COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Telecommunications Engineers

Continental Cablevision: 1996 Service in Technology Award winner

Competition and reliability: Industry newsmakers speak

Eight tips for headend troubleshooting

June 1996

Continental

Reader Service Number 44

First, however, Hundt provided a mock annual report of the FCC's "earnings" as a result of spectrum auctions for telecommunications. "Our revenues have increased from $200 million in 1993 to $11.4 billion in 1996," he said, "an increase in earnings per shareholder" up from 15 cents to $45.23 dollars—remarks that incited raucous laughter.

How does the FCC assess its ability to write the new rules of competition? Hundt said the Commission has had "very little time in which to issue the rules." Likewise, he added, the FCC must "come to grips with the fundamental issue of whether the country should have a set of uniform, national, specific rules or have 50 different statewide versions of telephone competition." Hundt said this issue must be decided by August.

Hundt urged cable operators not to yield to telephone companies in providing American schools access to the Internet: "With the introduction of the two-way modem, cable now has as good or better claim on the right to bring our children into the 21st century of learning."

While Hundt's remarks drew a standing ovation from the audience, not everyone was enamored of The Teflon Chairman. BET CEO Bob Johnson, who was unable to attend the speech, commented with surprise, "Reed was good? On *cable*?" Bill Cologie, president of the Pennsylvania Cable TV Association, said, "He messed with our bread and butter (rates), and now we have it back."

Following his address, Hundt left for the show floor, where he spoke from the Vyvx booth to a school in Chula Vista, CA, wired by Cox Communications.

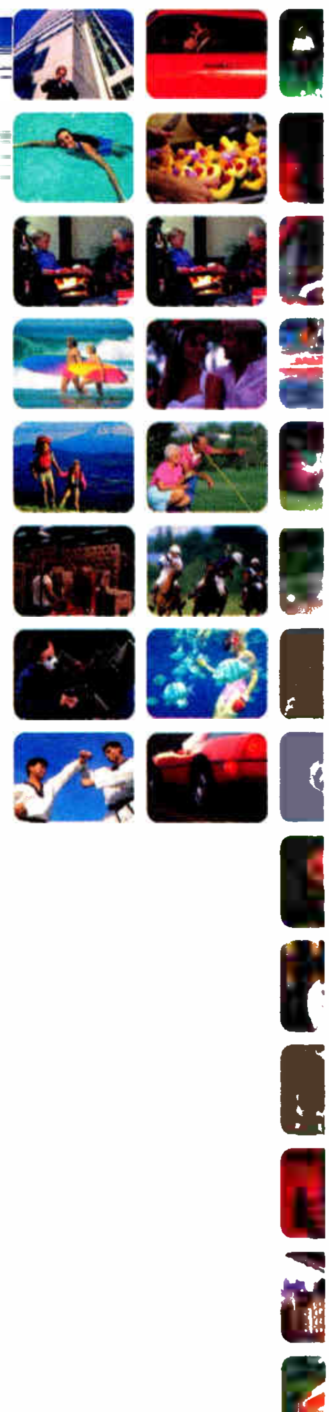
Think globally, act locally

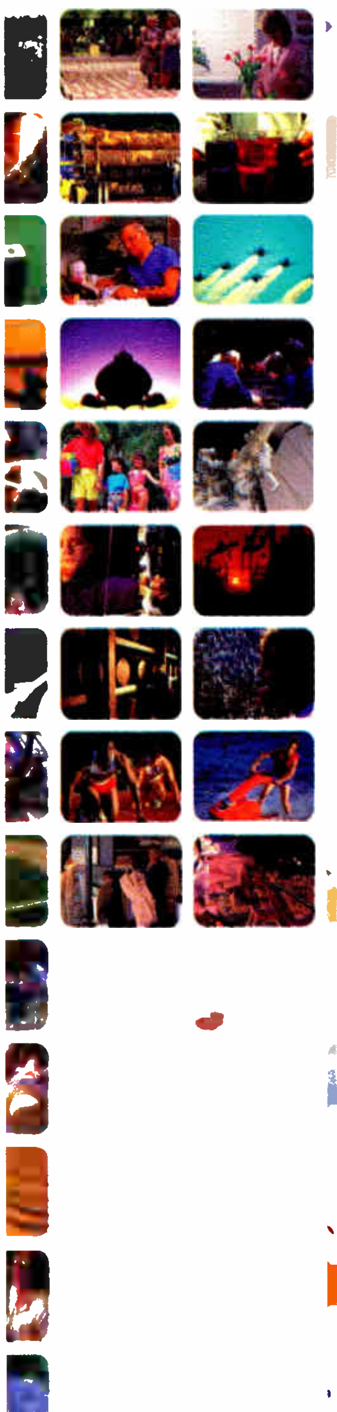
Panelists told early arriving attendees the cable industry must return to its roots by offering consumers niche services unique to cable TV. While DBS operators expect to capture a 10% share of the video marketplace by the year 2000, they lack one key ingredient: localism. It's here, said panelists, that cable can thrive in the future.

Addressing technological concerns, CableLabs President Richard Green called 1995 the year of the cable modem, driven in large part by the success of the Internet: "We had planned on this developing as a product, but the Internet has pushed it earlier than we expected."

The future keys to developing this product, he added, are reliability, the return path and creating standards so modems can be sold as a package with computers. Green noted the work on modems will be completed in three phases: the first set of interface requirements have been completed; the next phase will finish in the second quarter; and the whole process will be completed and field tested by year's end.

Other key issues, said Green, are telephony and digital compression. As for compression, Green said CableLabs is in the process of finishing up an eight-month study on encoders and decoders. Several announcements made at the show claimed that the products meet MPEG-2 standards. Satisfying his "look-ahead" requirements for the session, Green said the next 10 years will see the advent of high-quality theater-grade programming, the continuation of traditional TV, and browsing-style TV. **CT**





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Reader Service Number 15

All smiles in The City of Angels

Prior to the Telecommunications Act, who would have thought that FCC Chairman Reed Hundt could make a cable crowd laugh, much less give him a standing ovation? Who would have predicted an opening session speech by Vice President Al Gore lauding cable's good corporate citizenship? The previously unimaginable was the modus operandi at Cable '96.

Amidst all the good cheer, NCTA President Decker Anstrom warned the industry not to repeat the mistake it made in the wake of the Cable Act of 1984: failing to build upon relationships with public officials and the community. While cable's On-Time Guarantee customer service campaign is polishing its bespotted image, the fact is that customers still portray cable service as "seriously lacking." But that will all change in the near future, said Comcast President Brian Roberts, as cable continues its fiber deployment, which increased 20% over the last year compared to the telcos' modest 3.5% fiber increase.

Evidence of a brighter future lies in the cable modem's high-speed Internet access, which will play an integral part in cable's educational efforts, as highlighted at the opening session by Discovery Communications CEO John Hendricks, and by the FCC's Reed Hundt, who spoke to students at a cable-wired school from the showroom floor.

Data over cable

Addressing the race to deliver data over cable networks, one technical session asked, "Why wait for connectivity?" Moderated by Dan Pike, senior vice president of science and technology, Prime Cable, the speakers covered the gamut of high-speed Internet access and data delivery options.

Esteban Sandino, PC services manager for Rogers Cablesystems, offered tips on managing the high-speed CATV data network, followed by Scientific-Atlanta Senior Staff Engineer Frank Koperda, who covered cable modem protocols. Koperda suggested keeping the old protocols when possible and adapting them to a new model while using emerging standards.

Com21 Chief Architect Mark Laubach introduced his presentation as "intentionally controversial," and covered what he termed "quality of service" differences for each service. In the broadband race to the home, the answer to simultaneously delivering multiple services is ATM, said Laubach. But ATM to the home does not necessarily mean ATM in the home, he cautioned. Using a seven-year financial model, Laubach showed multi-tier delivery at a substantial profit, while single-tier showed a loss. "I'm just the technical guy," he said, don't shoot the messenger.

Terayon Corp. President Shlomo Rakib presented synchronous CDMA as the solution for high-speed data over cable, citing its high capacity, robustness, scalability and delivery of multiple services over all-coax networks.

Terry Wright, chief technical officer of Convergence Systems Inc., wrapped up the session with a discussion on an ATM architecture he said would allow 125-home packets vs. many thousands. All ATM segments use the same high-quality spectrum, which is especially important for the return path, Wright said, and urged attendees to think beyond cable modems and anticipate future technologies.

Can cable make the call?

At the "Cable Telephony: Design and Delivery" technical session moderated by TV/COM's Bob Luff, Scientific-Atlanta Staff Engineer Bouchung Lin weighed the strengths of FDMA and TDMA access methods for delivering telephony over hybrid fiber/coax networks. Lin concluded that FDMA is superior in efficiently using the limited RF resource and is easier to use in isolating noisy spots.

Doug Hohulin, business development manager with Motorola, discussed T-1 transport of conventional PCS, lauding cable's 95% of homes passed as a tremendous base plant.

CT Editor and Cable Pioneer (Class of '77) Rex Porter (left) and Paul Maxwell (right), publisher and Cable Pioneer (Class of '89), welcome Paul Levine, CT's senior publisher into the Pioneers Club. Eighteen new members were inducted into the Pioneers at a black-tie dinner celebrating its 30th anniversary, held at Cable '96.

Hohulin detailed macro cell, micro cell and RAD cell technologies, and stressed that they can be used together and need not be mutually exclusive.

Bell Atlantic Vice President of Network Technologies Patrick White rounded out the session with a discussion on traffic requirements for cable's potential broadband services (telephony, data, video and multimedia) and outlined delivery requirements for each.

Standing ovation for ... Reed Hundt?

Continuing the cable love-fest initiated by Vice President Al Gore on Monday, FCC Chairman Reed Hundt hosted a veritable comedy extravaganza before a packed breakfast crowd, including a video presentation poking fun at the corporate successes the FCC's spectrum auctions have enabled.

The presentation was not all levity, however, as Hundt explained the FCC's concerns in implementing the recently adopted Telecommunications Act of 1996. He also exhorted cable operators to take a leadership position in accomplishing President Clinton's goal of bringing America's schoolchildren into the era of Internet communications. →

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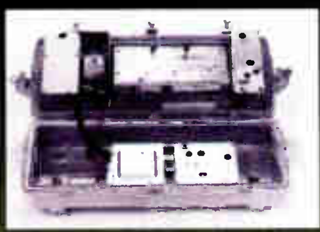

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trunking or high-quality videoconferencing. There's nothing to say, however, that PRI could not be used in residential applications with a broadband media to the home. (Could this be another use of the cable data channel?)

"Services" is the next word in ISDN. This technology was developed with user applications in mind. ISDN provides the capability for multiple, simultaneous sessions of voice, data and even video over one access interface. End users perceive their access interface to be one "line" into the home or business that can simultaneously establish a voice conversation, view the subject of the conversation, and manipulate PC data pertinent to that subject. An example might be an engineer developing a prototype of a new outboard motor. The engineer working at home could call an assistant at the corporate research lab. The assistant might point a video camera at the first working model of the motor in the lab. That video image could be transmitted back to the engineer over the same ISDN access interface as the voice conversation. The engineer might then continue a conversation with the assistant, view the working model, and simultaneously access a spreadsheet over the remaining ISDN channel for model parameters stored in the lab computer.

Of course, this application could have been done with a combination of telephone lines and one or more cable modems connected to one or more cable data channels. The video quality might have been better because of greater available bandwidth, but the ISDN solution neatly packages all the required components into one system.

Now, consider the "digital" in ISDN. This one is self-explanatory. Well, maybe. It is correct that digital information has been transmitted from personal computers over phone lines for years. The difference is that with an analog line, we need to modulate an analog signal with digital information, while with an ISDN line, pure digital pulses go out over the B or D channel. (The signal on the analog line may contain digital information, but it's really an analog waveform.) Since the ISDN signal is truly a set of digital pulses, the ISDN card in the computer that interfaces to the line is not a modem (modulator/demodulator). The signal is digital all the way from the computer into the central office switch. What this means is that there is potentially less problem with noise on the line.

Finally, ISDN contains the word "network." ISDN is being implemented both nationally and internationally. End-to-end digital solutions are being actively marketed by the telephone companies and are operational in the field. Digital telecommunications switches manufactured by multiple vendors support those applications with standard ISDN interfaces. Customer premise equipment, from digital voice station sets to computer cards, are widely available, and prices are coming down. In short, there's an installed base of equipment and its users that won't go away, and is in fact supported by vendors and service providers. If the cable telecommunications industry wants access to that market, it will have to be compatible with it. **CT**

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Reader Service Number 47

By Justin J. Junkus

ISDN isn't "I still don't know"

In recent issues, this column has discussed digital concepts in the world of telecommunications. In March, you may recall, we touched on how the signals used to set up and monitor telephone calls are now digital. In April, we discussed how digital and data communications relate to each other. Now, it seems appropriate to look at integrated services digital network (ISDN), the telecommunications industry's first attempt to bring digital technology to the local loop.

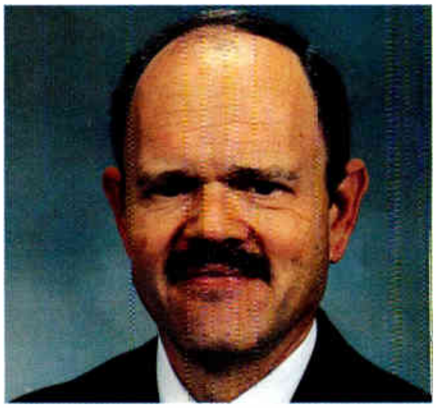
Why discuss a technology with only 144 kbps of bandwidth when the newest cable data offerings will be offering megabits of bandwidth? There are lots of reasons, but the chief one is that ISDN is not going to die, even when the majority of MSOs offer data channels to consumers. ISDN is not a competitor. It is a partner.

Justin Junkus has over 25 years experience in the telecommunications industry. Previously the AT&T cable TV market manager for the 5ESS switch, he is currently president of KnowledgeLink Inc., a telecommunications training and consulting firm. He can be contacted for comments or questions via e-mail at JJunkus@aol.com.

ISDN technology

ISDN — the name says a lot about the technology. First, consider the "I," which stands for "integrated." With digital technology, the distinction between voice information and data information on a line becomes blurred. If voice and data are both coded into 1s and 0s, why not handle both from the same physical terminal? That's exactly what happens with ISDN. ISDN telephone sets have serial port interfaces to connect with a corresponding port on a computer. In addition, computer cards and software are available to make your desktop PC an ISDN telephone (with the appropriate voice interface).

Another facet of ISDN integration is the multiple sessions that are possible over one telecommunications access interface. An access interface is the connection to the public switched telephone network. A session is a voice conversation or data transfer from the physical set of wires going to the public switched network. With traditional analog access, the two-wire subscriber loop is the access interface. One telephone line is available per



analog access interface. ISDN changes this limitation. For the basic rate interface (BRI), three channels are available on one access interface. Two of them are called B channels. These each provide 64 kbps of bandwidth and typically are used for voice calls. The other channel is a D channel, with 16 kbps of bandwidth, and is used for equipment control or packet data.

There is another ISDN access interface called primary rate or PRI. This interface requires a T-1 line to the subscriber and provides for 24 simultaneous 64 kbps channels of information. For the most part, PRI is currently used by business applications, such as PBX to central office

at first glance. I call it the value of customer goodwill.

Having dedicated full-time PM staff performing an effective PM program means that the number of service calls will continue on a downward trend. System reliability will improve, as will picture quality. Better system, happier subscribers. Happier subscribers, less churn.

Churn

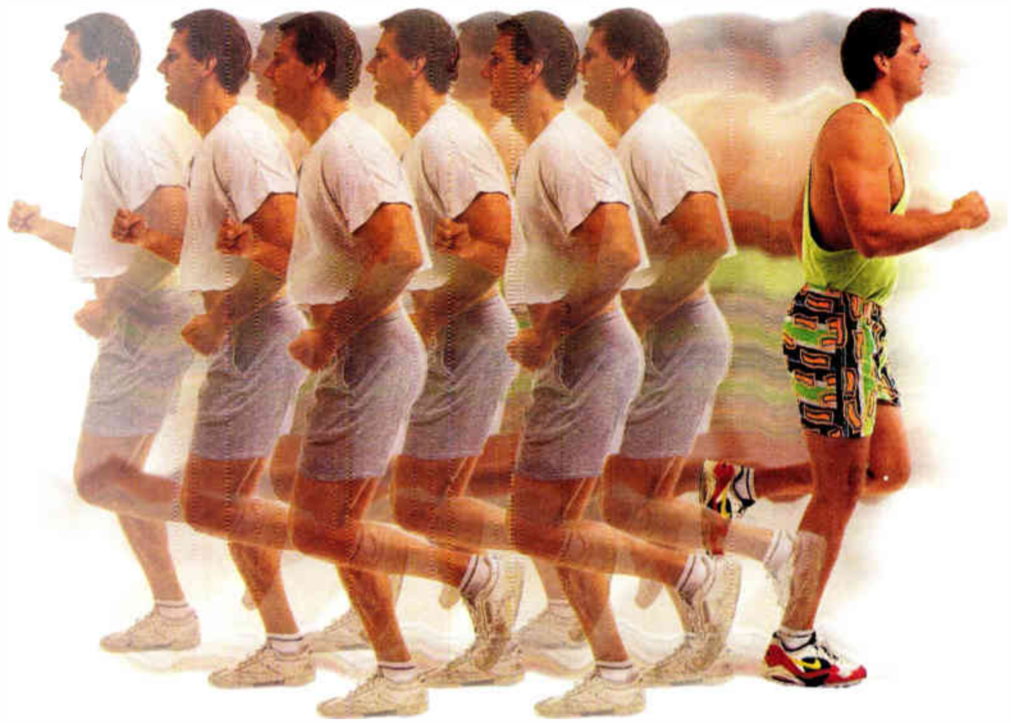
That takes us to the next point, the cost of churn. To get a little background on this, I spoke with some colleagues from the operations and marketing side of the business. Consider the value of a subscriber, both from a capital perspective—what the subscriber is worth when the system is sold—and a gross revenue perspective. For the former, let's use $2,000. For the latter, $30 per month over a subscriber life of five to seven years (this may vary depending on how your company calculates subscriber life) works out to between $1,800 and $2,520 in gross revenue. As you can see, each subscriber is worth quite a lot.

Churn can be broken down into controllable and noncontrollable. Noncontrollable churn, which averages about 15% per year, is mostly attributable to subscribers who move. The actual figure will vary from market to market, but in our hypothetical system, 15% is 3,000 subscribers per year. Controllable churn—nonpay disconnects, dissatisfied subscribers, etc.—can comprise an additional 15% to 25%, or, in the case of our hypothetical system, between 3,000 and 5,000 subscribers per year. Here, too, the actual figure will vary from market to market. I'm going to be conservative and assume that our hypothetical system has an annual controllable churn of 10%, or 2,000 subscribers per year. What happens if we can reduce that to 9.7%?

If our service call reduction efforts prevent just five subscribers from disconnecting each month, we save the company $10,000 in capital value, $1,800 in annual revenue, and between $9,000 and $12,600 in subscriber life revenue for those same five subscribers. Over the course of a year, the 60 subscribers saved are worth $120,000 in capital value, $21,600 in annual revenue, and $108,000 to $151,200 in subscriber life revenue.

While you may or may not agree with some of the specific figures I've used here, the philosophy is what counts. Plug in your own numbers. It's obvious to me that customer goodwill has a definite dollar value. If some of that customer goodwill is the result of improved service due to PM and a corresponding reduction in service calls, then those maintenance efforts become pretty much self-funding.

In the past, many disgruntled subscribers who disconnected eventually came back. In today's environment, with multichannel multipoint distribution service (MMDS), direct broadcast satellite (DBS) and other competition, disgruntled subscribers have the opportunity to take their business elsewhere and never come back! This makes it all the more important to ensure we are providing the best service possible. **CT**



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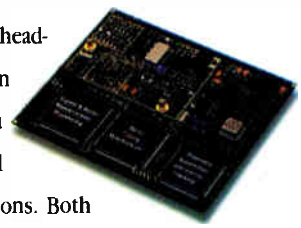

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Reader Service Number 138

By Ron Hranac

The cost of service

For several years I have used service call percentage tracking as a means of gauging the cost of a cable system's corrective maintenance activities. Also called "demand maintenance," corrective maintenance is our response to problems that result in a service technician being dispatched to a subscriber's home or to some portion of the network requiring attention. That is, when performing corrective maintenance, we are fixing problems after they happen.

An effective measure of corrective maintenance is monthly service call percentage, which is defined by the following formula:
SC% = (T/N) x 100

Where:
SC% is the monthly service call percentage
T is the number of service calls in a one month period
N is the average number of subscribers during the same month

For example, if a 20,000-subscriber system has 800 service calls during one month, its service call percentage for that month is 4%. Based on 22 working days per month, this averages just over 36 service calls each day in our hypothetical system. Being conservative and using a figure of $25 per service call, this system's corrective maintenance is costing about $20,000 per month.

In case you're wondering, the $25 per service call figure includes the technician's salary plus overhead, vehicle and tools, dispatch, customer service representative (CSR) time to talk to the subscriber and write up the call, computer processing/logging, etc. If you do the analysis, you'll probably find the real cost is more than the $25 figure I'm using here.

Ron Hranac is senior vice president, engineering, for Denver-based consulting firm Coaxial International. He also is senior technical editor for "Communications Technology."

I've seen figures as high as $45 each.

When tracking service call percentages, the definition of service call includes all service calls for all reasons that involve rolling a truck. Among these are the usual service calls (network and drop problems) plus subscriber-caused problems, TV set fine tuning adjustments, no fault found, no one home, and so on. The key is anything that requires a technician to go to the field.

Typical cable systems have average service call percentages around 3% per month. Very well maintained systems have monthly service call percentages in the 1% range. I've seen monthly figures from as low as 0.22% (very unusual) to as high as 26% (also very unusual). If our hypothetical 20,000-subscriber system had a monthly service call percentage of 26%, its staff would be taking care of 5,200 service calls each month, or more than 200 per day. At 0.22%, the figures would be 44 per month, or two each day.

But let's use the 4% figure for our hypothetical system. If service calls could be reduced by half—and a good preventive maintenance (PM) program has been shown to sometimes have that much impact—corrective maintenance costs would likewise be cut in half. With a 2% monthly service call percentage, our hypothetical system's staff would have to deal with 400 calls per month, or just over 18 a day. At $25 each, that's an estimated $10,000 per month for corrective maintenance compared to the previous $20,000 per month.

Bottom line savings

So how does that savings actually make it to the bottom line? One obvious way is staff reduction. If each service technician can complete, say, eight calls per day, the first scenario at a 4% service call percentage will require five technicians (technically 4.5, but I'll round up since I've never seen half of a technician). At a 2% rate, three technicians could do the work (technically 2.25, but quarter technicians are

even harder to find), and with a little extra individual productivity, maybe two could do it.

In this particular example, I would consider an alternative to outright staff reductions, though. Instead of laying off a couple of competent technicians, I would give them new job assignments: full-time PM or perhaps other technical positions that you were going fill with new hires.

So, you ask, where are the savings? Service calls went down, but staff size stayed the same.

Well, if you were planning to fill other technical positions with new hires, you just avoided the need to do that by utilizing existing, already trained and experienced staff. Staff size is the same, but you are starting those new positions with individuals who already know the system and will require little, if any additional training.

