the total eligible voting members. We would like to see more of you participate in this process in 1998 because we as a changing organization want to see our members' needs being met.

Your second opportunity to influence the Society's growth will be in completing the bylaw referendum enclosed in the election package. Here you will find a simple "yes/no" vote on some of the changes we are proposing to make within SCTE's national bylaws. The suggested changes will help bring the language and meaning of this important document up-to-date.

I encourage all of you to participate in what I consider to be one of the most influential Society events of the year. Take the time to vote today, and when the new directors take their seats at Cable-Tec Expo in June, SCTE will present an even stronger, united front to the industry. CT

Bill Riker is president of the Society of Cable Telecommunications Engineers.