Furthermore, because they are experienced, you bypass the usual productivity ramp-up problems. From one perspective, the previously mentioned staff reductions will save actual dollars, but from another perspective, transferring existing staff to other functions will save budgeted dollars. At worst, we can call this alternative a wash.

Moving the two service technicians into full-time PM has a more tangible impact on the bottom line, but one that may not be so obvious

they are receiving the best possible services."

Subcommittees to meet at Expo '96

Meetings of the Society's Engineering Subcommittees will be held in conjunction with Cable-Tec Expo '96 at the Opryland Hotel in Nashville, TN, in accordance with the following schedule: the new Digital Video and Data Standards Subcommittees will meet on Sunday, June 9; the Maintenance Practices and Procedures and Material Management/Inventory Subcommittees will meet on Tuesday, June 11; the Design and Construction Subcommittee will meet on Thursday, June 13; and the Interface Practices Subcommittee will meet consecutively on Thursday, June 13, and Friday, June 14.

Cable-Tec Games slated for Nashville

The Society's 1996 National Cable-Tec Games Event will be held during the Cable-Tec Expo '96 Welcome Reception on Monday, June 10 from 6 to 8 p.m. in the Opryland Hotel in Nashville, TN.

Those who have participated in previous Cable-Tec Games will find this year's national tournament to be similar to previous ones, with a few notable exceptions. This year, there will be at least 20 participants and 20 eligible alternate contestants. These individuals will be selected by the Society's regional directors for their respective regions, as they did for the 1995 National Games event.

These competitors will assure a full slate to compete in the 1996 National Games on an individual basis rather than in teams. Participant eligibility will be based on the following criteria: 1) Current National or Installer SCTE membership, as well as local chapter membership; 2) Participant must be from the region that he or she represents; and 3) It is preferred that the player has participated and has won past Cable-Tec Games events at a chapter, state or regional industry event.

Guidelines for the 1996 National Games will be derived from the *Cable-Tec Games Handbook*, soon to be available from SCTE. All winners of any Cable-Tec Games event conducted under these guidelines and approved by the Cable-Tec Games Subcommittee will be eligible to win a complimentary registration to the 1997 National Games to be held at Cable-Tec Expo '97 in Orlando, FL.

The 1996 National Games will include past favorites such as "Cable Jeopardy" hosted by NCTI; "Cable Prep" hosted by CommScope, Gilbert, LRC and Times Fiber; "Go Fetch" hosted by Antec/Telewire; and the event that premiered at the 1995 National Games and stumped many of its contestants, "Black Box," to be hosted by Trilithic and Wavetek. Also look for another new game to premiere at this year's event.

NCTA president/CEO to address Expo '96

National Cable Television Association President and CEO Decker Anstrom will present a keynote address to attendees of the Society of Cable Telecommunications Engineers annual trade show, Cable-Tec Expo '96.

Anstrom's address will be delivered on Monday, June 10 during the Society's Annual Engineering Conference. The conference, which deals with the latest developments in telecommunications technology, kicks off Cable-Tec Expo '96, which will be held June 10-13 at the Opryland Hotel Convention Center in Nashville, TN.

The Engineering Conference is scheduled from 8:30 a.m. to 4:30 p.m., with Anstrom's address slated to take place at approximately 2:45 p.m. in the Opryland's Delta Ballroom. Anstrom is expected to discuss the new opportunities the recently enacted Telecommunications Act provide for the cable industry, as well as the industrywide On-Time Guarantee customer service campaign and public affairs initiatives that are part of the industry's The Future is on Cable program. He also will stress the importance of technical excellence in the telecommunications industry's future as NCTA takes on a more vocal role in promoting the increasing necessity for well-trained service personnel. The rapidly evolving and converging technologies that create great technical challenges will require a more highly skilled work force to maintain the level of service that consumers demand.

SCTE welcomes 15,000th member

The Society is celebrating the welcome addition of its 15,000th member! Barry Reed, manager of the Brisbane Exchanges for Optus Vision in Australia, recently joined the Society, along with some of his fellow managers at the company. They were "looking for a way to get some information from overseas just to see what's happening around the world," Reed states.

This is truly a testament to the tremendous growth in the Society's membership and scope over the last few years. In particular, international membership has made significant increases, with SCTE welcoming members not only from Australia, but also England, Canada, Germany, Russia, Argentina, Taiwan, China, Japan, Belgium, Switzerland, Brazil and many other countries.

At press time, the total membership is 15,358: 12,745 Active National Members and 2,613 Installer Members.

SCTE membership has dramatically increased over the last 10 years. (A decade ago the Society had 2,700 members.) This significant growth is primarily due to the success of SCTE's many services and programs such as Cable-Tec Expo, the Conference on Emerging Technologies, the Broadband Communications Technician/Engineer (BCT/E) and Installer Certification programs, local SCTE chapters across the nation, regional training seminars and the wealth of technical information available through the Society.

"Reaching this level of membership is very exciting for the Society and keeps us continually striving to meet the needs of our members," comments SCTE President Bill Riker. "We have introduced two new regional training seminars this year and have been very pleased with the response from the membership. We also are in the process of producing even more training videotapes and publications.

"We have been listening to the members and are trying to develop new programs and training resources that will fit the specific needs of the membership. We are always eager to hear from members to make sure that

Reader Service Number 18

priced at $27 per share. The company, which was formed as a result of AT&T's planned restructuring into three separate, publicly held companies, designs, builds and delivers public and private networks, communications systems and software, consumer and business telephone systems and microelectronics components. Bell Laboratories is the research and development arm for the new company.

Of the total stock offering, over 98 million shares are being offered in the U.S. and Canada, and 14 million are being offered outside the U.S. The company's net proceeds from the offering will be used to repay approximately $2 billion of short-term working capital indebtedness and for general corporate purposes.

After the offering, there will be a total of more than 636.6 million shares outstanding with AT&T owning approximately 82.4% of the common stock. AT&T has announced its intention to divest its ownership interest in Lucent Technologies by Dec. 31, 1996, by means of a tax-free distribution to its shareholders.

ComSonics, Falcon enter repair agreement

ComSonics Inc. of Harrisonburg, VA, and Los Angeles-based Falcon Cable entered into a CATV equipment repair partnership agreement. Under the agreement, ComSonics will service and repair all of the MSO's CATV line, headend and test equipment. Falcon operates cable systems in 43 regions of the U.S.; it comprises more than 350 headends.

According to Gary Armentrout, sales program and services manager at ComSonics, repairs will not be done on site. Instead, regular pickup runs from ComSonics' web of regional representatives will be scheduled to bring the equipment in for servicing at the regional repair site. Approximately 80% of Falcon's equipment servicing needs can be met in this way. For headends too distant from a regional rep for scheduled pickup, the customer will be able to ship the item, Armentrout said.

TW, Fanch form joint venture

Time Warner Cable and Fanch Cablevision of Indiana formed a joint venture that will serve 373,000 subscribers in 17 states, a deal approved by US West that will fall under its TWE investment.

Time Warner will own 49.5% and contribute 130,000 subscribers from five systems in Pennsylvania and one in West Virginia, while Fanch will contribute 57,000 subscribers from Indiana, Kansas, Louisiana, Mississippi, Michigan, New York and Ohio, and an additional 186,000 subscribers from current Tele-Media, Mission Cable and Simmons acquisitions partially funded by a Blackstone Capital Partners II investment.

Time Warner will manage systems in New York, North Carolina, Texas and Ohio, adding about 73,000 subscribers to its clusters and Fanch will cover the rest.

mulation. In spite of this and other interruptions, the company's profitability in the third quarter improved in comparison to the second quarter preceding it due to strict cost-cutting measures. The company said the dramatic increase in orders anticipated following the passage of the Telecommunications Bill has not yet materialized.

SCTE grand opening

Chairman John Vartanian and SCTE President Bill Riker helped celebrate the Society's grand opening of its new national headquarters recently.

Texscan, Wehco sign $5.5 million agreement

TSX Corp.'s Texscan subsidiary entered into a $5.5 million purchase agreement with Wehco Video Corp. Inc., an Arkansas corporation. According to the agreement, Texscan will manufacture and sell to Wehco the necessary optical laser transmitters, optical headend receivers and transceivers, and active RF, optical and optical/RF receivers required to rebuild, upgrade and reconstruct the broadband fiber/coaxial CATV system network in Longview, TX, Pine Bluff, AR, and Hot Springs, AR.

The equipment will be purchased over a 30-month period from June 1996 through Dec. 31, 1998. This agreement may be extended and/or modified to include additional equipment purchases for an additional 12-month period.

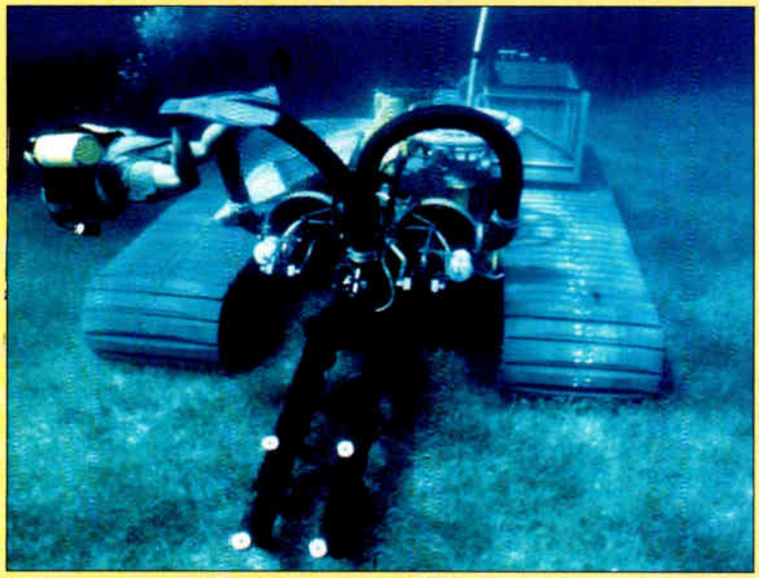
Lucent Technologies announces IPO

Lucent Technologies Inc.'s initial public offering of more than 112 million shares of common stock was

Cable pioneers

JC Sparkman, recently retired from TCI, and Stuart Feldstein, senior partner in the law firm of Fleishman and Walsh, recently were inducted into the Arizona Cable Television Pioneer Hall of Fame.

Underwater fiber challenge



So you think your fiber deployment is a challenge? Here's a shot of General Offshore Corp. performing undersea harbor deployment of fiber-optic cable.

the acquisition of the fiber optics business of Porta Systems Corp. which included product technologies for optical couplers, attenuators, fiber distribution equipment, cable assemblies and connectors.

Tellabs has best first quarter ever

Telecommunications equipment manufacturer Tellabs Inc. began its 22nd year of operation with the highest sales and earnings for any first quarter in its history.

Sales for the first quarter ended March 29 were over $172.2 million, up 21.1% from its first quarter 1995 record of over $142.2 million. Sales for first quarter 1996 were second only to fourth quarter 1995 sales of $181.3 million.

Net income for the first quarter was $31.1 million, up 35.7% from $22.9 million a year earlier, up from $38.1 million in fourth quarter 1995. Earnings per share of common stock were 34 cents, compared with 25 cents for first quarter 1995. (All earnings per share amounts have been adjusted to reflect the effect of the two-for-one stock split that occurred on May 19, 1995.)

Third quarter results issued by C-COR

C-COR reported a net income of $1,362,000 on sales of $36,904,000 for the third quarter ended March 29, 1996. This compares to a net income of $686,000 on sales of $29,985,000 for third quarter 1995. Earnings per share for the quarter ended March 29, 1996, were 14 cents. The company's fiscal year ends on the last Friday in June.

Net income for the first nine months totaled $4,689,000 on sales of $112,201,000. This compares to net income of $4,826,000 on sales of $87,268,000 for the first nine months of fiscal year 1995. Earnings per share for the first nine months were 47 cents compared to 49 cents per share for the first nine months of fiscal year 1995.

The company's performance in third quarter 1995 was impacted by the costs of bringing its Reedsville manufacturing plant on-line. Several severe storms in the northeast in third quarter 1996 impacted business, closing down the company's three Pennsylvania facilities for a full day when the governor prohibited all road travel because of the significant snow accu-

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The DIR-747 Satellite Receiver

Reader Service Number 86

Cox, Continental to trade systems

Cox Communications Inc. and Continental Cablevision Inc. signed a letter of intent to trade cable TV systems representing approximately 97,000 customers. Closing of the transaction is expected in the fourth quarter of 1996, pending legal and regulatory approvals. Financial details of the transaction were not disclosed.

According to the terms of the agreement, each company will receive approximately 48,000 new customers in areas that are contiguous to locations where the companies already have a significant presence. The trade typifies long-term strategies for both companies to form major clusters for the purpose of providing advanced telecommunications services, including voice, video and high-speed data via cable TV infrastructure. The transfer of ownership of the systems should appear transparent to customers, the companies said, with no interruptions in delivery of service or products.

Continental will receive Cox's systems in western Massachusetts and Weymouth, MA, which are contiguous to Continental's systems in Quincy and Springfield. Continental is the largest cable operator is the state. The addition of these systems, and the completion of an acquisition of several systems acquired in another trade announced earlier this year, will increase Continental's customer count in Massachusetts to more than 800,000.

Cox will receive Continental's systems in James City and York County, VA, and Pawtucket, RI. Cox currently serves 260,000 customers in the Virginia towns of Norfolk, Portsmouth, Virginia Beach and Newport News, and separately has announced letters of intent to acquire systems in Hampton, Williamsburg and Chesapeake. In total, Cox's Hampton Roads, VA, operation will serve approximately 380,000 customers when these transactions are closed. Cox's New England operation currently serves 235,000 customers in Connecticut and Rhode Island. Cox separately announced a trade with Tele-Communications Inc. to acquire a system in Rhode Island. When the announced transactions are closed, Cox's New England operation will serve 385,000 customers, principally in Connecticut and Rhode Island.

Arizona Games

In Arizona, cable people take their Cable Games seriously. Here at the recent Arizona Cable Telecommunications Convention, contestants donned matching T-shirts and battled for medals in four categories: Cable Splicing, Go Fetch, Multimeter Reading and Cable Jeopardy.

Antec announces first quarter results

Antec Corp. announced that sales for first quarter 1996 were up 2.2% over first quarter 1995. Sales increased to $162.4 million for the first quarter ended March 31, 1996, compared to $158.8 million for first quarter 1995. Net income for first quarter 1996 was $2.6 million (11 cents per share). This compares with net income of $4.4 million (19 cents per share) for first quarter 1995.

Augat reports first quarter results

Augat Inc. reported a 14% increase in net income to $6.6 million (33 cents per share) for the first quarter of 1996, compared with 1995 first quarter net income of $5.8 million (30 cents per share). Sales for the first quarter increased 8% to $145 million compared with $135 million for the first quarter of 1995.

In March 1996, Augat announced

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Managing Editor, Laura K. Hamilton
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Account Executives
Mike Elmer, (303) 839-1565, ext. 34
David Gillespie, (303) 839-1565, ext. 35
Joel Goron, (301) 340-7788, ext. 2106
Tim Hermes, (301) 340-7788, ext. 2004
Rebekah Markheim, (303) 839-1565, ext. 33
Director of Marketing & Circulation Services, Maxine Minar
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CT Publications Corp.
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CT Sales and Editorial Offices
1900 Grant St., Suite 720, Denver, CO 80203
(303) 839-1565 Fax (303) 839-1564
e-mail: CTmagazine@aol.com

Corporate Offices

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

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

David Shaw, Senior Vice President/Group Publisher
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EDITOR'S LETTER

TV Rex makes an offer you shouldn't refuse

I've been working with the 1995 Society of Cable Telecommunications Engineers Membership Survey and it struck me that there were an awful lot of responses about training and the cost of videotapes sold by the Society. Almost every respondent made statements concerning the availability and cost of training materials. It was especially interesting to read that the Broadband Communications Technician/Engineer (BCT/E) Certification training tapes "are too expensive for an individual" or "we need a group training program to help get us through the maze of information leading to certification." And many members said, "I'd be willing to pay $25 to $50 for a good quality training tape."

So, have I got a deal for every system and MSO out there! How about a complete 24-program series of tapes for the low, low price of $33.15 per tape? Yep, for the average cost of $80 per student (less, if the training group is larger), your system can train your technical staff so thoroughly that, upon completion, each person will be prepared to take and pass the BCT/E Technician level Category IV examination for national certification in "Distribution Systems." Many of you have said this is the most difficult category in the program and yet its importance is paramount to the maintenance and operation of any telecommunications system.

How does the program work? Well, first you order it from SCTE headquarters, 140 Philips Road, Exton, PA., 19341-1318, phone: (610) 363-6888. (Or, when you're in Nashville, TN, for Cable-Tec Expo '96, why not stop by the SCTE Bookstore?)

Now that you have the program, appoint a trainer or facilitator (usually a technical manager or engineer). Schedule regular meetings, which typically would last two to three hours each. Provide every student with the textbook, *Cable Television*, by William Grant (which you probably already have in your library). During the meetings, discuss each videotape program. The trainer or facilitator can answer any questions and encourage discussion of that subject matter. Between sessions, trainees prepare by reading the next chapter or so in the textbook. The first tape and chapter of the program ("How a Cable System Works") is geared for technicians and nontechnical personnel alike. You will probably want to make it required viewing for all new-hires, including customer service representatives (CSRs) and technicians.

Try out this program and you're well on your way down the pathway to success in the land of telecommunications.

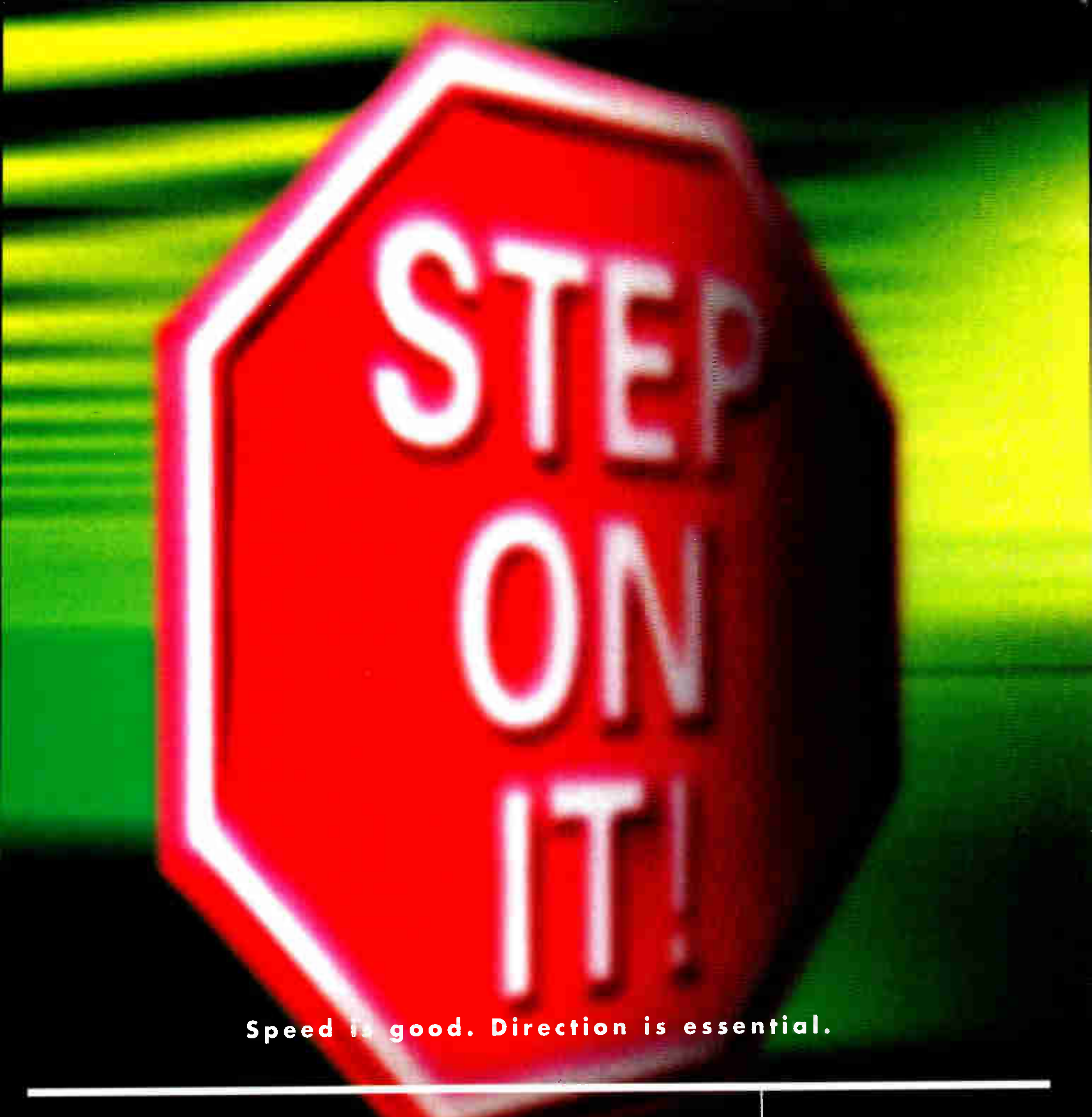
Convention buzz

As I write this, I have just returned from Los Angeles and the best National Cable Television Association show ever. And I have been attending them since the '60s! A great mixture of cable, telephony and computer technology held one's interest, but the show was so huge that I don't see how attendees could be sure they saw it all and didn't miss something in another hall or room. In fact, the only bad side of the show had to be that it was just so spread out that one's knees buckled and ankles ached long before one's interest came close to being satisfied.

Probably most gratifying was that I saw a new cooperative spirit between the "cable" people and the "telephony" people. Perhaps now we understand the communications path is neither cable nor telephony but a joint effort by all.

Now get ready for this month's Expo in Nashville, folks. You ain't seen nothing yet!

Rex Porter
Editor


STEP ON IT!
Speed is good. Direction is essential.

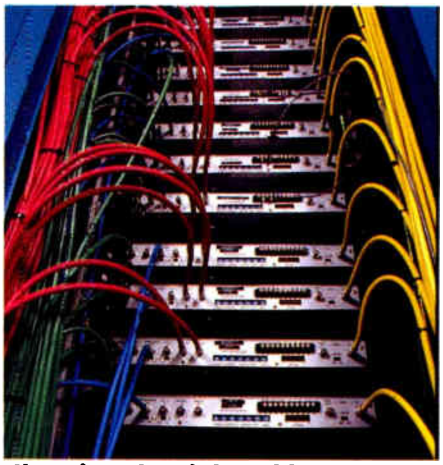
CONTENTS JUNE 1996

FEATURES

Cable-Tec Expo • 166

FEATURES

Q&A with John Wong • 92



Choosing the right cable • 136

Back to Basics • 162

Back to Basics • 164

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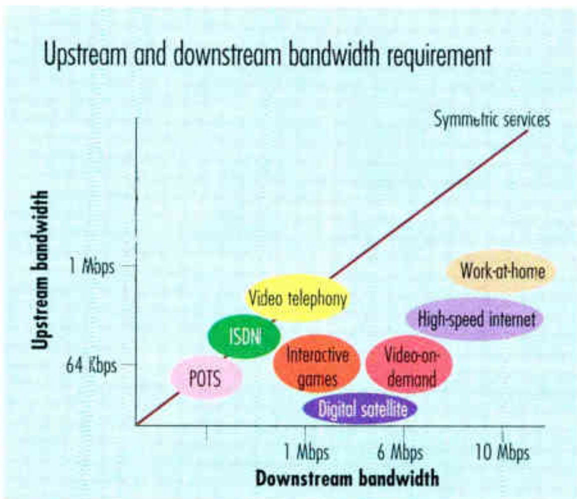
CONTENTS JUNE 1996

DEPARTMENTS

News • 12

Newsmakers: Part 2 • 52



HFC vs. SDV • 70

FEATURES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Cablevision: 1996 Service in Technology Award

Boldly going where no one has gone before ...

By Rex Porter, Editor

"Communications Technology" and the Society of Cable Telecommunications Engineers are proud to announce the winner of the 1996 Service in Technology Award: Continental Cablevision. The following is a short overview of the company's commitment to implementing and advancing telecommunications technology. Continental will be honored at this year's SCTE Cable-Tec Expo Annual Awards Luncheon in Nashville, TN.

One year ago at Cable-Tec Expo '95 in Las Vegas, many in our industry's technical arena were talking of returning to the office to begin experiments in telephony, digital transmission, data transmission and beyond. Everywhere you turned, there were discussions and plans for an exciting future.

One company that really took all that talk and parlayed it into action in 1996 was Continental Cablevision. Not satisfied with just wait-and-see, it's leading the broadband telecommunications industry into new frontiers and establishing a leadership role in digital transmission, data delivery, Web interface and education across the nation.

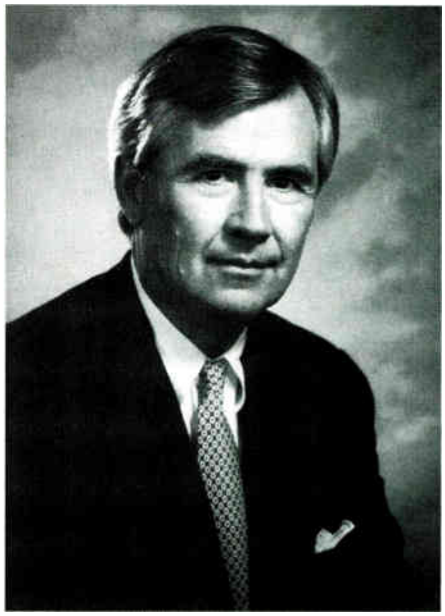
Educational commitment

When Continental Cablevision activated an interactive broadband communications network at Boston College in Autumn 1995, it marked the beginning of a series of notable engineering projects that would ultimately lead to its selection as winner of the CT/SCTE 1996 Service in Technology Award.

"Continental shares the results of its discoveries with others in our industry."

The Boston College network allows students to connect to a wide variety of video and data services (including high-speed access to the Internet) from their dormitory rooms and multiple points around campus. The project also includes a telecommuting trial for students, faculty and administrators, allowing full access to the on-campus network from participants' homes. The network connects 2,500 classrooms, 400 administrative offices and more than 6,000 dormitory rooms.

In keeping with its strong commitment to local education, Continental has donated a fiber-optic transmission system that links two schools in the



Amos Hostetter, Jr.
Chairman and CEO

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to the

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the 1996

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for your engineering

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WAVETEK

Rob Strickland
Senior Vice President,
Information Systems

Lincoln Unified School District in Stockton, CA, and the district's administrative offices. Students, teachers and administrators can communicate via voice, video and data in science classrooms, libraries, performing arts facilities and administrative offices. Local and wide area networks (LANs and WANs) have been created in each classroom providing Internet access.

Other trials

Continental has completed a trial involving the transfer of data at high speeds over a cable network between Exeter Hospital in New Hampshire and doctors' offices in the Exeter area. Without leaving their offices, doctors can send and receive patient records and X-rays over Continental's hybrid fiber/coaxial (HFC) network at speeds up to 700 times faster than conventional dial-up telephone lines.

"With http://www.continental.com, Continental operates a thriving home page on the Web."

In partnership with BBN Planet Corp., Continental also is conducting a market trial of high-speed access to Internet and data services via Continental's cable network to some 200 subscribers in several suburban Boston communities. Utilizing cable modems, the six-month trial offers access at speeds hundreds of times faster than currently available through the existing telephone network. In addition, trial participants have received computer software to browse the World Wide Web and utilize e-mail.

The trial also involves customer support services and product marketing. With http://www.continental.com, Continental operates a thriving home page on the Web. The highly interactive site is among the first of its kind for a major cable operator and provides access to a variety of customer-oriented information services. It allows customers in their 20-state service area to communicate with company representatives by electronically sending inquiries and other e-mail requests. One of the site's more innovative domains is an interactive TV listings service, allowing customers to search through the complete spectrum of cable programming and customize channel lineup displays containing their favorite channels.

Company background

Historically a technological leader in the broadband communications industry, Continental is the nation's third largest cable system operator, serving more than 4.2 million subscribers in 20 states. The company employs nearly 10,000 people and is organized geographically into five U.S. regions and several overseas divisions.

A pioneer in the use of digital in cable in the United States, Continental is helping to take the technology's promise overseas as well. It has joint digital ventures in Fintelco S.A., in Argentina (550,000 subscribers), Optus Vision in Australia (over 3,000,000 homes), and Singapore CableVision in Singapore (750,000 households, businesses and public institutions).

In February, 1996, Continental announced an agreement to merge with US West Media Group. That merger is expected to be completed by early 1997.

With inspired leadership from Chairman and CEO Amos B. Hostetter, Jr., creative management from President Bill Schleyer and advanced engineering direction from Vice President of Engineering David Fellows, Continental continues to set examples for other telecommunications companies to follow. As it moves forward into new frontiers of telephony, data delivery, teleconferencing and education, Continental

Dave Fellows
Senior Vice President, Engineering and Technology

shares the results of its discoveries with others in our industry. Its willingness to provide regular information on their projects throughout the year has helped other smaller operators to begin testing data transmission, telephony and various new business possibilities.

When Chairman Hostetter was interviewed last year, he spoke of two obstacles to cable's future. One was a lack of a level playing field and the other was insufficient access to capital. Since that interview, President Clinton has signed the new Telecommunications Act of 1996 into law, creating a new and competitive climate and eliminating Hostetter's first obstacle. Hopefully, the second obstacle will be cleared for Continental in its pending merger with US West Media.

"A pioneer in the use of digital in cable in the United States, Continental is helping to take the technology's promise overseas as well."

Hostetter remarked that assuming the two conditions he mentioned were met, success in cable telecommunications would be strictly a matter of depending on one's own wits and ability. Continental has proved itself to be a company with lots of "wits and ability."

Bill Schleyer
President

In the past, the Service in Technology Award has gone to an individual or an engineering team within a company. In 1996, the award goes to "the company," and all of its employees for engineering success and the spirit of cooperation.

Even David Fellows and his exceptional engineering staff could not have sustained such stellar performance throughout the past year without the dedication and support of the rest of the Continental team.

Congratulations, Continental! **CT**

Continental Cablevision facts at a glance

National rank: Third largest U.S. cable TV operator

Total revenues (1995): $1.4 billion

Subscribers: 4.2 million

Homes passed: 7.2 million

States served: 20
- **Northeast region:** Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island
- **Southeast region:** Florida, Georgia, Virginia
- **Midwest region:** Michigan, Ohio
- **Central region:** Illinois, Iowa, Minnesota, Missouri, Wisconsin
- **Western region:** California, Idaho, Nevada, Washington

International operations: Argentina (50% owner in Fintelco S.A.); Australia (46.5% owner in Optus Vision); and Singapore (25% owner, Singapore Cablevision)

Other current lines of business: Alternate access, direct broadcast satellite, programming, and 12.5% owner of National Cable Communications L.P.

Advanced technology projects: Broadband network for the campus community; interactive education network for local schools; high-speed, interactive telemedicine network; high-speed access trial; and customer-friendly World Wide Web site.


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Envisioning the future

Tomorrow's revolution for the Information Age

In last month's installment of this special two-part report, *Communications Technology* spoke to some of the top technically oriented executives in both cable and telephony. Surveying the nature of today's communications networks and predicting where the technology is ultimately headed, they took on some of the industries' hottest topics: the realities of convergence; the passage of the Telecom Act of 1996; the promises of high-speed cable modems; and training issues. For a summary of last month's report, see the sidebars on pages 57, 59 and 66.

This month, our experts tackle the big issue that anyone envisioning the communications infrastructure of tomorrow will invariably come back to: network reliability/availability. They also consider the realities of cable/telco convergence.

Participants included:

- **Wendell Bailey** (vice president of science and technology) and **Rich D'Amato** (senior director of public affairs) at the **National Cable Television Association**
- **Harry Bosco** (chief technical officer, **Lucent Technologies**)
- **Ian Craig** (president, broadband networks, **Nortel**)
- **Walt Ciciora** (consultant)
- **Jim Chiddix** (vice president of engineering and technology, **Time Warner**)
- **Jim Ducay** (managing director of data networking services, **NYNEX**)
- **Tom Elliot** (president, **TCI Cable Management Corp.**)
- **Joel Engel** (vice president, technology, **Ameritech**)
- **David Fellows** (senior vice president of engineering and technology, **Continental Cablevision**)
- **Richard Green** (president, **CableLabs**)
- **Gary Handler** (group president, **Bellcore**)
- **Ron Hranac** (senior vice president of engineering, **Coaxial International**)
- **Ross Ireland** (vice president of network engineering, **Pacific Bell**)
- **Bob Luff** (president, **TV/COM**)
- **Jim Phillips** (corporate vice president, **Motorola**)
- **Bill Riker** (president, **Society of Cable Telecommunications Engineers**)
- **John Seazholtz** (chief technology officer, **Bell Atlantic**)
- **John Sie** (chairman and CEO, **Encore Media Corp.**)
- **John Vartanian** (vice president of technology operations, **Viewer's Choice**)
- **Joseph Wetzel** (vice president for the Multimedia Group, **US West Multimedia Communications**) and **Bud Wonsiewicz** (vice president of **US West Advanced Technologies**)

"Our networks are roughly twice as reliable as the phone network now. This assumes proper maintenance."
—Tom Elliot, TCI

Eric Butterfield is associate editor, Laura Hamilton is managing editor and Alex Zavistovich is senior editor for "Communications Technology."

# of telecommunications

By Eric Butterfield, Laura Hamilton and Alex Zavistovich

• **Wendell Woody** (executive director of sales) and **Janet Burton** (national marketing manager) of **Sprint/North Supply**

The telcos' promise of "hitting nines" (having the network up and running 99.999% of the time) has been tossed around for years while cable's network reliability/availability has usually not been viewed as a strong suit. Cable's trump card in the days of cable vs. telephony was always its wide bandwidth, not its reliability. However, cable vs. telephony is at best a fuzzy debate in this age of convergence and cooperation.

Despite the fact that almost everyone agrees that in the not too distant future you won't be able to tell the difference between the two businesses, the traditional reliability/availability debate is one that dies hard.

Bell Atlantic's John Seazholtz says, "I believe our reliability (telcos') is higher and I think the Federal Communications Commission statistics more than bear that out."

But TCI's Tom Elliot and the NCTA's Wendell Bailey beg to differ when it comes to cable's reliability.

Elliot says, "Our networks are roughly twice as reliable as the phone network now. This assumes proper maintenance."

Bailey also agrees that perception is perhaps not the reality here. "From an engineering point of view there's absolutely nothing wrong with our reliability," maintains Bailey. "When we measure our reliability the same way the telephone companies measure theirs, we come out very well. Better than they do, in fact."

Robert Luff of TV/COM says, "I don't buy into the description of cable networks as inherently unreliable. There have been great improvements over the cable system of 10 years ago, when everyone used 30-35 amp cascades with no standby batteries."

"When we measure our reliability the same way the telephone companies measure theirs, we come out very well. Better than they do, in fact."

—Wendell Bailey, NCTA

The public's old perceptions about cable are beginning to change, but perhaps the idea that the telcos are more reliable is erroneous. As Consultant Walt Ciciora puts it, "If you don't get a phone call, it could be that the network is down or just that no one is calling you. It's different in video. Even if cable's reliability were exactly the same as telcos', the public would perceive a difference."

Cable's answer to reliability/availability problems, or the perception of problems at least, seems to lie in its adoption of hybrid fiber/coax (HFC) architectures, which have proven to be much more reliable than traditional cable systems.

Motorola's Jim Phillips says

that if HFC lives up to all its "big pipe" possibilities, the architecture could very well wipe away cable's traditional disadvantages in telephony and data delivery. But cable isn't the only one that can implement HFC. Many telcos are so impressed by both its reliability/availability and bandwidth promises that they're taking up the charge toward HFC as well.

"There have been great improvements over the cable system of 10 years ago, when everyone used 30-35 amp cascades with no standby batteries."

—Robert Luff, TV/COM

"The telco guys are beginning to put HFC trials in and they're going international with HFC. They certainly are trying to get expertise on HFC, and I think they'll do that by hiring people from traditional cable backgrounds," says Phillips.

And cable people are getting a lot of HFC practice. Take Continental Cablevision for one. The company is completely revamping its ideas about plain old coax cable systems.

"We're not your father's cable system anymore," says David Fellows of Continental. "A typical tree-and-branch cable system isn't particularly reliable; I wouldn't put my cable service on it."

In Fellows' opinion, a straightforward HFC upgrade gives 99.97% up time. He adds that installing ingress filters to protect data customers from interference by nonsubscribing cable customers and creating smaller nodes will bring that number very close to all nines.

Fiber deployment: How far should it go?

Fellows brings up an issue that any company upgrading its nets right now should be seriously considering. That is, node size. How far do you need to push fiber to provide essentially perfect service to demanding customers and what are the economic realities of the decision you finally make?

"When I'm starting from a clean slate I'm going to build for the future, not deal with an incremental investment on top of what I have," says Bell Atlantic's Seazholtz. For him that means fiber-to-the-curb (FTTC).

Pacific Bell is not looking at going that far but rather serving 400-500 homes using fiber-to-the-neighborhood architectures, says the company's Ross Ireland. However, he says it makes sense to take fiber homeruns to businesses where there's a lot of aggregated voice and high-speed data traffic.

Seazholtz agrees: "Ultimately I would envision fiber into a business location at your terminal. But the thing with fiber that we'll always have is that you need lasers and photodiodes to detect the laser

beams and those things consume power."

In business applications where backup power is available, you could depend on reliable power to the lasers, Seazholtz says, "But if you're talking about a home, if you lose power to your house, that means you're going to lose the lasers."

Pac Bell's Ross Ireland adds, "If you get into more rural or residential environments where the bandwidth requirement from the end user isn't as great as you would find at a high-rise building, taking fiber to each individual home or end user does not look economic."

What about Ameritech's fiber deployment plans? The company's Joel Engel says, "Something on the order of 92% to 94% of our customers are within two miles of a fiber node and 84% of them are within one mile of a fiber node. And we're going to continue to drive the fiber deeper and deeper."

Ameritech is taking an interesting approach to providing video services in addition to its traditional telephony offerings. "If I'm a telephone company and I already have a pretty good fiber and twisted-pair network where the fiber goes pretty deep, and the twisted-pair is fairly short, then I might elect to put the video over (hybrid/fiber) coax and leave the voice on the twisted-pair. That's exactly what Ameritech has decided to do."

So in Engel's opinion, where is the optimal point to push fiber into an HFC network? "It's at a point where you need to put an amplifier into the coaxial cable" he says, "It turns out to be about 2,000 feet away from the home and in a typical suburban neighborhood that serves about 64 customers."

"Even if cable's reliability were exactly the same as telcos', the public would perceive a difference."

—Walt Ciciora, consultant

Sizing up MMDS and DBS

While the telcos are looking at the promise of video services, cable TV's biggest competitors in video entertainment are still multichannel multipoint distribution service (MMDS) and direct broadcast satellite (DBS).

Richard Green, president of CableLabs, says MMDS will not be too much of a threat except in specific markets, citing that it works better where there are fewer trees like out west.

TV/COM President Bob Luff likewise notes MMDS's flat terrain requirement as a problem as well as propagation. "Both technologies have serious limitations that are difficult for their proponents to address," says Luff. "DBS is not local and not two-way. While they have telephony upstream to make their program choices, they have downstream bandwidth limitation because that one satellite spectrum has to serve a whole nation of 100 million homes. That means sparingly limited bandwidth per household."

Luff adds that while digital compression may have addressed MMDS's minimal channel capacity, the technology is still limited to fairly narrow two-way return bandwidth.

"With DBS you're talking about 16 slots, 16 to 24 transponders," says John Sie, chairman and CEO of Encore Media Corp. "Cable's got ultimately about 108 slots."

Sie urges cable not to limit itself to 550 MHz on 750 MHz plant: "You don't need, I don't believe, 200 MHz just for interactive where you don't even know what the application is."

What worries cable ops about MMDS and DBS isn't technology, but brand name recognition.

"When you have a brand like AT&T or MCI associated with DBS, and regional Bell operating companies investing in wireless," says Dave Fellows, senior vice president of engineering and technology at Continental Cablevision, "their promotion and distribution capabilities are cause for concern, even if the product is weak. To combat DBS, cable operators have to stress localism: local channels, local origination." —*EB*

US West Multimedia Communications' Joe Wetzel shared some of the modeling studies his company has done in considering the fiber deployment issue. "For the next several years while the business develops, we think 500-home nodes is a good spot to be. As demand increases, the first thing we'll do is reduce the split on the lasers because right now you come off a fiber from a headend and then you typically split the laser a few ways to feed a 500-home node."

Reducing the split on the lasers doubles and triples capacity downstream, says Wetzel, and the next step after that would be to subdivide the nodes.

He adds, "We're pretty confident there are lots of things you can do without necessarily taking fiber down to the curb or down to 64 homes."

Motorola's Phillips seems to sum up our panel's opinion about how far to take fiber today when he says, "Right now I'm not sure what fiber-to-the-home is going to get you other than a huge bill."

The convergence question

With the Telecom Act as its catalyst, convergence has become a reality. Facing a future of accelerated activity, both telcos and cable operators are assessing the opportunities in a race for the consumer. So how fast will the convergence of technologies take place?

"I don't see this convergence occurring in a meaningful way in the marketplace until the end of the decade," says John Seazholtz, chief technology officer at Bell Atlantic.

"We're not your father's cable system anymore."

—David Fellows, Continental

Jim Phillips, corporate vice president of Motorola, believes that compression technologies currently under development will allow for some good possibilities over twisted-pair, but thinks convergence will happen faster over hybrid fiber/coax (HFC) networks, particularly over the next couple of years: "If you look at the bandwidth that's resident in HFC systems, they have some big advantages, especially when it comes to video and data. HFC as a platform will race out ahead in terms of delivering multimedia."

Over the next five years, Phillips sees the demarcation between telcos, RBOCs and cable providers disappearing. "To that extent, we're just calling them operators these days."

As for the telcos, "They're obviously going to be taking a hard look at ADSL technologies," says Phillips. "That's the key."

Technologically speaking, the sky is the limit. While high-speed interactivity to the home seems likely in

Training for the basics and beyond

Technological changes are taking place in the cable industry so quickly it's becoming a case of "sink or swim."

For NCTA's Wendell Bailey, good installers and engineers take classes on their own to allow them to handle this change. Those who don't make the effort may not make the cut as the industry evolves, he says.

Training in digital communications is essential for John Vartanian of Viewer's Choice. "The recent technical developments in cable—compression, high-speed data, telephony, interactivity—all take advantage of digital communications. Those who don't understand how digital signals are changing their businesses will be left behind."

Technical personnel must assume responsibility for their own success, according to Tom Elliot at TCI Cable Management Corp. Agrees Walt Ciciora, "Technologists need to self-educate." Proactive training efforts from cable technical staff is important for customer service, he says.

What are key areas for training? US West's Joe Wetzel places emphasis on greater experience with computers: "I think they should learn about Internet technology. If they're not computer literate, they'd better be soon."

Computer training is also on the list for Pacific Bell's Ross Ireland, especially Internet protocols such as TCP and IP. He also recommended training in fast-packet technologies such as ATM. "Fast packet technologies are going to be the wave of the future," says Ireland.

"Battle lines are shifting to the front line of customer contact: installers and technicians," said Robert Luff of TV/COM. Technology has moved too fast for personnel to learn the basics of subjects such as two-way communications, he says. In that rush, engineering basics in general have been overlooked, commented Coaxial International's Ron Hranac. "It's not unusual to have our front-line technicians lack basic electrical concepts," he says.

The fundamentals of telephone and coaxial cable repair are critical training areas for SCTE's Riker. He emphasizes such basics as knowing how to install and maintain feeder system plant and house drops—"something that many do not do well today," he says. —*AZ*

the near future, what remains to be seen is how many people will be willing to pay for these services.

"New business opportunities for both the cable TV companies and the telcos," says Harry Bosco, chief technical officer of Lucent Technologies, "will only be limited by creativity in meeting market demand."

Bosco sees converging applications becoming more integrated through a combination of subscriber interfaces and client-server software. "As we evolve the network hardware," he says, "we must ensure we pay as much attention—maybe more—to evolving the client-server software suite."

Ian Craig, president of broadband networks, Nortel, says, "In the past I would characterize the convergence of these technologies as driven by network cost efficiencies. Today, however, the ability to deliver multiple services is fundamental to many companies' outright survival.

"The challenge facing each industry is how to leverage their current infrastructure to accelerate time-to-market, yet not sell themselves short in being able to deliver the types of interactive multimedia services envisioned for the near future."

As for the delivery of those services, Joel Engel, vice president, technology, Ameritech, says, "It is true that many of these services—perhaps all of these services—could be provided on the same technology. But there are several technologies of which you can say that all of these services could be provided."

One scenario Engel foresees is this: "One company may provide voice, video and data over coax. Another might provide voice, video and data over twisted-pair. A third company might provide all of those over microwave radio. But for some

"When I'm starting from a clean slate I'm going to build for the future, not deal with an incremental investment on top of what I have."

—John Seazholtz, Bell Atlantic

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companies it might make sense to use a family of technologies rather than a single technology."

For instance, Engel says, a cable company operating over coaxial cable may strive to provide all services over coax rather than build a twisted-pair network. On the other hand, a telephone company with fiber going pretty deep into the network and twisted-pair fairly short, might elect to put the video over coax and leave voice on twisted-pair. "That's exactly what Ameritech has decided to do. We're using HFC for the video and we're leaving the telephone on twisted-pair."

"Something on the order of 92% to 94% of our customers are within two miles of a fiber node and 84% of them are within one mile of a fiber node. And we're going to continue to drive the fiber deeper and deeper."

—Joel Engel, Ameritech

What many see on the horizon is asynchronous transfer mode (ATM). "A highly interactive multimedia environment requires a different type of network architecture than one required for data access only," says Craig. "This implies broadband access, ATM switching, synchronous optical network (SONET) transport and interactive multimedia network software."

"By the end of this decade,"

says Seazholtz, "both systems will be delivering ATM-based streams. We will have, frankly, all of our video and data (advanced data) delivered over the ATM stream. Voice—POTS switched voice—will be carried separately on the copper wire. Clearly the ATM stream can carry voice traffic."

Ross Ireland, vice president of network engineering, Pacific Bell, agrees: "I think in the long pull (ATM) looks like the best long-term technical answer for being able to integrate these different technologies."

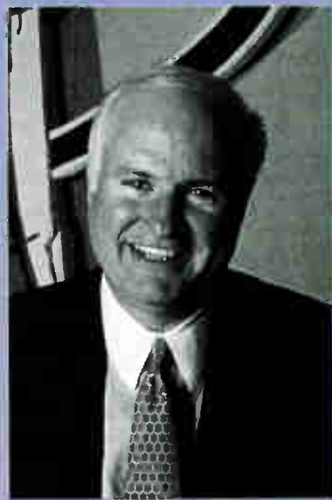
Ultimately, says Ireland, voice, data and video will be carried over ATM and, in the not too distant future, telecom networks will move to ATM even for voice, "although it will take a while before that plays a major role in our networks."

While ATM is quite good for data, it's also quite capable of video, says Ireland. "I believe it ultimately will be quite good for voice. I think that's the direction we ought to all be pushing."

"The new piece of the puzzle for us is the video component," says Seazholtz, "and while we've carried video and special services for the broadcast industry for at least a decade, offering it to consumers and video information providers clearly is a new business for us and one that we'll be aggressively pursuing." ➞

"Right now I'm not sure what fiber-to-the-home is going to get you other than a huge bill."

—Jim Phillips, Motorola



Bosco stresses that applications must be access infrastructure independent: "A single application is transparent to the particular access technology and presents itself to the subscriber in the same fashion, regardless of the access technology, assuming that the subscriber interface device is common across access technologies, within the physical bounds of the access technology."

While multiple access technologies (HFC, SDV, ADSL, HDSL, SDSL, twisted-pair, wireless, passive optical network, etc.) are vying to be the long-term favorite for all passive fiber-to-the-home delivery, Bosco says the access technology selected will be based on a number of factors, including cost, bandwidth requirements, subscriber and service provider demographics, deployment time frames, and so on.

"What is critical in both the near term and long term," he says, "is the ability for the service platform (headend or central office equipment) to support all of the different types of access technologies. This will allow the lowest cost solution to be used based on the customer's needs."

Bosco says subscriber devices used to interface with applications will vary widely, ranging from low-cost, low-intelligence devices to mid-ranged intelligent devices (offering slightly more processing and graphics and memory) to very intelligent higher end devices.

As an example, Bosco says an application running on a low-end device could provide a text interface, while the same application running on a mid-range device could provide a combined text/graphics interface. This single implementation of the application would alleviate the cost of multiple application developments and additional ongoing maintenance costs.

These low-cost and mid-ranged devices, coupled with client-server software, along with advances in access and network technology, will help stimulate and drive new business opportunities for telcos and cable companies. **CT**

Cable modems usher in data delivery for cable

When it comes to new revenue streams for telecommunications, most experts agree that the development of cable modems has unlocked data delivery for cable. Telcos, however, stand by time-tested technology such as ISDN to serve the same purpose.

Cable companies' HFC networks may have the advantage of speed over the telcos in delivering data. According to Sprint/North Supply's Wendell Woody, a 2 megabit still video image takes 0.5 seconds using cable TV. That makes Internet access an attractive opportunity for increased cable revenue.

> **"It will be hard to tell after a while between a CATV and a telephone company."**
>
> *—Gary Handler, Bellcore*

Woody points, however, that the market for on-line services over cable is unknown. "There's some question whether people will pay $25 to $35 a month just for this high-speed access," he says. For Walt Ciciora, however, commercially available cable modems may solidify the market. "The (high-speed Internet access) opportunity is even greater when coupled with standardization of modems so consumers can own them."

Motorola's Jim Phillips believes that "a major market in 1997 will be high-speed data access over HFC networks," which he adds will have "lower provisioning costs" than ISDN or asymmetrical digital subscriber line (ADSL). Pacific Bell's Ross Ireland disagrees, however, noting "there are a number of challenges associated with bringing that technology to market in a large scale." For Ireland, telcos' moderate-speed ISDN offering is the answer.

Cable modem technology has focused attention on two-way data delivery, says TV/COM's Robert Luff. "Cable modems have been the catalyst for robust deployment of telephony," he adds, noting "the things you have to do to the network to use modems are exactly the same things you have to do to activate the network for telephony."

Is the distinction between telephony service and data delivery becoming academic? Sprint/North Supply's Janet Burton says cable operators should consider "telephony on tomorrow's terms—a mixture of wired and wireless applications, high-speed data transmission, LAN and WAN networking opportunities."

In fact, telephone company experts have looked at telephony for some time now as more than just completing a phone call. In terms of delivery of information, Gary Handler of Bellcore says, "it will be hard to tell after a while between a CATV and a telephone company."

Mobility (PCS), long-distance, high-speed data, broadcast and interactive multimedia comprise the major service opportunities for telcos over the next five years, according to Ian Craig at Nortel. For NYNEX's Jim Ducay, opportunities for telcos come from bringing value and creating value from their networks. With compression technology, voice, data and video can be carried at smaller and smaller bandwidth. Ducay advocates telcos' ISDN networks over cable's HFC architecture as a preferred established data delivery mechanism.

Ultimately, when cable operators reflect on telecommunications services, the key is not if, but when. As Elliot puts it, "(Cable companies) will certainly be a driver in any new business."—*AZ*

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INSTAL

By Steve Shmania

HFC vs. SDV: What you need to know for data

The debate of the last few years between hybrid fiber/coax (HFC) and switched digital video (SDV) architectures is over. The two approaches exist in relative parity as architectures to be considered for network deployment. Both architectures have been selected for deployment by different network operators, indicating the viability of both options. In fact, SDV has become the technology of choice for some telcos because of its ability to cost-effectively deliver multiple unrelated services including telephony, video and data over a single broadband delivery platform to the home, small business and community.

The current debate is focused on how to satisfy the growing demand for high-speed data services by residential and small business customers, particularly for Internet and work-at-home network applications. The key differentiator of data services from other broadband applications is that high-speed data services require a healthy upstream bandwidth capability. In addition, high-speed data services require dedicated, low-latency, reliable and secure network connectivity. Solving the bandwidth problem with a capable broadband delivery platform is critical to the success of network operators in their effort to satisfy this growing market demand and generate new revenue.

Choosing the right network architecture to deploy requires careful consideration of bandwidth needs, platform compatibility, standards and cost to support high-speed data services along with other services to be offered over the network. The first step is understanding how these architectures compare and how they satisfy the requirements for high-speed data. The benefits of a broadband delivery platform for all services also should be considered.

"The current debate is focused on how to satisfy the growing demand for high-speed data services by residential and small business customers, particularly for Internet and work-at-home network applications."

HFC and SDV comparison

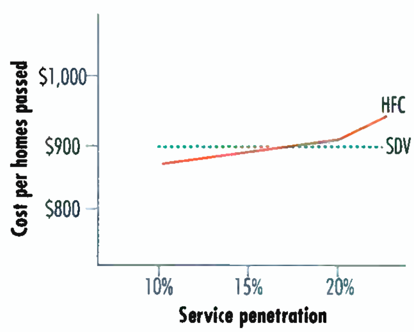
HFC uses a passband approach in which parallel RF carriers conforming to the traditional cable TV spectrum plan are modulated to carry broadcast or interactive signals to attached subscribers. HFC uses optical fiber to deliver analog video, digital video, high-speed data and telephony to a node that serves approximately 500 homes.

In contrast, SDV uses a baseband approach in which time division multiplexed signals are transported in their native "on/off" digital format to carry signals to their subscribers. SDV uses optical fiber to deliver telephony and digital signals to a node at the curb that serves 8 to 50 homes.

From the optical node, HFC uses a point-to-multipoint distribution system of coaxial cable that is run past the homes to be served. All services are delivered to the home via a coaxial cable. The downstream digital and telephony signals are typically delivered between 550 and 750 MHz, and the upstream signals in the spectrum between 5 and 40 MHz. Analog broadcast is carried between these spectrums in the 50 to 550 MHz range.

From the optical node, SDV uses a point-to-point distribution system to deliver signals to each home to be served. Telephony signals are delivered to the home via standard twisted-pair copper wires. Digital video and data signals are delivered to the home via either twisted-pair wires or coaxial cables. Analog broadcast signals may be delivered via a hybrid

Figure 1: Installed first cost comparison of SDV and HFC technologies



Steve Shmania is product line manager for BroadBand Technologies Inc.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"(HFC and SDV) exist in relative parity as architectures to be considered for network deployment."

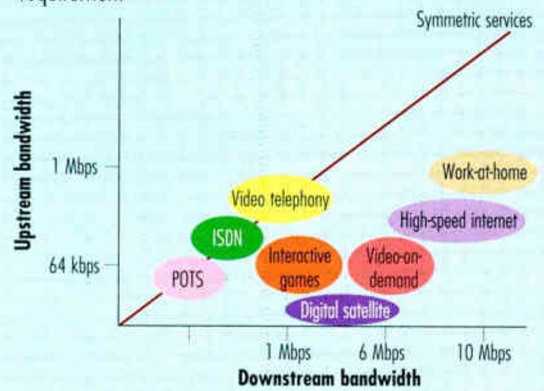
fiber/coax (HFC) underlay that also provides powering to the node. Analog broadcast signals may be passively combined at the curb or at the home with broadband digital signals and share the same coaxial cable to the home. The downstream and upstream broadband digital signals are delivered in the spectrum between 5 and 30 MHz, above the telephony spectrum and below the analog broadcast spectrum.

In the SDV architecture, fiber terminates at a node that resides close enough to residences that each home can be served using a point-to-point link. Therefore, less sharing of the fiber's bandwidth is implemented (roughly 20 homes vs. 500 homes in an HFC system) and the post-node distribution facilities are not shared over multiple homes. The result is considerably more bandwidth available on a per-home basis than is the case in the HFC approach.

Published studies indicate that the costs can be similar for both approaches, as can be seen in the example shown in Figure 1 on page 70. Although the specific crossover points can be debated, the direction of the conclusion is clear. At low data rates and low penetration rates, HFC technology is less costly. As data rates and penetration rates rise, SDV fiber-to-the-curb (FTTC) technology is less costly, thus it becomes the most cost-effective alternative. *(Editor's note: These assumptions may not be valid with other cost assumptions for HFC. Depending on density, specific architecture, node size and other factors, HFC network costs per home passed may range as low as $200-$600.)*

HFC costs increase with increasing penetration because of the addition of equipment needed for providing the larger capacity required to meet demand for dedicated bandwidth. The increase in slope of the cost curve beyond 20% penetration is the result of moving the optical node to serve fewer homes to provide the additional bandwidth per home passed that is required to meet the demand. The SDV curve is flat reflecting the fact that sufficient bandwidth is available to meet the demand because the optical node is placed close to the subscriber from the outset. Data intensive services such as Internet and work-at-home may actually drive this

Figure 2: Upstream and downstream bandwidth requirement



crossover point lower as a result of the upstream bandwidth demanded by data services.

High-speed requirements

Internet and work at home access today use the existing telephone network, usually over standard telephone lines. Work-at-home telecommuters often need extra phone lines for fax and voice, and many will need access to their business or local area network (LAN).

Bandwidth requirements, as shown in Figure 2, are critical in the selection of an architecture. Data access over standard phone lines is slow, with good lines capable of supporting up to 28.8 kbps (kilobit per seconds). High speed data requirements are at least 1 Mbps (megabit per seconds) downstream and 128 kbps to 1 Mbps upstream, with up to 10 Mbps or greater for downstream full-motion video, voice and large data files.

Low latency is critical to the performance of applications such as video conferencing, multi-party video games, "chat" lines and groupware. These applications require "real-time" interactivity, and variations or delays in the network limit the ability of the network to serve these applications.

Bandwidth and latency of a network are relative to the demands placed on it by the services to be transported and the level of simultaneous users. Because the design of HFC systems is rooted in a broadcast-oriented approach, delivery of point-to-point services is problematic, especially as the demand for those services increases leading to many simultaneous users contending especially for upstream bandwidth on the shared coax facility. In contrast, the design of SDV systems is rooted in a point-to-point approach providing dedicated 52 Mbps downstream and 1.62 Mbps upstream bandwidth to the end user. Additionally, SDV uses hardware-based, ATM cell routing to provide a low-latency downstream and upstream path, unaffected by load.

Security is of paramount concern to all data services applications as well. In HFC all signals are broadcast across the shared coaxial network where set-tops and cable modems tune or "eavesdrop"

Reader Service Number 10

to their signal on the network. All users on that shared coax have access to all signals, leaving room for theft and malicious interference. Network encryption is believed to overcome signal theft, but adds greater cost to the network. Since the SDV architecture is a star and not a bus, one home never has access to signals being received by another home. In other words, unauthorized signals are never there to steal with SDV. The control of the network is maintained in the network. This SDV feature avoids costly encryption electronics and software.

Reliability can be looked at in terms of network performance. Shared coax distribution service drop and house wiring condition play a significant role in the performance issues of HFC networks. Both adversely affect the bandwidth and reflection environment and both are the primary contributors to noise ingress problems. Most of the problems occur because of poor-quality wiring, splitters and connectors. The noise is of sufficient magnitude to interfere with the subcarriers transporting digital signals. The net effect of this noise environment is that reverse channel signals may be routinely interrupted, leading to low service quality for data services applications, requiring the additional cost of frequency agile schemes to overcome this noise.

"Published studies indicate that the costs can be similar for both approaches."

Since SDV architecture takes a fundamentally different approach to signal distribution than HFC architecture, many of the previously mentioned problems are eliminated or minimized. While noise is present in the drop and house wiring in the SDV architecture, the use of point-to-point drops eliminates the noise funneling problem faced by shared-bus HFC systems. Frequency agile schemes are not required to overcome impulse noise. The result is a much simpler approach and reduced cost in the optical node and data modem electronics in the SDV approach.

HFC systems will offer cable modems for the high-speed data services interface. The cable modem interfaces to the HFC system coax cable and provides a standard Ethernet 10BaseT interface for a point-to-point computer connection. The subscriber computer also requires an Ethernet 10BaseT interface. The actual data transfer rates are highly dependent on bandwidth contention with other users on the same shared coax bus. →

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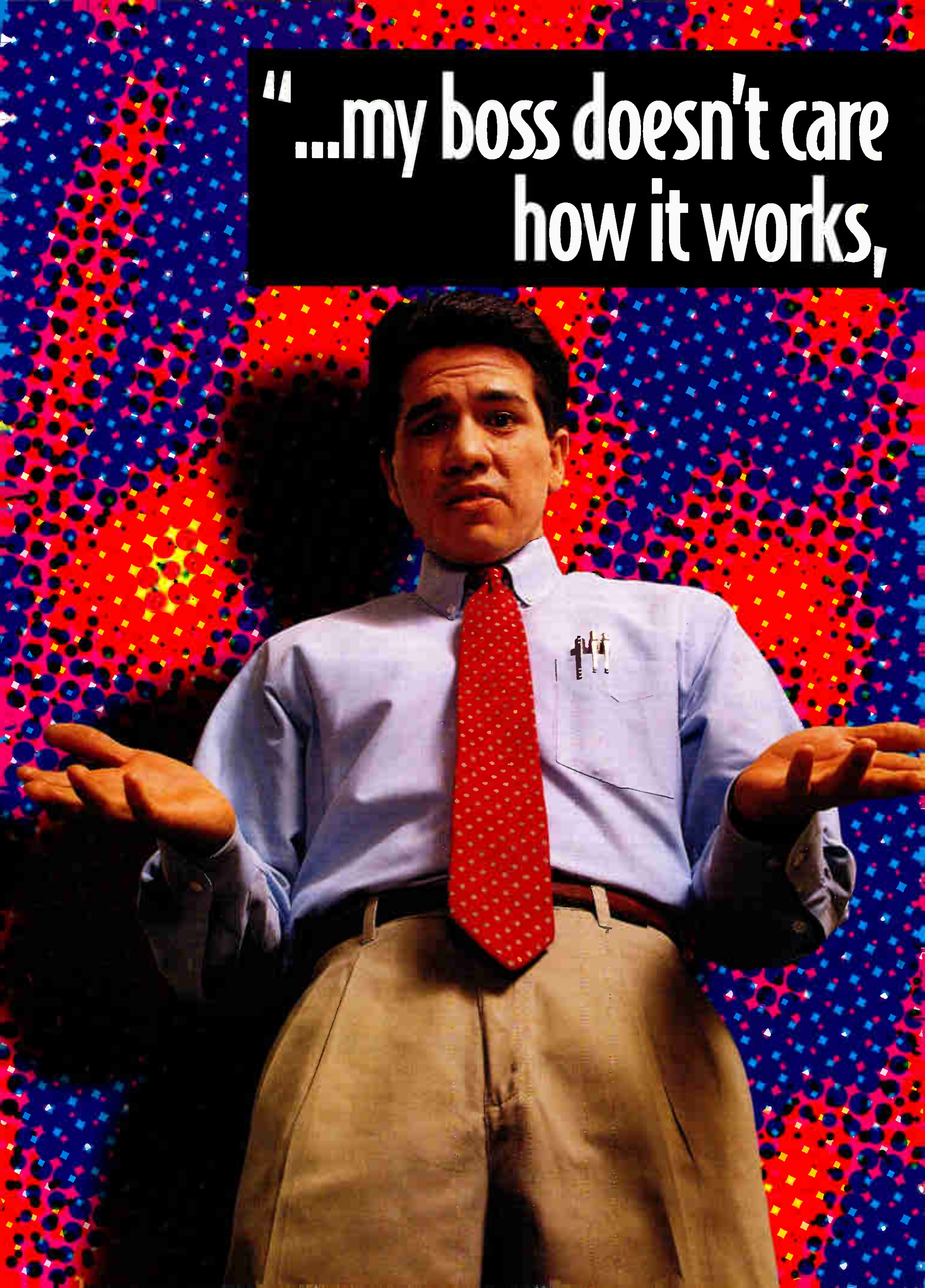
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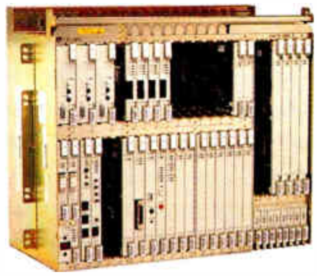

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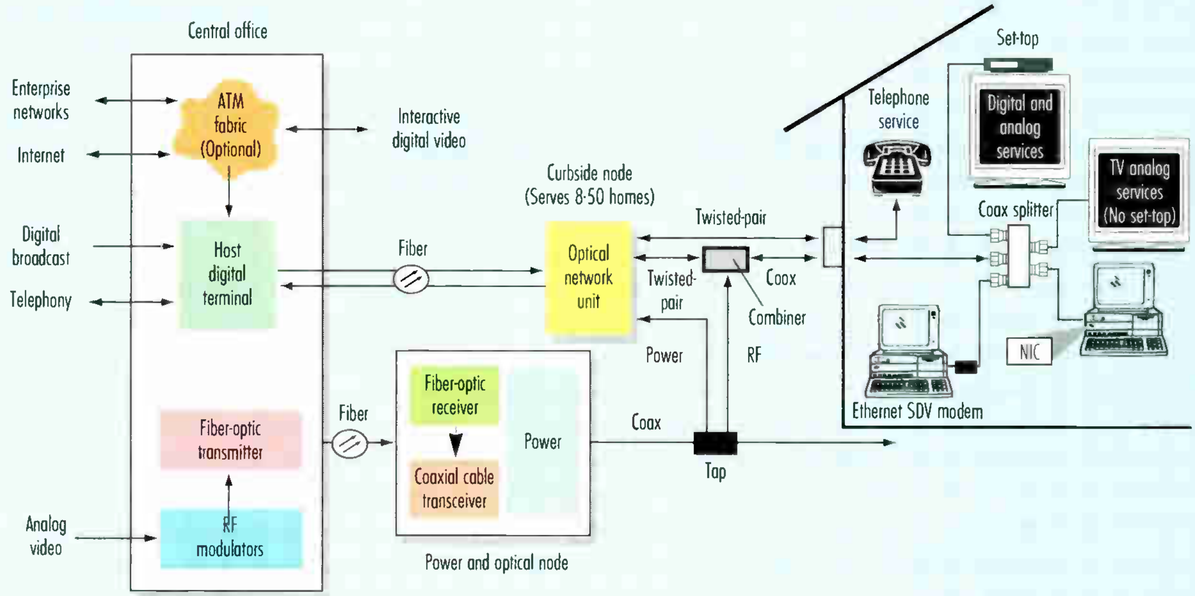
Figure 3: SDV fiber-to-the-curb broadband delivery platform



SDV systems (see Figure 3) will offer a simplified network connection with the network interface card (NIC). The NIC is a simple digital interface between the SDV drop and the peripheral component interface (PCI) bus, which is the industry standard computer backplane interface. It supports an end-to-end asynchronous transfer mode (ATM) network and full SDV payload of 52 Mbps downstream and 1.62 Mbps upstream drop. The interface is relatively simple and does not require the additional network interface costs of HFC. SDV systems also will offer SDV modems with the Ethernet 10BaseT interface, similar to the HFC cable modems but with the simpler SDV interface.

Service independence is achieved in SDV systems by delivering a standardized—not proprietary—ATM packetized signal to the home. ATM is an open standard for transporting any type of digital data. Any service provider can easily adapt their specialized home terminals to accept an ATM input using currently available chip sets. The availability of the chip sets and the standard compliant interface will speed the availability of services. The result will be that consumers will be able to purchase different types of services more quickly.

"SDV FTTC has many advantages over HFC for network deployments where multiple services and moderate or better service take rates are expected."

Benefits

SDV FTTC has many advantages over HFC for network deployments where multiple services and moderate or better service take rates are expected. SDV technology provides a single broadband delivery platform for bundling services and creating network revenue generating opportunities. The platform is cost effective for near-term and long-term deployment capability and provides service independence with an all-digital transport based upon industry standards such as ATM and synchronous optical network (SONET).

Telcos have installed SDV extensively in labs and field trials domestically and internationally for several years. SDV networks are in commercial deployment in Dover Township, NJ, and Richardson, TX, with revenue generating broadband video services operating on them. The next logical service extension is to offer data service. SDV offers the choice of industry-standard, high-speed network interfaces: either the NIC for maximum bandwidth capability through the network or the Ethernet SDV modem for legacy computers without PCI bus capability.

Upgrading networks to either the HFC or SDV broadband delivery platform typically requires extensive rehab of outside plant, providing the opportunity for telephone and cable companies to evaluate and deploy either architecture. Telephone companies are choosing SDV because of its robustness for the long-term as a cost-effective broadband delivery platform for multiple services. Cable companies looking to differentiate their service offerings should explore the benefits of deploying SDV as a broadband delivery platform and the competitive advantages it offers for many deployment opportunities. **CT**

By Raja Natarajan and Paul Vilmur

Providing high-reliability telephony and data over HFC

The following is adapted from a presentation given at the Society of Cable Television Engineers' 1996 Conference on Emerging Technologies.

CATV networks are designed to provide broadcast video services in an efficient manner. These networks are now being upgraded to provide two-way telecommunications services. Surrounding this upgrade are several questions about the capabilities and limitations of the upgraded network. In this article we attempt to identify the strengths and weaknesses of an upgraded CATV network, how it could evolve to meet future needs, and how it compares to other access technologies (e.g., fiber-to-the-curb—FTTC) that are currently being considered for deployment.

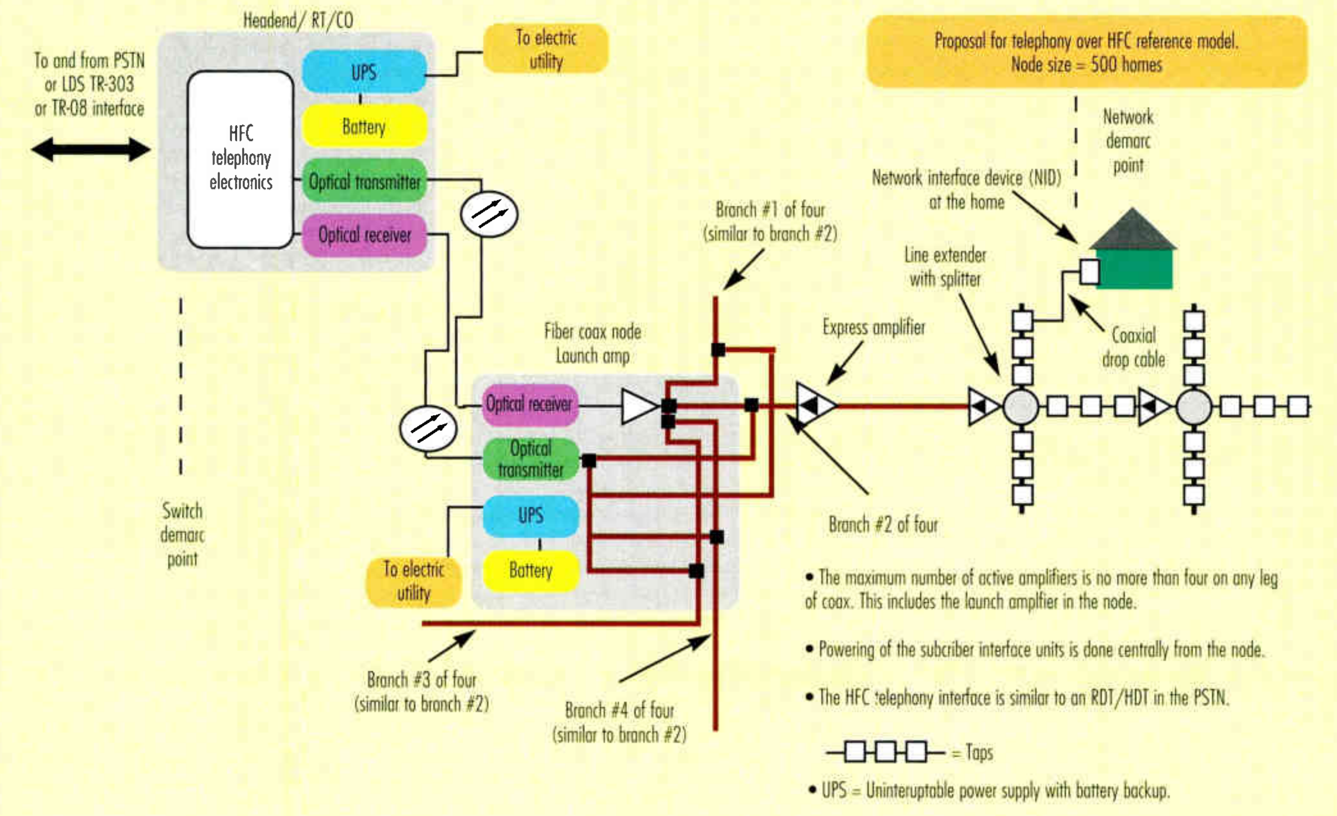
Raja Natarajan and Paul Vilmur are staff engineers with Motorola Multimedia Group.

The main source of confusion is the reliability of CATV networks. The CATV network has historically been designed and built for cost-effective distribution of broadcast video services. The networks had as many as 20 or 30 amplifiers in cascade and no sophisticated network management system. The decision to upgrade the CATV network, in the past, was based mostly on economic savings. Today, technology to provide telephony services over the CATV network is available and is planned to be deployed by both CATV companies and telcos. To compete in the telephony market, CATV networks have to be upgraded to meet the quality and reliability customers have come to expect from telephony services.

The complex nature of today's communications networks with ever-increasing dependence on protocols and network management software requires vendors not only to produce near zero-defect hardware but also exceptional software quality.

The telco-provided "lifeline" telephone service has well defined requirements and reliability criteria. As more telecommunications companies are starting to deploy a CATV-like hybrid fiber/coax (HFC) architecture for providing both video and telepho-

Figure 1: HFC reference model



Elements of the HFC reference model

Element	Quantity	AFR (%)	Median MTTR (hours)
HDT	1	2.1	2
Headend UPS	1	0.2	2
Headend laser	1	2.32	2
Headend optical receiver	1	0.71	2
Optical fiber	6 miles	2.64	6
Optical node	1	2.1	4
Optical node UPS	1	0.2	4
Coax cable	1 mile	0.44	6
Express amplifier	1	0.63	4
Line extender	2	0.48	4
Directional coupler	1	0.13	4
Taps	8	2.1	4
Drop cable	100 feet	1	4
NID	1	3.3	4

ny services, there is a need to understand the underlying reliability and service capability of the HFC networks.

Reference architectures

Figure 1 (page 82) consists of an active and an optional protect path (not shown) to the optical node. From the optical node, the coaxial distribution cable is launched in four directions with each coax serving approximately 125 subscribers. This architecture allows the network to be upgraded gracefully to meet increasing need for bandwidth by the addition of electronics at the headend and at the fiber coax node. There are no more than four bidirectional amplifiers in cascade on the coaxial cable distribution to maintain high reliability for telephony services. This is possible by limiting the area served by the fiber coax node to approximately 500 homes.

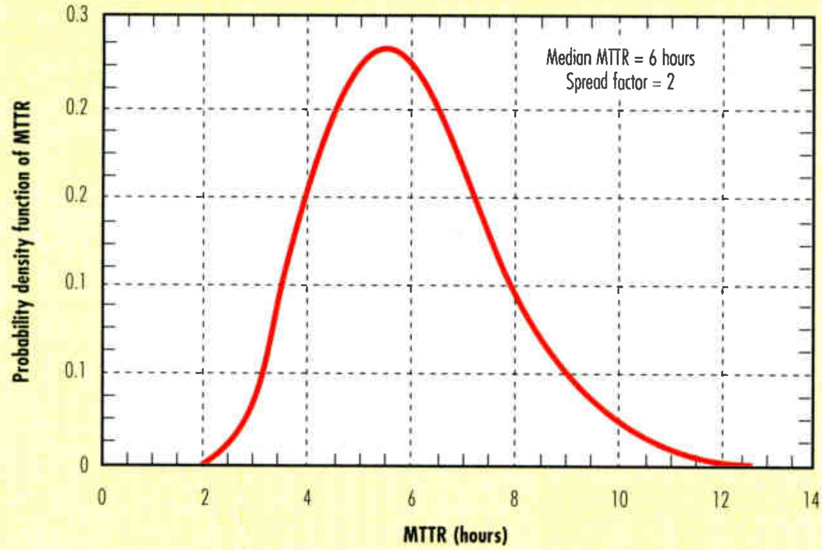
Reliability

Common concerns about HFC networks include reliability, powering, noise ingress, upgradability and services.

The CATV network is designed to provide broadcast video services in a cost-effective manner. The reliability of the CATV network is therefore engineered to meet the requirements of the broadcast video service. To provide telephony services, the CATV network has to be upgraded with fewer and better amplifiers, more fiber, backup to commercial power, network monitoring/operational support systems, and follow consistent methods and procedures on installation and maintenance.

The availability of an HFC architecture (using Figure 1 on page 82) is a function of the failure rate of the ele-

Figure 2: MTTR distribution of fiber cable repairs



ments of the reference model as well as the mean time to repair (MTTR) for each element. This relationship is indicated in the following equation:

Outage (minutes/year) =
0.6 AFR (%) MTTR (hours)

In this equation, the element failure rate is given as an annual failure rate (AFR) in percent.

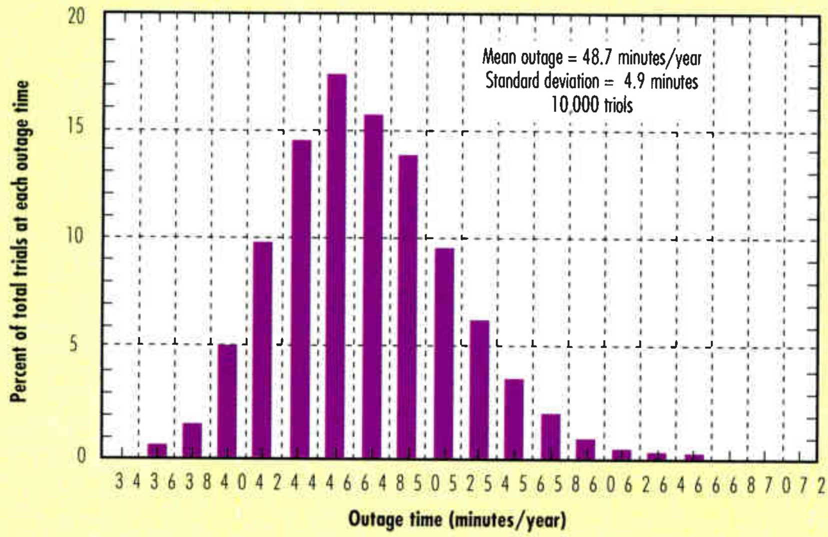
Referring again to the HFC reference model, the elements of the model along with their annual failure rates and median mean time to repair are given in the accompanying table.

The annual failure rate for each element is based on the latest data available.1 The only assumption of network redundancy made is that the power supplies in the headend and at the fiber node are backed up.

Since all the elements of the HFC model are in series, the total outage time will be the sum of the individual element outage times given in the previous equation. The median MTTR is two hours for elements in the headend, four hours for elements out in the network and six hours for fiber/cable repairs. The MTTR will have some distribution around the median. For this example a lognormal distribution is assumed with a spread factor of 2; that is the 1% and 99% points of the cumulative density function are assumed to be at the median value divided by 2 and the median value times 2, respectively. An example of the MTTR density function used for cable cuts is shown in Figure 2.

Using similar distribution functions for headend and field MTTRs and the AFRs from the table, 10,000

Figure 3: Outage distribution for the HFC reference model



trials were run using the above equation to get an outage distribution for the reference HFC model. The results are shown in Figure 3.

The mean outage is 48.7 minutes/year with a standard deviation of 4.9 minutes. A cumulative density plot of this outage distribution shows that for the particular MTTR distributions used in the example, 90% of the time the outage will be less than 53 minutes per year and that 99% of the time the outage will be less than 60 minutes per year. (See Figure 4.)

As more HFC networks are deployed with comprehensive network management systems and with the ability to test the network from the PSTN switch interface to the NID at the home, the median MTTRs will be reduced with a resultant reduction in overall outage time. For example, if the median MTTRs can be reduced by as little as 20% by network monitoring and testing, the resulting outage distribution shown below indicates that outage time will be less than 44 minutes 99% of the time.

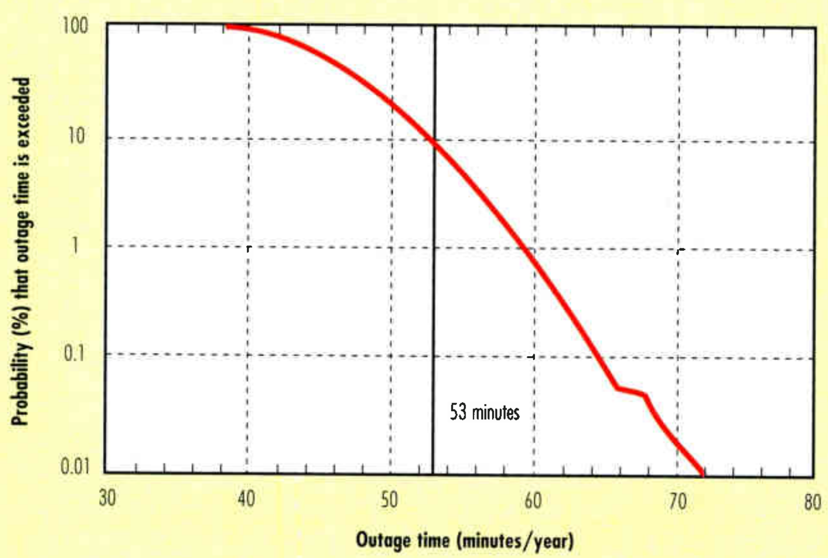
Powering issues

Powering is an issue for the following reasons:

- Commercial power without backup batteries is not reliable enough to support telephony services.
- Capacity of batteries vary widely with temperature and age of the battery.
- Monitoring, maintaining and disposal of batteries is a problem with distributed power supplies with backup batteries.
- The existing CATV drop cable in some places may not be suitable for carrying power.

Some of the powering issues are common to both FTTC and HFC. Since the FTTC architecture does not have a metallic media from a central location, an overlay powering network is required to network power the curbside optical network units (ONU) serving between four and 24 homes. In an HFC network with centralized powering, it is sufficient to provide battery/generator backup at the fiber/coax node location serving approximately 500 homes. Centralized powering capability on the same coaxial cable that carries the telecommunications services is a feature of the HFC architecture that solves most of the powering issues and increases the reliability of all the services. In addition, centralized powering along with a backup generator allows a lower capacity backup battery.

Figure 4: Cumulative density of HFC model outage time



Noise ingress

The HFC architecture, as it exists today and will exist at least in the near future, uses the 5 MHz to 30/40 MHz band as the return communication band from the subscriber to the headend. This band is subject to ingress interference into the cable distribution plant from sources like short wave broadcasts, amateur radio, CB radio, paging transmitters and maritime radio as well as impulse noise interference from sources like home appliances, motors, lightning and automobile ignitions.

Most FTTC systems that use the same coaxial cable drop for analog and digital video/data services, make use of the sub-split spectrum (5 to 35 MHz) for the digital video and data to and from the subscriber. Therefore, these systems suffer from similar noise ingress issues as HFC. In addition, such FTTC systems require a noise-free sub-splitband in the inside house wiring.

There are a number of steps that can be taken either to reduce the levels of ingress in the return plant by

the service provider, or mitigate the effects of ingress on the service offered by the equipment provider. These include:

1) Incorporate a comprehensive return plant maintenance program. This could include: tightening all loose connectors; replacing corroded connectors; sealing the distribution plant from water migration; examining the distribution plant for cracked cable sheath and RF leakage; and checking for proper bonding and grounding.

2) Segregate the return plant bandwidth and block the portion allocated to telephony services from ingress from the home.

3) Provide frequency agility so that the return signal can avoid interfering carriers.

4) Use a robust modulation scheme or include forward error correction as part of a conventional modulation method for high-speed data applications.

Upgradability

Upgradability is a major strength of HFC networks. The fiber node size can initially serve a large number of homes passed and based on market needs, the node can be split to a smaller size, thereby increasing the bandwidth available to each subscriber. This reduces the up-front investment, especially when the demand for new services is not clear. With FTTC, the ONU size has to be decided up front and is difficult and expensive to change at a later time.

In an FTTC system, there is typically a modem at either end of the drop cable. Though a high-bandwidth signal is brought to the ONUs, the modem limits the amount of bandwidth that can be delivered to the subscriber (e.g., 50 Mbps downstream and 1 Mbps upstream). The electronics in every ONU have to be changed to upgrade to a higher bandwidth. Because the entire spectrum is broadcast in an HFC network, it is possible to provide bandwidth-on-demand.

Services

The HFC network can support all of the switched as well as ATM/packet-based services envisioned for now and in the future, including high-speed Internet access, video-on-demand, work-at-home, interactive services, games, transactional services, video telephony, tele-education, and analog CATV services.

The HFC network can provide all of these services over a single integrated infrastructure. The FTTC network requires multiple networks to support the same. This results in increased cost not only to build the network but also in ongoing maintenance.

The HFC network meets the needs of the market today and grows gracefully to handle the needs of the future. A properly designed HFC network can exceed the reliability objectives of today's telephony services. **CT**

Reference

[1]*Merk, Chuck, and Srode, Walt, "Reliability of CATV Broadband Distribution Networks for Telephony Applications, 'Is It Good Enough?,'" 1995 NCTA Technical Papers, pages 93-107.*

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Reader Service Number 196

INTERVIEW

By Alex Zavistovich

Q&A with the FCC's John Wong

John Wong is chief of the engineering and technical services division of the Federal Communications Commission's Cable Services Bureau, and the primary cable technical consultant to the rest of the Commission. The FCC has been his sole employer; he started at the Commission in 1977, after graduating with a BSEE from the State University of New York at Stonybrook. Wong also has completed graduate course work in telecommunications policy at George Washington University in the nation's capital.

"Communications Technology" Senior Editor Alex Zavistovich recently sat down with John Wong to discuss the implications of emerging technology and increased competition in the cable industry. The views expressed are Wong's and do not necessarily represent or reflect those of the FCC.

Communications Technology: *Let's talk about the implications of the Telecommunications Act of 1996. Has the FCC discussed the formation of any new departments to regulate telephony or PC data flow, or any new services cable operators may get into?*

John Wong: That question is slightly ahead of time. There are some plans on how to handle some of the more immediate issues, but it's a bit premature to provide details. Depending on how everything shakes out of the 80 or so rulemakings that are part of the act, that will determine what the future organization may be. I don't know how far away that new organization may be.

CT: *It looks like some MSOs may be planning to "overbuild the Internet" to allow access to more than the Internet and whatever other on-line services currently exist. Is that business currently regulated by the FCC?*

Wong: It's at best tangentially regulated by the Commission, but the Commission also is looking at how the different businesses are becoming intertwined with each other and what new ventures are going to be developed. We will encourage as much competition as we can for all

the industries, and for new players in some business' traditional areas of dominance. That will be increasing, especially in light of the new act.

CT: *So the FCC does feel a need to get involved in the regulation of these services? To what degree do you feel you might be involved?*
Wong: The FCC doesn't necessarily feel a need to be *involved* in the regulation; still, we're going to keep a close eye on it.

CT: *Are LANs and WANs now regulated by the Commission?*
Wong: In terms of interference from the equipment, yes. In terms of the overall network structure, no.

CT: *Most of the older franchises don't mention fees on data transmitted from customers' homes. Do you foresee any case in which cable operators may have to pay extra franchise fees for the extra services?*
Wong: Franchise fees are strictly between the local municipalities and the cable operator. In terms of franchising issues, that's outside the scope of what we do here.

CT: *Some customers may want to subscribe only to high-speed data services, not necessarily to cable video services. Is PC interconnection with cable lines likely to be another area of regulation?*
Wong: In the best of all worlds, that issue should be kept between the subscribers and the operator. Less government intervention is best, in any case.

CT: *What are the current actions your division is working on?*
Wong: Most of the work that I do here is pretty much old news in terms of signal leakage and technical performance standards. We are trying to stay on top of what's being done in the industry in terms of equipment compatibility. We also keep on top of other issues, including home wiring and overbuilding by telephone companies. Currently, there are more legal and political issues involved than technical issues, because the technology is already out there.

CT: *You mentioned equipment compatibility. Many cable vendors have*

begun working together to establish interoperability standards, especially for data delivery over cable. How does what these groups are doing relate to what the FCC may require?
Wong: I think the best way to go for the industry is for a de facto standard to be established by these groups, rather than having the FCC become directly involved. The industry knows best what its needs are and what equipment it needs to buy to meet those needs. It can be difficult for the FCC to tell the industry, "this is best for you." Rules and regulations in technical areas, especially in these fast-changing technological times, are difficult to establish. Whatever we adopt may be three years behind by the time we adopt it. So it's best to have the industry establish standards where it sees a need, then come to us for endorsement or, in the worst case, make it a requirement.

CT: *Are there any specifications that the FCC considers necessary for data transmission?*
Wong: We have not issued a notice of proposed rulemaking on digital standards because the technology is changing so fast. Where would we begin? There are many different layers involved. Should we look at digital standards only at the output of whatever magical black box it's coming through? Should we deal with the transport layer?

I think the main thing the Commission may want to do is look at the output, then treat the whole network and all the equipment as a black box, and not regulate the input. I think we should let the industries loose and let them develop their competitive devices, so long as we all understand they must fit into a particular framework. Anything beyond that may slow down the industry in terms of competition, development and design.

"The industry knows best what its needs are and what equipment it needs to buy to meet those needs."

CT: *But in the meantime, will there be any involvement at all on the part of the FCC—any technical specifications to mitigate the effects of ingress on the system?*
Wong: Ingress is something the industry can correct for itself. The reason is, when you have ingress or noise going into the system, it can create havoc with whatever it is you're doing, or it may cost you more to filter out the noise; it's obvious you need to do something about it. At the Commission, we're concerned more with *egress*, or interference with other services that may be

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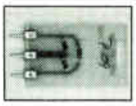

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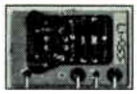

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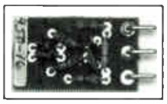

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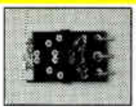

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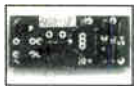

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caused by the users of the equipment or the network.

Cable operators run the gamut of spectrum from 5 through as high as 750 or 1,000 MHz; there's just so much over-the-air usage in that area. There is a problem in terms of signal leakage from the plant that affects these over-the-air services. Ingress, especially when dealing with data delivery, may be corrected by the industry.

On the other hand, I can say for sure that the Commission's cable signal leakage rules—which are for egress limits—have helped the industry tighten up their plants. By setting up those rules, we tightened up the system, and allowed cable operators to go digital more easily.

CT: *We're talking about the cumulative leakage index (CLI) rules?*
Wong: That's one set of rules, yes.

CT: *How are systems doing filing Form 320 for CLI?*
Wong: So far, they're still doing pretty well, but I can see we've reached a plateau in terms of the data we're receiving. Like anything else, the Form 320 requirement was implemented some time ago, in 1990. It's been five years; the issue is no longer in the spotlight. The attitude of responsibility for signal leakage is coming down. As that goes down, the importance attached to those requirements also decreases. My guess is that the level of responses is not going to improve in the next couple of years.

CT: *Is there any specific technology for the cable industry that's fascinating you these days?*
Wong: I'm an old cable hand, so my heart is really with cable. I see the cable industry with this huge conduit, which makes things a lot easier in delivering whatever you may want. It all comes down to how you use it. When operators are laying fiber, they're putting in large bundles, so there's a lot of dark fiber. It's just a matter of time before cable operators are able to switch back and forth, and create even larger conduits.

Cable operators also have the luxury of bandwidth; that means the laws of physics are going to be on your side, and you may not have to worry about squeezing or compressing signals to make applications work. With cable, I mean, 10 megabits per second for data—what is that to a 750 MHz system? Yes, there are return path problems, ingress problems, equipment problems. You do have to ask what that's all going to cost. On the other hand, the black box that may answer that question may be just over the horizon. I'm fascinated by how the cable industry can use this great infrastructure to do whatever it pleases.

CT: *So, who do you think is going to come out on top in the long run, the telcos or the cable industry?*
Wong: *(laughs)*

CT: *Well, I had to ask.*
Wong: In the coming years, I don't think the two are going to be that different. Let's just leave it at that. **CT**

By Ernest Tsui and Michael Meschke

Digital testing: Keeping signals robust

Some of the key differences in the testing and diagnosis of digital vs. analog signals were discussed in our previous article (*Communications Technology*, May 1996, page 82). This time we're focusing on keeping digital signals sufficiently robust to provide clear pictures without appreciable danger of rolling over the "falls" into the freeze-frame area.

The analog/digital difference occurs fundamentally because unlike the relatively simplistic analog processing circuits for NTSC, digital signal circuits are adaptive and performance-dependent based on the particular design. Nevertheless, specifications for set-top performance need to be developed and used to determine what impairments can be tolerated. Digital signals must be just as reliable (and probably more so) as analog NTSC signals because they will carry pay-per-view (PPV) revenue (upstream), cable modem data and telephony in the future.

"Two-way interactive transmissions ... will make bit error rate measurement an important performance parameter."

Analog TV signals allow the technician to diagnose problems via the TV picture. The technician then goes about repairing the system such that the impairment(s)—e.g., composite triple beat (CTB), carrier-to-noise (C/N), etc.—meet Federal Communications Commission and cable operator standards, then checks to ensure the picture is satisfactory.

On the other hand, there are no FCC regulations or cable operator standards for digital signals at this time. Early digital installation and maintenance need to be as robust as possible since digital performance will be highly dependent on the type and design of the tuners, filters, demodulator, equalizer, error correction, deinterleaver, etc., in the set-top subsystem. Secondly, further testing needs to be done to quantify performance standards.

To ensure that digital signals operate satisfactorily, they must have a built-in margin to allow for impairments that will drift (or vary) with time or with changing environment (temperature, humidity, hair dryer turning on/off, etc.). This margin is the performance parameter that will keep the signal from going "over the falls" into a severely degraded digital picture or freeze-frame mode.

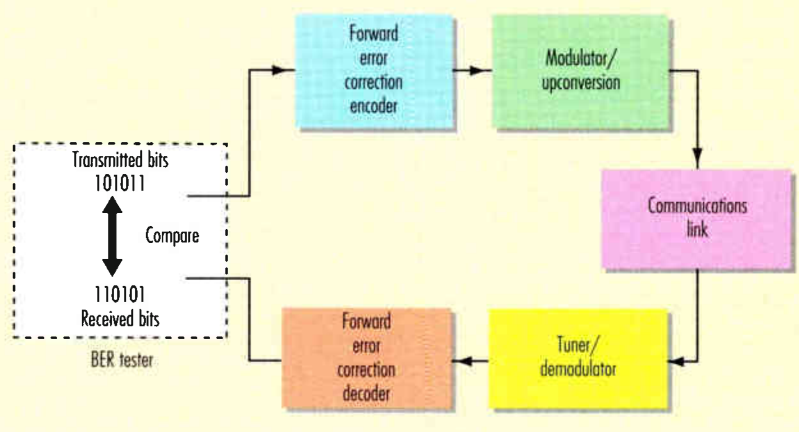
Margin measurements

In order to understand margin, the bit error rate (BER) measurement needs to be introduced. The BER measurement is commonly used in telephony, microwave and satellite communication systems that utilize digital modems (modulators/demodulators) to transmit data, voice and video. Today, one-way digital transmissions travel over cable for the transmission of DMX and/or Sega channels. Two-way interactive transmissions over cable modems, interactive TV and telephony signals will make BER measurement an important performance parameter. New digital set-top boxes and cable modems will most likely have a built-in BER measurement system that also can be monitored.

BER

Let's explain the BER measurement. Figure 1 shows a generic BER test setup. First, the test communications link must be chosen. One exam-

Figure 1: Generic bit error rate setup



Ernest Tsui is division manager and Mike Meschke is senior staff engineer at the Commercial Telecommunications Division of Applied Signal Technology.

ple would be a link starting at the headend and ending at the subscriber's set-top box. At the headend, a known sequence of bits is generated in the BER tester and is then modulated to be inserted into a 6 MHz channel slot. At the subscriber premises the output of a demodulator and FEC decoding is taken (through appropriate test equipment or, if available, through test points in the set-top box) and input into the BER test receiver. This data is compared with the known sequence of bits transmitted through the BER test transmitter at the headend. (See Figure 1, page 100) Any bits in error are noted, as well as the ratio of the number of bits in error over the total number of bits transmitted over a sufficiently long measurement time to achieve the required BER accuracy.

The BER averaging time is a very important parameter because the lower the actual BER, the longer it will take to get an accurate reading. This is because at lower BERs, there are fewer bit errors and it takes a certain amount of time to get a good statistical sample of the errors. For example, it is well known that in a coin toss, the probability of getting heads or tails is 50%. If you flip the coin only four times there is a high likelihood that you may not get the desired two heads and two tails—in fact, the probability is only one in four! However, if you flip the coin 1,000 times, there's a much better probability that you would get an accurate 50% heads/tails count.

The same concept holds for bit errors. If the desired BER is 1 error in 10 million bits on the average, then it would not make sense to make the measurement over 1 million bits, because the error may not even turn up, or there is a chance that, for example, a 6-7 error burst may occur as well. A good rule of thumb for random (non-bursty) errors is that the error rate measurement confidence level is good to the inverse of the square root of the number of errors in percent. For example, if nine errors are measured over an interval of time, then the BER measurement is accurate to approximately $1/\sqrt{9}\% = 33\%$. If 100 errors can be measured, the measurement is accurate to 10%. This 10% variation in BER will generally translate into a C/N or margin error of less than 1 dB, which is sufficiently accurate for most purposes.

To illustrate the time interval requirement, let's say that you want to measure the error rate to 10% accuracy and the actual error rate is one error per 10 million bits transmitted. To get the required 100 errors, an average of 100 errors x 10 million, or 1 billion bits, need to be transmitted! Assuming that approximately 30 Mbps (Megabits per second) are transmitted, it would take approximately 33 seconds to accumulate the 100 errors. Table 1 (page 104) provides the required averaging times as a function of BER and data rate for a 30% BER accuracy.

Other methods of estimating the BER from the forward error correction and decoding circuits also are available, which is extremely useful for in-service testing. This procedure is complex enough to warrant its own article, but for now it suffices to say that BER testing for cable will have to be

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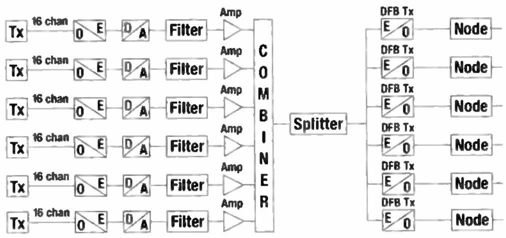

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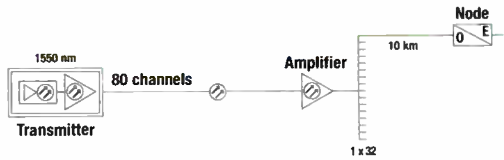

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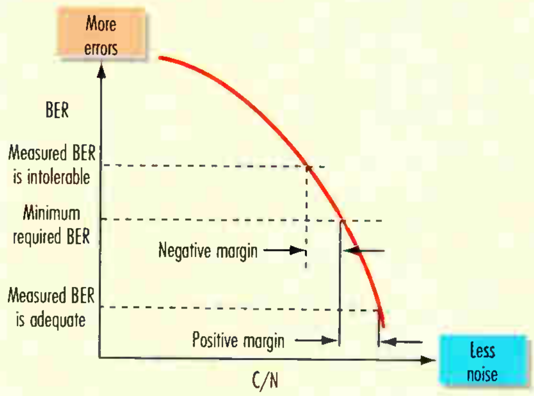
Table 1: Required BER averaging times

Data Rate BER	300 kbps (upstream example)	3 Mbps (digital music example)	30 Mbps (cable modem example)
1×10^{-4}	330 ms	33 ms	0.3 ms
1×10^{-6}	33 s	3.3 s	0.3 s
1×10^{-8}	33,000 s	3,300 s	330 s

(30% BER accuracy assumed; significant reduction in averaging time required over 10% and still <1 dB accuracy)

as ubiquitous as it is for telephony, microwave and satellite to maintain system performance for the MSO's digital modems.

Figure 2: Margin calculation

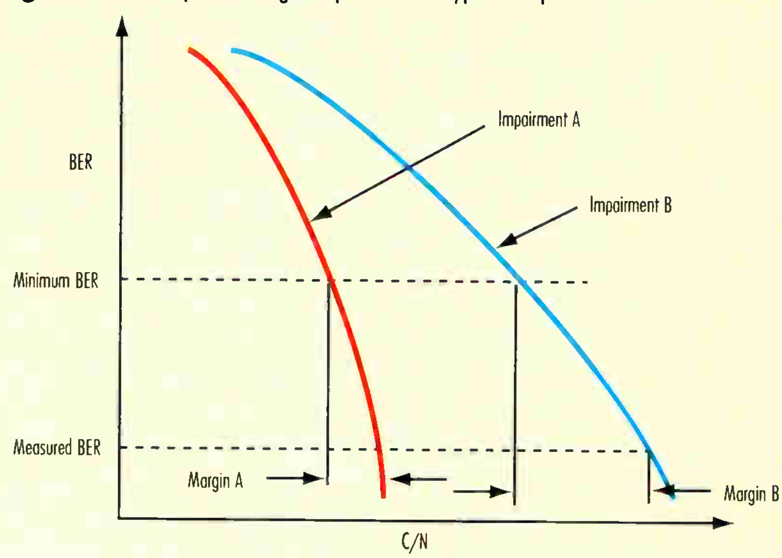


The margin

The margin is defined as the required C/N—or signal-to-noise ratio (S/N)—required to get from the actual BER to the required BER. Figure 2 illustrates the concept of margin using BER measurements. Positive margin is defined as the amount the C/N needs to degrade (usually in dB) before the minimum acceptable BER is reached. Negative margin is defined as the increased amount of C/N required to decrease the BER to an acceptable minimum rate. (See Figure 2.)

C/N is used here because it is familiar to the cable technician and engineer in relation to the analog signal C/N. For digital signals, the equivalent to this is the average signal-power-to-noise-power ratio (measured in the signal's symbol rate bandwidth). Since QAM (quadrature amplitude modulation) signals are normally Nyquist transmit-filtered and matched-filtered at the receiver, the noise bandwidth equals the symbol or baud rate exactly (e.g., for a 5 Mbaud signal, the Nyquist filtered noise bandwidth is exactly 5 Mbaud as well). →

Figure 3: Example of margin dependent on type of impairment



It is known that BER curves will differ depending on the impairments imposed on the signal as well as how the demodulator reacts to them. In fact, the BER measurement alone will only be marginally useful in cases where the impairments are not diagnosed, since there is not an accurate correlation between C/N required to get the BER from where it is to where it ought to be if the impairment is not known. Clearly, nor is there a general way to diagnose the impairment from just observing the error rate. To illustrate this, Figure 3 on page 104 shows BER vs. C/N curves for two different impairments (a mild impairment, A, and a severe impairment, B). As is illustrated, the margin for impairment A is much smaller than the positive margin for impairment B, although they both measure the same BER. A more realistic case is when there is negative margin or when the measured BER exceeds the minimum required BER. In this case, the additional C/N required to "mitigate" the effects of impairment B can be substantially more than for impairment A.

Thus, the nature of the impairment(s) must be diagnosed before the available margin can be accurately estimated. In any case, the BER should always be measured. If it is higher or lower than required, this should be noted before further diagnosis.

Negative margin

If there is a negative margin, the impairments should be diagnosed to correct the BER deficiency. However, the diagnosis problem is compounded (as discussed in detail in our article in the May issue of *CT*) by the fact that the digital TV picture is nearly useless in giving information on the nature (or level) of the impairment. The diagnoses for digital signals will have to be made on the signal itself. Based on these estimates, the margin can in turn be calculated.

Positive margin

One method of estimating the amount of positive margin is simply to add noise to the signal until the BER is degraded to the minimum acceptable level. The amount of noise added in dB is then the margin. This method is not acceptable when there is negative margin, as clearly can be the case when a technician is servicing a trouble call. The reason is that one cannot easily take noise away from the signal to achieve the required lower BER. If we could do this, we would all have perfect TV pictures all the time!

Clearly, when there is negative margin, the technician will have to diagnose the problem first and then estimate the margin after the problem is corrected.

Again, the BER/margin measurement can be made at any point in the system although, in general, it will decrease from the headend outward into the system. In the following, we discuss system design and measurements that are made at various points in the cable system to ensure reliable digital signal transmission.

Digital power requirements

How much power should be allocated to digital? If the system requires additional channels and there are few vacant channels available, digital signals can be added at the rate of 10 to 15 or more digital TV channels for each analog 6 MHz channel allotted. The digital signals do not have to be -10 dB down in this case, since there are only a few signals and they will not significantly affect CTB, CSO, etc., through the system amplifiers. In fact, in our experience, the digital signals should be given as much power as possible (at least equal to the analog signals) to ensure that they are robust. This is because the vacant channels are usually vacant because they are either in a roll-off region or are in a band that has significant "over the air" interference. Thus, the digital signals need more power to overcome the resulting loss of carrier-to-interference ratio (C/I).

For a rebuilt system with 750 MHz capability, with analog from 50-450 MHz and digital from 550-750 MHz, the digital signals should be transmitted with reduced power (6-10 dB below analog) to avoid significant intermodulation effects on the analog (and digital signals) carriers through the system amplifiers as reported by Hamilton and Stonebeck.[1] Waltrich also suggests the use of a noninterfering sweep.[2]

Checking headend signal integrity

If the headend digital signal has distortions, they will result in a reduction of margin to all subscribers. It is therefore extremely important to

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Table 2: Examples of interference sources

Internal	External
Electric blenders	Citizens band radio
Hair dryers	Ham radio
Lawn mowers	Shortwave radio
Electrical motors	Paging
Microwave ovens, etc.	Land mobile
	Auto ignition noise

maintain signal integrity in the headend. Periodic measurements should be made to ensure proper transmitter frequency output, transmit (Nyquist) filter frequency response, "constellation alignment" (i.e., I/Q quadrature distortions), baud/symbol rate accuracy, cluster variance (i.e., "tightness" of constellation points), etc.

Observations of C/N and C/I also may be performed at the headend to estimate the C/(N+I). Aging headend installations may experience increased ingress and/or noise and digital signals because their noise-like appearance tends to hide these degradations. However, by observing "beneath" the digital channels, and reducing the noise and ingress that may lie beneath them, the system margin can be further improved.

Finally, measurements should include BER at the headend as a calculation of the best possible system margin from which a reference for the reduced margins at other points in the system can be established.

Trunk/distribution testing

For signal levels, check again for spurious signals or ingress affecting the digital signals from the amplifiers. Check across all digital signals due to frequency variation of spurious and ingress.

Digital CTB/CSO is noise-like, whereas analog CTB/CSO is a summation of video and audio carrier signals of different phases. Both types of distortions should be measured, since this information will aid in fault isolation. For example, in a system with separate fiber links for the digital and analog signals, an excessive digital CTB/CSO with a good analog CTB/CSO may indicate a potential laser amp problem on the digital side, whereas if distortion on both types is excessive a trunk/distribution amp problem is probably at fault.

Perform BER/margin testing to assess available margin before the drop or premises.

Drop/premises testing

The two key measurements to ensure adequate digital signal quality are bit error rate/margin and signal level diagnostics. The BER should be measured accurately (refer to the section on BER) and the impairments inferred from the signal distortions measurements (as opposed to the TV picture for analog). From these two measurements—BER and impairments—the margin can be estimated. To ensure digital signal quality, an adequate margin must be maintained to cope with the potential future time- and environment-variation of the impairments.

Upstream testing

The integrity of home and drop wiring must be maintained to avoid


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ingress insertion into the upstream. Insertion into the upstream is like a river system where streams collect into creeks and creeks into rivers (cable trunks links). The resultant accumulated ingress can be substantial and difficult to locate, so it is critical to ensure that the home wiring is secure against ingress. Connectors and their integrity will be the key. Drop wiring needs to be protected from damage due to subscriber activities. Downstream tests can help ensure wiring integrity, but upstream is over a different frequency band entirely and is susceptible to impulsive or burst noise from CB, ham, shortwave and other sporadic interference sources (Table 2 on page 108) that can leak into upstream signals and, not always appreciably, affect the downstream signals.

Although upstream modems have efficient measures (e.g., frequency agility, etc.) to overcome problems restricted to portions of the spectrum, the capacity of the overall upstream channel (5-40 MHz) will increase if ingress can be minimized at the subscriber premises. Technicians could check for upstream problems from the set-top, ground/bonding block and the tap to isolate problems to house wiring vs. drop wiring.

The challenge will be to isolate the problem when the interference is actually present. For example, the subscriber may experience outage when a particular home appliance is on and at the time of the service call the appliance may not be operating. An alternative would be to replace all old connectors and wiring with insufficient shielding at the time of the service call. With this approach, the challenge would be to ensure that there is sufficient margin available after the repair. BER/margin measurements at the drop or tap can be taken with a transmitter at the set-top.

Summary

With the high revenue potential in each 6 MHz channel and the increasing demands of subscribers, operators need to ensure that digital signals are available as close to 100% of the time as is practical. This can be done with a combination of measurements, including BER and margin. BER can certainly aid technicians in assessing digital signal performance. However, the BER measurement can be time-consuming and depends to some extent on when it is made, the nature of the impairments, and how close to the "falls" the system is operating. It is the margin measurement that is paramount in maintaining robustness in a digital system. The system margin should be checked at installation, after each trouble call, and throughout the system as sweeps are performed. Through the establishment of acceptable margin minimums, operators will know that their subscribers are indeed sufficiently "upstream of the falls" and in little danger of digital video failure. **CT**

References

[1] "How Digital Carriers Affect the Analog Plant," Hamilton, J. and Stonebeck, D., *CED*, June 1994, page 80.

[2] "Implementing digital compression at the system level," Waltrich, Joseph B., *Communications Technology*, March 1995, page 84.

By Richard S. Pradan, Majid Chelehmal, Tam Williams and Craig Chamberlain

Considerations for HFC return path design

This feature was originally presented as a 1995 NCTA Technical Paper titled "The Cable System Return Channel Transmission Environment." It has been adapted for use in "Communications Technology."

For many years, cable operators have been successfully carrying signals in the downstream or forward direction on their cable plants. With additional competition for delivery of video and other information services, interest has increased in adding two-way capability to the cable plants to enable new applications.

Cable operators have long recognized that establishing and maintaining integrity on the return path is more difficult than on the forward path. This discrepancy is attributed to the cumulative effects of noise, ingress and distortion at all points in the plant combining toward the headend. The advent of the two-way hybrid fiber/coax (HFC) architecture can alleviate this situation, since the plant can be segmented to contain a smaller number of homes per node, fewer miles of plant, and dramatically shorter cascades of amplifiers. However, changes beyond simple segmentation appear to be necessary to provide the level of performance required by many new applications.

The applications

A number of applications are planned for two-way cable plant. The most popular applications now using the RF return path are addressable set-top terminals with store and forward pay-per-view (PPV) polling, and status monitoring devices for network components. Applications for the future seem to have one common element and that is that the traffic is digital.

Cable operators have planned many applications for return traffic. These applications may be categorized by the performance demands they place on the link, as well as data capacity and symmetrical vs. asymmetrical data rates. Applications with symmetrical data rates, high two-way performance, and low to medium data capacity appear to be highly challenging. These are applications such as lifeline plain old telephone service (POTS) at 64 kbps, and video phones with between 384 kbps and 1.544 Mbps (T-1) data rates. These high-performance applications need to provide continuous, bidirectional, error-free transmission with low delay. Providing such services requires a well-planned and well-maintained

Richard Prodan is vice president of engineering for Cable Television Laboratories Inc. in Louisville, CO. Majid Chelehmal and Tom Williams are senior members of the technical staff of the engineering department, and Craig Chamberlain is a member of the technical staff.

Figure 1: Wiring diagram

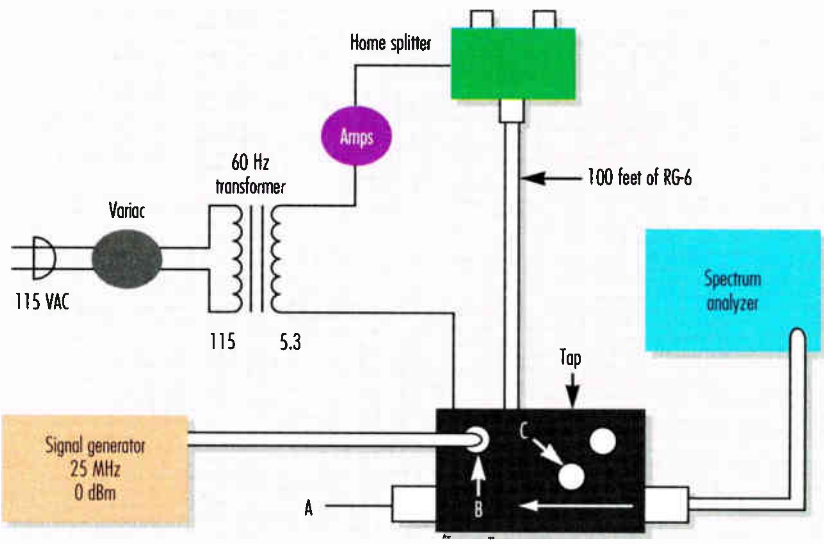
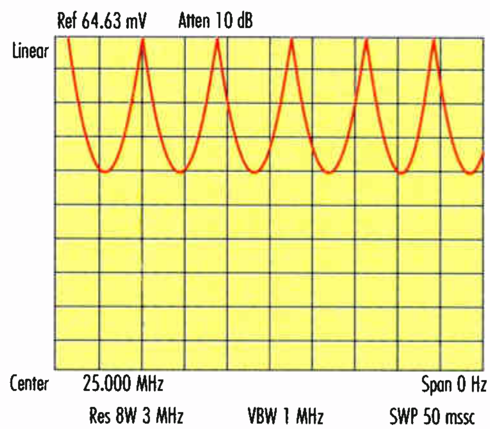
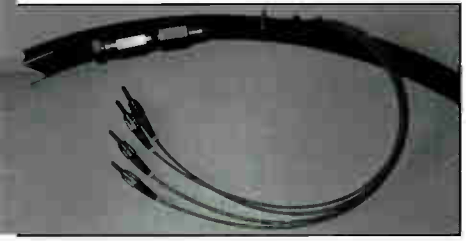


Figure 2: Modulation envelope





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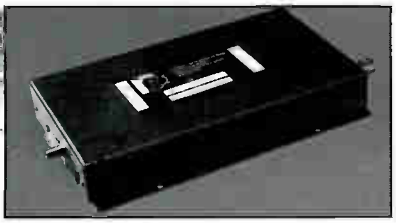

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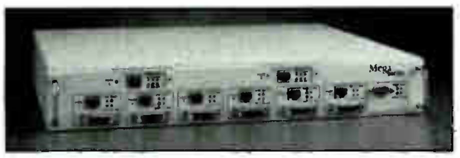

New Unique Fiber Optic Ethernet System Eliminates Data Collisions

Radiant introduces the most cost effective and technologically advanced method of connecting remote ethernet hubs together. The series DL200 allows transmission distances up to 100Km and data throughputs of 100Mbs. It can be used for any size system — large or small. Typical applications include interconnecting large metropolitan school districts or remote college or industry locations. Budgetary cost is less than $3000 per location.

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two-way architecture, with provisions for powering home devices, as well as very high network reliability.

High-speed asymmetric data requires medium upstream performance and high downstream performance. These data applications include video-on-demand (VOD), computer data, games, information network access and home shopping; they may run on the homeowner's

"Changes beyond simple segmentation appear to be necessary to provide the level of performance required by many new applications."

TV set or home computer. The upstream signaling rate will be typically several orders of magnitude slower than the downstream rate. The medium upstream performance requirement arises from the ability of the network to determine whether a transmission error has occurred and automatically request a retransmission of the errant data within a short time period.

RF transmission

Downstream data transmission is expected to be substantially less troublesome than the upstream data transmission. This is evidenced by the low to medium speed data carriers now in use over downstream cable plant, to provide addressibility for set-top terminals, digital audio, market data and games. Reported trials of high-speed data modems by equipment vendors[1,2] and tests of high definition TV (HDTV) modems in field trials in Charlotte, NC,[3] show that these systems can be

made to work at acceptably low error rates. Carrier-to-noise and carrier-to-impairment ratios for thermal noise and spurious intermodulation components, as well as the level and delay range of transmission reflections found in most cable systems in a field study,[4] indicate adequate margin for many laboratory tested modem prototypes.[5]

The challenges presented by the upstream plant are not as well understood. Following are several impairment sources and characteristics affecting upstream data transmission performance.

• *Ingress:* Ingress can be categorized by the entry point into the return plant, and the origin and nature of the external signal entering the system. The plant may be partitioned into three entry points for signal ingress: the home wiring, the drop line and the hardline. The signals ingressing may be constrained to a localized frequency band such as a broadcast, or they may be of an impulsive nature such as noise generated by electrical motors, lightning or automobile ignitions, which affect the entire return band.

The Digital Transmission Characterization field study done by Cable Television Laboratories showed that 5% of existing homes (more than 10% in some upgraded, fiber-rich systems) may be classified as having poor isolation of 35 dB or less to broadcast signals in the 88-108 MHz band.[4] Further lab tests done at CableLabs showed that devices such as TV sets or FM band tuners connected to well-shielded home wiring could act as antennas by injecting ingress into the home wiring. This is the dual of the direct pickup (DPU) problem experienced by these tuners. Insufficient tuner shielding allows a broadcast signal to ingress both into the tuner's circuitry and into the home's cable wiring.[6,7]

Knowledge of the percentage of the ingress entering the network through the home wiring, the drop cable and the hardline, respectively, provide insight into the characteristics of ingress. In a study done by AT&T,[8] high-pass return-band blocking filters were placed on the sides of the homes. The ingress was partially reduced, but substantial ingress was still coming in through some number of drop wires. A further dramatic reduction was achieved when the high-pass filter was moved to the tap, thereby isolating the drops.

A study by the CableLabs Network Integrity Working Group discovered that all sources of ingress are not equal.[9] That is, some ingress sources are much worse than others in affecting modem performance. (A QPSK—quadrature phase shift keying—T-1 data modem without error mitigation was monitored). If the break in the coax is near a source of strong RF emissions, the impact of the break is compounded. Many of the sources of interference are identified with human activity. The study found that interference increases on weekends.

Since the break in the coax shield may be due to an intermittent connection, and since the source of the electrical noise may also be intermit-

tent, the exact location of the break in the coax may be very difficult to pinpoint.

• *Common path distortion:* This problem is caused by a rectifying action at a junction between dissimilar materials (e.g., metal/oxide) on the portion of the cable plant that is common to both forward and return signals. Forward signals are mixed together by diode action. Some of the mixing products fall in the return band, then travel back upstream. With a standard forward frequency plan, the distortion product's spectral characteristics are manifested as three beats every 6 MHz, one at integer multiples of 6 MHz caused by second-order distortion, and the other two caused by third-order distortion 1.25 MHz on either side of the second-order beat.

Clipping of the return laser diode: Analog laser diodes used to convert electrical signals into optical signals are generally biased to provide the best possible signal-to-noise ratio (S/N) within the linear dynamic range for a nominal input signal. This nominal signal level is generally defined to be four T-channel carrier wave (CW) carriers. If an electrical signal with an appreciably stronger level appears at the input of the laser, the light output waveform will clip asymmetrically, due to the laser output extinguishing below the minimum drive level.

Spurious intermodulation products will be spread throughout the entire return band. Thus clipping, if occurring frequently, has a deleterious effect on all of the transmitted carriers present. Clipping may be caused by ingress summing with the legitimate carriers, or by transmitters operating with excessive RF power.[10,11,12,13] The use of the HFC architecture has brought improvements to the return transmission system due to reduced noise resulting from node size reduction, but it has also introduced this possible clipping liability, which should not be ignored.

• *Distortion of the return amplifiers:* The return amplifier distortion effect is similar to laser clipping, except that the waveform will more likely be clipped in a symmetrical fashion. The issue is that the linear output power of an amplifier is limited, and overdriving the input causes output distortion. The practice by some equipment manufacturers to use low-power, low-cost discrete transistor amplifiers for return, instead of high-power hybrids, enhances this problem.

• *Power line current induced hum:* If power line AC current flows through the tap or drop cable, some portion of the AC current will pass through the ferrite cores inside the tap. This current, if sufficiently large, will cause core saturation and hence hum modulation.[14] Figure 1 on page 112 shows a wiring diagram that demonstrates the effect on a carrier passing through a 17 dB four-way tap that also has AC line current passing through one of the tap ports. The AC current is unevenly distributed between the RG-6 coax center and outer conductors, since the home splitter provides a low resistance path. →

Twenty-six percent hum modulation of the 25 MHz carrier occurred with only 5 amps of AC current. Different modulation percentages are measured if the generator is connected to points A or C. On the handful of samples tested, less hum modulation was measured through point A. Figure 2 on page 112 shows the modulation envelope. Current flow through the drop cable is especially large when the home's power line neutral is bonded poorly. When the power company loses a phase, current through the tap can also increase. When a power line phase is dropped, the coaxial hardline cable, which is bonded to the power line's neutral, carries a portion of the imbalance current for the power company. Only signals traveling through the affected tap should be modulated.

• *Plant maintenance and alignment.* A number of alignment and maintenance issues affect plant performance.[9] Amplifier gain misalignment has been found as one source of upstream signal distortion. Loose seizure screws on amplifier housings carrying AC power has been identified as causing upstream interference. The upstream interference created by loose seizure screws has broadband energy modulated at the power line frequency. Several other maintenance and alignment problems have been observed, some of which are related to overdriving the downstream amplifiers.

• *Switching regulator noise:* This interference is caused by the switching power supplies inside amplifiers, and hence comes from inside the cable plant. This noise source appears impulsive in nature, but should not be a serious problem with modern distribution equipment. This interference may get worse at cold temperatures and is generally observed between 5 and 10 MHz.

• *Lack of fault isolation capability:* This is a serious weakness of current HFC construction, especially for the return signal path. The return signals may be viewed as being on a bus structure. Hence a problem with a drop on one branch adversely affects signals that are combined from all other branches toward a common receiving point. In fact, one poorly behaved transmitter or ingress point can render the return network inoperable. To complicate matters, the nature of the impairment may be time-variable with the impairment disappearing before a technician can locate the origin of the impairment.

• *Overpowered transmitters:* Periods of high bit rate errors can be associated with converter polling times. In that case, investigation showed that the converter's return path transmitter RF power output is fixed, and the transmitter produced harmonics that affected data carriers.

• *Frequency response distortion:* Normal static return impairments can affect transmissions, such as group delay distortion from diplex filters, frequency response nonflatness, signal reflections due to impedance mismatches, and random noise. Because of the lower cable loss of the return band, reflections with long delays may be stronger. Overall, these static impairments should not represent an insurmountable design

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Conclusions

The transmission environment in the upstream direction poses several unique challenges. The sources and characteristics of the various transmission impairments discussed here need to be effectively mitigated to ensure reliable delivery of new digital services. A combination of robust transmission equipment design, efficient performance monitoring and meticulous system maintenance within a manageable architecture must successfully address these issues. **CT**

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By Ken Eckenroth

Leakage priorities: Now more than ever

Discussion and documentation. These two words define progress and are the key to keeping a topic fresh in the minds of the people who work with it. With that in mind, the ongoing battle with ingress and egress always should be discussed and documented by broadband technicians and engineers, no matter how much of a handle we have on it.

Signal leakage has been debated for years in the cable TV industry. It's such an important concern that even small operators who are not required to document certain proof-of-performance (POP) tests to the Federal Communications Commission must document cumulative leakage index (CLI).

"It's amazing how well the broadband community is doing on signal leakage."

Let me explain this further. A small operator is not required to perform some POP tests, but this doesn't relieve it from the responsibility of making sure the equipment is performing to these technical standards. The system just doesn't have to demonstrate it to the FCC in certain cases.

In contrast, let's look at CLI requirements. The small operator is

Ken Eckenroth is vice president of technology at Cable Leakage Technologies in Richardson, TX.

required to ride out his system every 90 days and log every leak over 20 μV/m. It must keep these records for five years. If it operates channels in the aeronautical frequencies (108-137, 225-400 MHz), it must perform a yearly CLI with all leaks 50 μV/m or higher. Most operators will be in the aeronauticals because there are only 20 available channels below 400 MHz outside of the aviation frequencies. It's interesting to note that even something as important as an Emergency Alert System (EAS) is not required for the small cable operator but signal leakage monitoring is.

Emphasis is placed on signal leakage no matter what size system you are because of the potential source of huge RF electropollution. Even if the small operator is not in the aeronautical frequencies, it is still in the other occupied bands such as ham and commercial two-way radio. Shared spectrum is not something to be taken lightly.

Also, a cable operator has a valuable asset in his return path and it must be protected from noise. You've surely heard all the talk lately about the 5-40 MHz spectrum being a huge trump card for cable operators because it has much more capacity than the telcos' twisted-pair. But new services over cable like data delivery and telephony will not work well if there is too much ingress getting into the system.

SMATV

What about a satellite master antenna TV system (SMATV)? These systems have leakage requirements too. They cannot exceed 150 μV/m as stated in the FCC rules (Part 15). There's always been a concern about "rat killer" leaks originating from SMATVs. The issue of whether this is such a small blip of interference arising from a SMATV compared to a franchised city CATV operation seems to be the defining question. I do know one thing: A rat killer is a rat killer, be it from one location or the cumulative effects of several locations. Education about FCC Part 15 is the key. Pass it on. →

How are we doing?

It's amazing how well the broadband community is doing on signal leakage. We are finding and fixing our leaks and this is something that cannot change. We can ill afford to slip back. The Federal Aviation Administration is gearing up to split its "comm" frequencies again. The aviation radio manufacturers are already putting these split frequencies into their new designs. Cable operators could not offset our frequencies again because for one, modulators only have a frequency tolerance spec of ±5 kHz. What will save us from abandoning Channels 98, 99, 14, 15 and 16 is our post-1990 track record. Let's keep it up.

Antennas

One of the most important aspects of signal leakage is equipment calibration and antenna knowledge. Here are some things to remember. If you are generating a leak at your headend for your vehicle to drive 10 feet from and calibrate, remember to orient the antenna from the leak source the same way as the antenna on your vehicle. If you have a quarter-wave whip antenna on top of your truck, then orient the reference half-wave dipole from the source vertically and match the top element at the same height as the vehicle's antenna.

When you talk about antennas, a common question asked is how long the element should be for the frequency used. Well, for some reason I find this number easy to memorize: 11,811. You can find any wavelength with this number. Divide any frequency into this number and you will have the free space wavelength in inches.

For example: 11,811/139.25 = 84.8 inches. Divide this by 2 for the half-wave length of 42.4. Divide it by 4 for the quarter-wave element length of 21.2 inches. *(Editor's note: Most practical antennas will be about 95% of the calculated free space dimensions. A useful formula for half-wave dipoles is 468/f, where f is the frequency in MHz. The result will be the total dipole length in feet.)*

"We are finding and fixing our leaks and this is something that cannot change."

TVI

Let's move on to a related topic. A subject that has not been discussed in much detail in our broadband periodicals is TVI (power line or hydro noise). A headend technician can see the effects of TVI on VHF Channels 2-6 as sparkles that increase with density (spikes per burst). You can hear TVI on a RF leakage meter as a frying or buzzing sound. It is caused by the magnetic field surrounding the power lines. This becomes a broadband disruptive noise because of the fields interaction with the following: 1) Cornona (sharp edges on the gradient or strand); 2) Dirty insulators (in the insulator cracks); and 3) microgaps (loose pole hardware, etc.).

The majority of power leaks are from microgaps and dirty insulators. When it rains, the water cleans the insulators and acts as a conductor in the microgaps. The TVI from these sources will therefore cease abruptly during rainstorms and for a short time thereafter.

FCC rules Part 47, Section 73.683 concerning VHF Channels 2-6 for grade B contours (fringe areas) state that a minimum of 47 DBU. (dB above 1 µV/m shall be maintained 50% of the time to 50% of the locations).

What does this mean to CATV operators? If the VHF broadcaster maintains the 47 DBU (224 µV/m), it has done the job. This is between -14 and -18 dBmV depending on which VHF low-band channel is measured. The CATV operator's goal should be to keep a 40

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dB carrier-to-noise (C/N) between the desired signal and the TVI. 40 dBc (dB below carrier) should be enough to eliminate the sparkles, but you always should strive for as high a C/N as possible.

Power company cooperation is key in eliminating the TVI. The area that falls under the looking glass is approximately one mile between the headend over-the-air receive antennas and in the general direction of the VHF broadcast towers. Once The TVI in this area is found, quote the FCC rules and point out that this is a very small portion of its franchised area to deal with. Also, point out that if an individual homeowner had complained to the FCC about VHF TV reception and the source of the problem was TVI, the power company would be required to correct the problem. One homeowner. That's amazing.

It's important to archive power leaks because of their intermittent nature and because they are being fixed by another company. Utility company cooperation is underlined by the fact that we're all on the same poles.

Preventive measures also can be taken if the cause of the problem is understood. A southern California Edison study showed that a large portion of TVI was caused by slack dead ends (slack spans). Also, a strand crew putting in a down guy during construction might give the chain hoist one extra crank for good measure and inadvertently create a power leak.

TVI is only a small part of the CATV operators task with signal leakage. Methods of tagging the signal can help eliminate the headache of TVI being confused with a real cable leak in the area of plant away from the headend. Tagging also is useful in overbuild situations.

In conclusion, I recommend you contact the Society of Cable Telecommunications Engineers or the National Cable Television Institute for more information on signal leakage. There is plenty of documentation on the fundamentals. It's good to have reference material about CLI in-house. Once you have that, it is wise to take it a step further and discuss it at your local SCTE chapter. CT

By Joseph M. Baniak

Calculating noise and intermodulation distortions

Systems utilizing hybrid architectures need to assess the performance of any and all elements of the network such as an AM fiber link, AM microwave network and trunk and feeder networks.

The summation of noise or intermodulation distortion generated by separate parts of an overall transportation system can be calculated quite easily. The function of logarithms and decibels is covered in the textbook *Cable Television—Third Edition* (by William Grant) and various other texts and papers and need not be repeated here. However, the specification of carrier-to-noise (C/N) or intermodulation in their respective logarithmic expression dB or dBc can help us calculate the overall carrier-to-interference ratio of multiple element transportation systems.

A carrier-to-noise or distortion ratio is nothing more than the difference between the desired signal's strength to the undesired interference expressed logarithmically. We are familiar with the term C/N in dB or composite triple beat (CTB) in dBc. These are not absolute values of signal level, but rather the difference between the desired signal and the respective interference being evaluated. It doesn't matter if the carrier is 10 dBmV or 100 dBmV. A typical C/N of 45 dB can be measured when the carrier is at either level, and the same is true when measuring for the signal carrier-to-interference (C/I).

If we make an assumption that the carrier level for the distortion we wish to summarize is 0, then the interference of noise from a 45 dB C/N ratio will be some number of decibels below 0 or a negative number such as -45 dBmV. Assuming all elements of any transportation system also can be expressed in this fashion, we can use a calculator to find the overall system performance.

A typical AM fiber-optic link, for example, may have a specification for C/N under certain conditions of 52 dB. Serially added to that our system has eight trunk amplifiers that we have determined (through simple like-device calculations) produce a C/N of 51 dB. Our third distinctive element with its own link performance specification, is the bridger and line extender plant, which has a combined C/N performance of 60 dB.

If we make the assumption, as stated previously, that the noise of each of these elements is specified as below 0, we have the noise levels -52, -51 and -60 dB from reference 0. By reversing the mathematical process that produces logarithmic expressions, we calculate the absolute value of noise produced by each element when referenced to 0 and add them together. Once added we can return that expression to the logarithmic form. →

Joseph Baniak is supervisor of technical field services for the Telecommunications Division of the New York State Commission on Cable Television, based in Albany, NY.

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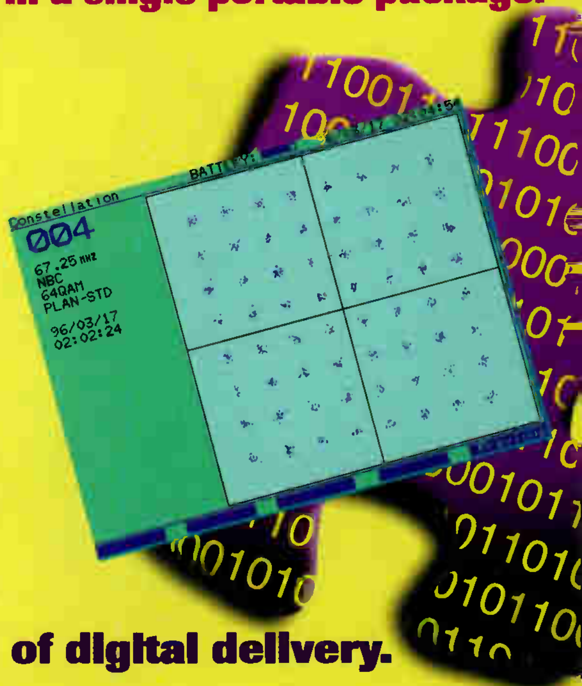

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-52 dB ÷ 10 = -5.2
Inverse log of -5.2 = .0000063

-51 dB ÷ 10 = -5.1
Inverse log of -5.1 = .0000079

-60 dB ÷ 10 = -6.0
Inverse log of -6.0 = .000001

The straightforward addition of these inverse log values is .0000152. The log of .0000152 is -4.818, and multiplied by 10 yields -48.18 or a C/N of 48.18 dB for the combined elements of the transportation system.

Conversely, the process also can be applied to calculate the performance of any one part of the transportation network. Let's assume the AM fiber link performance for C/N is specified and measured to be 52 dB and the C/N measured for the combined eight-amplifier trunk and AM fiber link is measured at 48.5 dB. We can determine the performance of the eight-amplifier cascade alone by subtracting the AM fiber link performance from the combined performance of the two elements. (See the accompanying figure.)

Calculating network performance

	AM fiber link		8 trunk amplifiers		Combined C/N
	52 dB	+	51 dB	=	48.5 dB
	÷ -10 = -5.2		-5.1		
Inverse logs of =	.0000063	+	.0000079	=	.0000142
			Log of	=	-4.85
			Multiplied by -10	=	48.5 dB

Extrapolating the formula ...

If we know the combined performance of the system and one of its segments, we can calculate the remainder as shown:

Combined		8 amplifiers		AM fiber link
48.5 dB	–	51 dB	=	52 dB
Combined C/N		**AM fiber link C/N**		**8-amplifier C/N**
48.5 dB	–	52 dB	=	51 dB

Overall performance
-48.5 dB ÷ 10 = -4.85
Inverse log of -4.85 = .0000142

AM fiber link performance
-52 dB ÷ 10 = -5.2
Inverse log of -5.2 = .0000063

Subtraction of the inverse logs yields .0000079, the log of which is -5.1. Multiplied by 10, this yields -51 or a 51 dB C/N for the eight-amplifier cascade. Providing the manufacturer's specifications dictated such a performance we could be confident that the cascade was working at the specified level without injecting signals for test purposes on this equipment alone. The individual and combined elements measured allow us to calculate the other element's performance mathematically.

This process also is valid for the addition of intermodulation distortions, keeping in mind the rule for voltage addition, which requires a power of 20 rather than 10 as described in the text book.

For example, say one wishes to calculate the CTB of an AM fiber-optic link, a terminating trunk/bridger station and a line extender amplifier. The link has a manufacturer's CTB specification of -67 dBc for the specified channel loading and operating levels. The trunk/bridger has a specification of -60 dBc for CTB with the respective operating parameters, and the line extender's CTB is specified at -65 dBc. The combined CTB for these three network elements can be calculated as follows:

-67 dBc ÷ 20 = -3.35
Inverse log of -3.35 = .00045

-60 dBc ÷ 20 = -3
Inverse log of -3 = .001

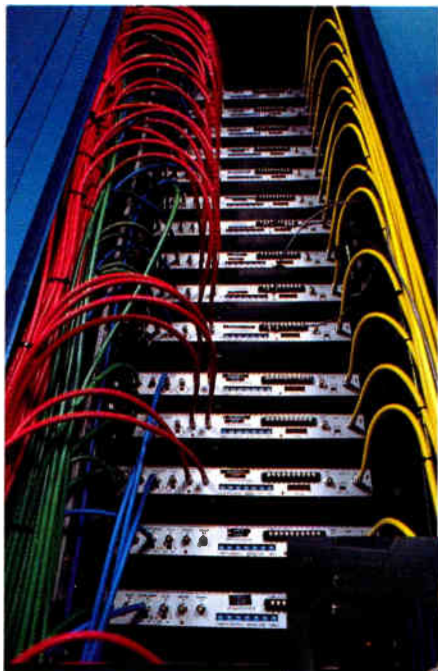
-65 dBc ÷ 20 = -3.25
Inverse log of -3.25 = .00056

The sum of the inverse logs is .00201, the log of which is -2.697 and multiplied by 20 equals -53.9—or a combined CTB for the three elements of our network of -53.9 dBc. The same process of subtraction can be used to evaluate individual elements of the network for intermodulation contributions as we did previously with noise, respective of the rule that we work with a power of 20 rather than 10. **CT**

By Paul Arvin

Selecting cables for the future: Comcast of Maryland's story

Editor's note: Are you planning on upgrading the cable in your plant? If so, there are two important things to remember: Select cable that is appropriate for the job at hand, and make sure it has the capability to accommodate your future telecommunications needs as well. This article describes one system's experience at selecting cable that will handle its requirements well into the future. Space does not allow for an exhaustive listing of all the companies that manufacture or sell cable to the industry, but there are many cable telecommunications manufacturer guides and directories available that are excellent resources when you are buying cable for your system.)



Precision video cable (above) runs of up to 100 feet connect a wide variety of rack-mounted broadcast equipment.

Color-coded cables (right) provide for neat installation and facilitate testing and servicing at the Comcast facility.

"The upgrade is designed to improve current services ... and eventually pave the way for interactive services."

The fourth largest cable TV system operator in the United States, Comcast Corp., is gearing up for the future by expanding its core business into services that include cellular programming, alternate access telephony and international cable/telephony. The firm's "future-think" philosophy, which was put into action prior to the passage of the telecommunications bill, includes the recent implementation of a $100 million cable system upgrade at Comcast Cablevision of Maryland.

The Baltimore-based facility is a multiple-county systems operation that downlinks from a satellite and/or antenna (and utilizes local feeds) to supply programming to subscribers in Baltimore, Harford and Howard counties. The upgrade is designed to improve current services, allow for an expansion of channel capacity to 500 channels and eventually pave the way for interactive services such as video-on-demand (VOD) and on-line access. To accommodate both present and future plans, Comcast's cable system upgrade included the construction of a new combination headend/control room.

Cabling the master headend

Comcast Cablevision had several concerns regarding cable selection for the new headend. First, the cable would have to meet recently enacted Federal Communications Commission video testing regulations in spite of the long runs that would be utilized. In addition, the cable's shielding would need to offer

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Paul Arvin is senior marketing applications engineer for Belden Wire and Cable, of Richmond, IN.

ample protection against external (RF) interference and be strong enough to resist breakage and prevent signal leakage.

Joe Askew, Comcast headend technical manager, was responsible for overseeing the cable system design for the new Baltimore facility. According to Askew, "In this case, due to our concerns with long run lengths and shielding longevity, we decided we needed to upgrade our selection." After a few months spent researching cabling issues and visiting Comcast sites around the country, Askew decided that a cabling scheme using two different versions of precision video headend cables combined with fiber-optic trunk cable would fulfill his requirements.

According to Askew, Comcast's master headend installation in Maryland can be described as part analog and part digital. The actual satellite link is analog. The commercial insertion is digital. The basic floor plan is an open design with the equipment mounted in racks. All of the cabling is bundled, runs under the floor and comes up through the inside of the racks where it is hardwired to the equipment.

For the upgrade cabling scheme, Askew elected to install the fiber-optic trunk cable to the feeder, with fiber interconnects connecting the headend and hub

"Both versions of precision video headend cable are robustly constructed to minimize the effects of electromagnetic interference."

sites. Within the plant, the fiber handles 200 homes per node. Coaxial cable was installed from the node to the tap.

For the RF portion of the operation—the output of modulators to the final mix—Askew specified a 20 AWG (solid), silver-plated, copper-covered steel headend cable to be used from equipment to equipment, and from equipment to combiners. This cable is 100% sweep-tested from 5 MHz to 1 GHz (SRL 20 dB minimum), and features a gas injected foam polyethylene insulation and shielding for maximum signal protection. The shielding consists of an inner layer of foil/tape/foil tape bonded to the conductor's insulation with a layer of adhesive. This layer is then surrounded by a braid plus an outer layer of an aluminum/ polyester laminated tape bonded to the jack-

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et. A built-in shorting fold creates the effect of a solid metal conduit, providing metal-to-metal contact and improving the high-frequency performance of the cable.

Color-coded cabling

For connecting the headend's wide variety of broadcast-related equipment, Askew specified a different grade of precision video cabling—20 AWG (solid) bare copper cables; the brand he used is color-coded by use within the cabling scheme. Yellow is for video; blue is for 4.5 MHz; green is for IF; and red is for data. According to Askew, the color coding adds a degree of neatness to the cable installation and also facilitates any future testing and servicing. Included among the equipment utilized in Comcast's headend are RD satellite receivers, modulators, BTSC units and scrambling units.

The color-coded connecting cables are 100% sweep-tested from 5 MHz to 216 MHz (SRL 27 dB minimum), and have polyethylene insulation plus a tinned copper, double-braid shield to provide 98% coverage. To date, over 37,000 feet of this cable has been installed in the new Comcast facility.

Both versions of precision video headend cable are robustly constructed to minimize the effects of electromagnetic interference (EMI)—an important feature for broadcast applications, especially in view of the FCC's cumulative leakage index (CLI) standard.

Drop cable also plays a role in signal integrity and reliability. Recognizing the importance of signal integrity all the way to the subscriber's premises, Comcast Cablevision's drop cable also is specified with long-term reliability in mind. Installation Supervisor John Wade reports that the cable used for prewiring and post-wiring inside the household is 100% sweep tested from 5 MHz to 1 GHz and features a tri-shield design consisting of a bonded foil/braid shield reinforced by a surrounding layer of a laminated tape made of aluminum/polypropylene/aluminum. The burial drop cables, running from the junction box to the home, are protected by a nondrip gel barrier to improve the cable's corrosion resistance after installation. Messengered cables, traversing the poles to subscriber homes, also are protected by a triple-shield design.

Comcast Cablevision's new headend cabling upgrade is expected to help the firm remain competitive, customer-driven and equipped to meet the ever-increasing programming demands of subscribers. Askew is satisfied that his prime cable requirements—signal reliability and growth potential—have been met. "We believe the cables we've specified will deliver maximum protection against interference," he says. "What's more, we're confident they'll support the numerous enhancements everyone is anticipating in the broadcast industry." CT

By Jerry Moran

Easements: Your right-of-way

The CATV industry has enjoyed the benefits of the 1984 Cable Act in many ways. One of the benefits is the ability to use existing rights-of-way. After numerous challenges the industry has prevailed in the courts. But things are changing. Will you still enjoy that protection once dial tone is available on your system? The current thinking is that it will not. Similar problems are on the horizon for the telcos. Their easements cite "for telecommunications purposes" or words comparable to that. If they are providing video services, questions arise about their easement rights.

Your company is doing more than just stringing cable on existing poles and rights-of-way. Advancing technology requires more sophisticated equipment. You are required to find locations for this equipment that requires a permit from the local governing body or an easement from a private property owner. Which location is best? This article serves as a primer for the correct right-of-way.

We hear frequently from CATV engineers that interpreting easement rights puts them at the mercy of the local telco engineer to get that interpretation. After reading this article you will at least have an understanding of just what easements are.

What exactly is the correct right-of-way? It consists of the following:

1) It is the correct easement form, properly executed and notarized, by all of the legal owners of interest in the property.

2) The description of the property on the easement form is exactly as that described in the deed.

3) The location of the easement on the property is adequately described and leaves no room for interpretation by others.

4) The grantors of the easement were fully informed of what would be placed within its boundaries.

5) The easement is not a blanket easement. A blanket easement allows the easement holder to place its facilities anyplace on the property it wishes.

6) The easement is properly recorded in the recorder's/registrar's office in the county/parish in which the property is located.

7) Your plant is installed within the boundaries of the easement.

Let's address each one of the previous items and see what they really mean:

• *Legal owners:* How do you know who has an interest in the property? Some might think that it is a simple matter of checking the deed or the tax assessor's records. This couldn't be further from the truth.

Here are some reasons why. Deeds do not have to be recorded until the current owner(s) sell the property. Other transactions could have occurred after the current deed was recorded. There could be a contract for deed in motion and not recorded. (Some jurisdictions, not all, require that the contract be recorded.) If the property is leased when you acquire your easement, the lessee can keep you from exercising your easement rights under some circumstances if the lessee doesn't sign a release. If there is a life estate on the property do you know who must sign the easement?

The tax records are always a good place to start looking for ownership. However, that is all that they can really be used for. In most jurisdictions the party paying the taxes is the name that appears in the records. It is not necessarily the owner(s) name that appears.

Is there one or more mortgages/trust deeds on the property? When do you take a subordination from the lender(s)? Do you realize that without a subordination your easement could be made invalid if the lender takes the property back due to a default by the property owner(s)? The lender has as much to say about the property as the current owner(s). Sometimes this information comes as a shock to some right-of-way practitioners.

• *Correct property description:* The correct description of the piece of land

Right-of-way Q&A

Q: *Why isn't verbal permission from a private property owner acceptable? We are only placing an amplifier on the property. K.B., Kansas*

A: If your company is placing anything on the land of another it must receive permission in writing. The reason is that your company is claiming an interest in the property through an easement. The definition of an easement is: A nonpossessory interest in the land of another. According to the "Statute of Frauds" any transaction involving the transfer of any interest in real property must be in writing.

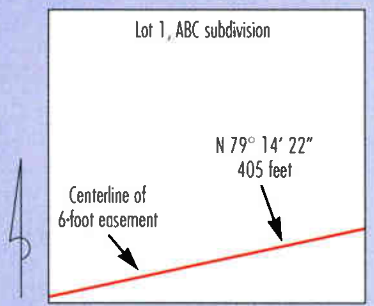
Q: *We took an easement from an owner and have not bothered to record it in the county recorder's office. Is there any necessity to have it recorded? G.M., California*

A: By all means get the document recorded. Recording the document imparts "Notice" to all subsequent purchasers of that property that your company has certain rights on their land. I'll add a word of caution, however. If the grantor of the easement sells the property prior to you having the easement recorded, the recording does no good. The reason? The new owners took title to the property without any notice of the existence of your easement. They could successfully challenge your rights!

Jerry Moran is vice president of NMI Management & Training Services in Oakland, CA, which specializes in right-of-way seminars and consulting. He welcomes questions from CATV/MSO engineers regarding rights-of-way. He may be reached by phone at (510) 530-9342 or faxed at (510) 531-2121. There is no charge for telephone consulting.


ADC Telecommunications

Figure 1: Example of metes and bounds description



An easement 6 feet in width in Lot 1 of ABC subdivision, the centerline of which is described as follows: Beginning at the southwest corner of said property; thence North 79° 14' 22" E 405 feet more or less to the point of termination at the easterly line of said Lot 1.

that you want an easement on is critical. A land description is unique to that particular parcel, to the exclusion of all other parcels of land in the world. An incorrect description may invalidate the easement taken.

Following are the most common ways to describe real property: metes and bounds (measurements and boundaries); the rectangular method (section, township and range); subdivision (lot and sometimes block); using the state plane coordinate grid system.

• *Location of the easement:* The easement may be described in many different ways. The most common is metes and bounds, which requires a survey. (See Figure 1 on page 150) Next is a single, two- or three-way call that sometimes may be accomplished without a survey if the property boundaries are clearly evident. (See Figure 2.) Sometimes an exhibit "A" is used, which is just a pictorial of the area encumbered. (See Figure 3 on page 152)

• *Owner(s) fully informed:* We have all experienced "buyer's remorse" at one time or another. Imagine how a property owner feels after he/she has granted an easement to your company for a buried line and one small aboveground device. On the day of construction the owner is confronted with the largest tractor made instead of a light-duty trencher, and a crane lowers a huge node into place instead of the small device. The easement document may allow for such equipment, but imagine how the property owner feels. This can happen, and if it does, someone's telephone is going to start ringing at your company's headquarters.

• *Blanket easements:* What's wrong with a blanket easement? Doesn't it allow the CATV company to place whatever it wants whenever it wants? Of course it does! But, if you owned the property, would you want some company to have the ability to place their plant wherever they want? Probably not. It can be a problem later when the company tries to enforce the rights granted under a blanket easement. If the property owner decides to fight, the blanket easement could be viewed as an "unreasonable burden" to the property. The court may restrain your company from enforcing any easement rights. The blanket easement also can cause problems for subsequent purchasers who try to obtain financing on the land.

• *Proper recording:* Recording the easement provides "notice" to subsequent purchasers of the property. When prospective purchasers are interested in the land, and a title search is conducted, they discover that the CATV company has an easement on the property. It is because of this dis-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covery that they are then notified of that fact. If they buy the property knowing that there is an easement, they take the property subject to the easement. In other words, they agree to honor the rights granted in the easement as disclosed in the search of the public records.

• *Easement boundaries:* The fact that you have an easement may prove worthless if the contractor places your facility outside of the boundaries of your easement. Sometimes it may be just an inch or two, but if you have a really picky property owner it could cost a lot of money to correct the situation. I recall a manhole that encroached just 2.5 feet outside of the easement into the owner's property. That additional 2.5-foot strip cost the utility $10,000. The original easement cost only cost $750. That utility learned the hard way that it is critical to obtain an easement large enough for some margin of error during the placement and installation job.

Public right-of-way

So far I have only discussed private property easements. Let's discuss the public right-of-way. Public roads and streets are occupied by utilities all the time. The right that a CATV company acquires from the town, city, county, or state is called a franchise. A franchise is usually granted in exchange for a certain percentage of gross revenue. Along with the rights of a franchise there are certain obligations.

The franchisee, your company, must accept the fact that it is a secondary user in the public way. If your company is a secondary user, who or what is a primary user? The traveling public is the primary user. Along with the traveling public, any other support function is a primary user. For example, traffic signals, street lighting and storm drains that clear the roadway during wet conditions are considered primary users. This means that if your company has a facility (line, pipe, pole, cabinet, etc.) in the public right-of-way and the road is going to be widened, your company must relocate the facility at its expense if its facilities interfere with the project. Do you then avoid the public right-of-way in order to protect yourself from the unknown future? Not necessarily.

From an engineering standpoint a look into the future always is helpful. You might ask the following questions before committing to public or private right-of-way:

• How likely is it that the current roadway will be widened?

• How wide is the current public right-of-way in relation to the width of the current paved roadway?

• Is the current paved roadway in the center of the public right-of-way?

• Does the public agency that has jurisdiction over the public right-of-way have any short or long range plans for changes or improvements to the right-of-way?

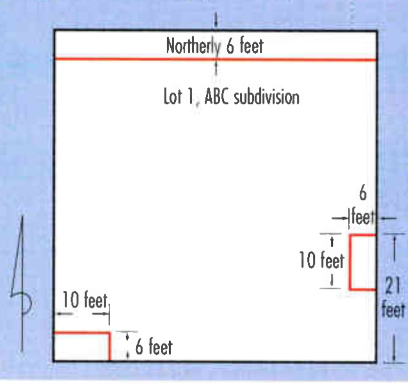
Let's take a hypothetical situation to help drive home a point.

A CATV engineer needs to place a large piece of equipment in conjunction with a large engineering project. A nice location is chosen within the public right-of-way and a permit is taken. The equipment is placed and service is now working out of it. The local agency later decides to widen the road from a two-lane to a four-lane. It kindly informs the CATV engineer that the

equipment is in the way and would you mind "sliding it over a few feet." We all know the chances of sliding it over. In most instances you will have to build a completely new facility, cut it over and then possibly scrap the old one. What if you had elected to acquire an easement in the first place, and placed your facility inside the property line? Presumably the local agency would have to buy or condemn a strip of land from the private property owners on each side of the roadway that is to be widened. If your facility was on the part to be taken, and you had a recorded easement, your company would be entitled to all relocation costs.

How much money would it have cost for the easement? It depends on the negotiating skills of the person acquiring it. The costs can range from a few hundred dollars to several thousand. I know one right-of-way agent who acquired an easement from an individual who wasn't particularly impressed with the $500 offer the agent had made for the easement. The owner, however, had "fallen in like" with the agent's sport coat. The agent, sensing victory, offered his coat in exchange for the easement. The owner accepted the offer and signed. The agent bought a new coat and submitted an expense of $149.95, plus tax, which his company readily paid.

Figure 2: Single, two-way and three-way calls



Single call
An easement located on the northerly six feet of Lot 1 of ABC subdivision, as measured along the easterly and westerly boundaries of said lot.

Two-way call
An easement located on the southerly six feet of the westerly ten of Lot 1 of ABC subdivision, as measured along the southerly and westerly boundaries of said lot.

Three-way call
An easement located on the northerly 10 feet of the southerly 21 feet of the easterly six feet of Lot 1 of ABC subdivision, as measured along the easterly and southerly boundaries of said lot.

Handling trespass complaints

Frequently an attorney is consulted on right-of-way matters when it could easily have been taken care of by someone properly trained in right-of-way matters. In fact, a frequent problem for many utilities is the scenario that follows.

The property owners call to complain about a pedestal on their property that they never saw before. They are absentee owners and recently decided to build their retirement home on the property. They can't find anything in their title report or deed that indicates that your company has any rights to be there. What are your options?

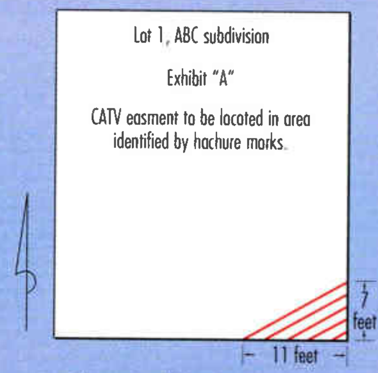
Trying to find some sort of easement or permit in your files, none can be found. Then you must weigh the cost of moving the plant vs. hiring an attorney to defend your presence on

the property. Without some documentation, the attorney is likely to say that it is very difficult to defend what appears to be trespass, in court.

Perhaps the pedestal was placed with verbal permission years ago. It probably was because you know that your company has never trespassed. You do some investigating and discover the pedestal was placed there 12 years ago but the current owners bought the land 6 years ago. You wonder why they never noticed the pedestal before. However, when they bought the property they really hadn't thought of where they would ultimately build their home until now. The pedestal is in the middle of the proposed driveway and they want you to remove it at your expense.

You might consider an optional approach. It doesn't always work but is worth a try. There is something in the law called "laches." It means "failure to act within a reasonable period of time." This can be interpreted to mean that the owner, upon purchase of the property, did not inquire as to the rights of your company and therefore has given tacit permission to leave the pole there. Will it stand up in court? Not likely, but it has worked on innumerable occasions. Remember, we are discussing an optional approach. A bluff.

Figure 3: Example of Exhibit A



The easement document would have a statement indicating that the location of the easement "shall be located as shown on Exhibit A, attached hereto and made a part hereof."

Another tactic to use is "prescriptive rights." Prescriptive rights can be invoked if your plant is clearly visible (open and notorious), in continuous use for the statutory time (five to 30 years depending on which state you are in), under a claim of right, and it must be adverse to the property owner. The use of prescription is much stronger than laches because it is a realistic possibility if it is taken to court and all of the conditions for obtaining a prescriptive easement have been met. The court can actually grant the easement.

The exception to this is in New York state. Utilities are prohibited from exercising prescriptive rights. Sometimes the inclination is to just move your plant, at your company's expense, without any fight or negotiation. It is more cost-effective in the long run to have a staff member or engineer who is well-versed in right-of-way matters than it is to refer it to an attorney every time a question arises about easements or rights-of-way.

In conclusion, remember when asking property owners for easements, put yourself in their place. Would you grant the easement if this were your property? **CT**

By Keith R. Hayes

BCT/E Certification: Nothing good comes easy, Part 1

Whew! Done! Over! Fini! After more than 12 years of climbing the cable TV technical ladder from contract installer to director of operations with many interim steps, I became interested in the Society of Cable Telecommunications Engineers' Broadband Communications Technician/Engineer (BCT/E) Certification program as a way to expand and document my broadband communications knowledge. After hearing much discussion and many positive comments at the 1993 Cable-Tec Expo in Florida, I decided to embark on the road to certification by taking my first exam there. Fourteen tests, 300 questions, six essays and 30 months later, I fulfilled my quest by becoming the 124th certified Broadband Communications Engineer. I also stopped along the way and became one of the 395 or so folks who are certified at the Technician level, and even completed Installer certification.

I cannot adequately describe my feelings of satisfaction, accomplishment and relief when Marvin Nelson, who at the time was director of certification for SCTE, notified me of my completion of the program. It was one of the most significant events in my life, exceeded only by my marriage and the birth of my son. It was good! I have been asked by many people, and indeed have asked myself many times, why? What is the BCT/E program? Is it difficult? Is it relevant? And most importantly, is it worth it?

My answer to the last three questions: Absolutely!

Keith Hayes is director of operations for Vanguard Cable Corp. in Atlanta. He is certified by the Society of Cable Telecommunications Engineers in both its Broadband Communications Engineer and Broadband Communications Technician programs.

About the BCT/E program

I have heard comments from various individuals regarding the perception of an aura of "mystery" around the BCT/E program. This perception exists despite more frequent testing and tutorials offered by the Society and its chapters, the detailed program guidelines in the July 1992 *Interval* and July 1995 *Interval*, as well as a number of columns from folks such as Bob Luff. Hopefully this article will be helpful to those who read it in erasing the mystery.

I will attempt to capture the meat of the program here. For more complete information, please refer to the "Complete Guide to Certification" in the July 1995 SCTE *Interval* or contact the SCTE at the address and phone number at the end of this article.

The BCT/E program was developed beginning in 1984 after the Federal Communications Commission asked organizations such as the SCTE to develop programs to replace the First Class Radiotelephone licensing procedure. The First Class license was widely used by the cable industry to document technical competence. The first BCT/E test was available in 1985, with the others completed and available by 1987. The first people became certified in 1988, beginning with Ron Hranac. Coincidentally, I was studying for my First Class ticket when the program was abandoned by the FCC, leaving only the general radiotelephone license. I eventually switched modes and got my amateur radio license, which is lot more fun anyway.

A couple of key differences of the BCT/E program from the FCC First Class Radiotelephone License are:

1) It is specific to the technical knowledge necessary in the broadband communications industry. (Radar anybody?)

2) It requires continuous industry education to ensure that anyone who has current certification is making the effort to keep up with technological advances within the industry. Just think, if you got your First Class license in 1980 and then moved out of the industry, would a prospective employer be able to tell if you had any broadband fiber-optic knowledge from your license? I think not. The level of training that is required for re-certification virtually ensures that you are

BCT/E requirements at a glance

Item	Technician	Engineer
Education	N/A	Formal electronics training or equivalent. (See July 1995 SCTE *Interval*.)
Experience	Two years CATV	Five years broadband, two of which must include responsible contribution to a significant technical function.
References	Three	Three
Exams	Must pass all seven Technician exams	Must pass all seven Engineer exams
Membership	National SCTE member	National SCTE member

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geosynchronous orbit at 120° W. longitude. What is the distance from antenna to satellite? Answers: a) 13,000 miles; b) 35,680 kilometers; c) 24,267 miles; d) 25,623 miles; e) 52,500 yards. Well, you can throw out answers a, b, and e, but you would have to calculate slant-range distance to determine if c or d was the correct answer. (Neither is correct; I picked a couple of numbers out of the air.)

Perhaps the previous example gives you a picture of the relative level of knowledge that differentiates the Technician exams from the Engineer exams. Another example might be where a Technician would be expected to know free-space attenuation at CARS band microwave frequencies, and an Engineer would have to calculate actual path loss. Clear as mud?

Category I—Signal Processing Centers

Q: *If the signal acquisition center is the headend, what is the tailend?*

A: The couch potato. (Don't shoot me—I'm a BCE, not a comedian.)

In short, this category covers all the intricacies of a headend: selecting a site, laying out a building, determining tower height and structure as well as the types and theory of the antennas put on towers, types of equipment, necessary maintenance, record keeping and FCC/other rules. If you are a headend tech or the supervisor of a headend tech(s), you should strongly consider testing in this category even if you do not wish to pursue complete certification. A couple of the key references for this category include the National Cable Television Association Recommended Practices for Measurements on Cable Television Systems and the 47 CFR Part 76 FCC regulations.

Category II—Video and Audio Signals and Systems

Q: *What parts of a house are contained in a video signal?*

A: The front porch and back porch.

Let's talk baseband. This area is for all headend techs, master control techs, LO/PEG folks, and anybody else who lives in the baseband environment. This category tests knowledge of the terminology, components, standards and formats of baseband video circuits, and looks at audio in the same vein with emphasis on monaural and BTSC/stereo transmission. Theory and operation of studio equipment such as TV cameras, videotape recorders and even studio lighting are covered. The category concludes with baseband tests and measurements, and the critical emerging technology of digital video and audio systems, from closed captioning to compressed digital video. Probably the most critical references for this category are the *NAB Engineering Handbook* and the NTC Report #7 that is found in the NCTA Recommended Practices.

"There is an old adage that an engineer doesn't know everything, but knows where to find anything he needs to know."

Category III—Transportation Systems

Q: *If Rod Serling lived in the Twilight Zone, where does a microwave engineer live?*

A: The Fresnel Zone.

This category is perceived by many to be the most difficult examination at the Engineer level because it includes solving for complex items such as satellite-to-TVRO link and distance and bearing for microwave hops. In fact, many BCT/E certificants, myself included, have had the distinct pleasure of enjoying this examination more than once. This category looks at the general theory of noise, modulation techniques, measurement systems and equipment, and the regulatory agencies and rules that apply. The focus is then narrowed to microwave systems; AML/FML as well as requisite site engineering; and fiber-optic systems, including fiber transmission basics, link analysis, modulation, and installation and maintenance. The last area covered in this category is the one that fascinates our customers the most: satellite systems. How in the heck do we receive signals from more than 22,000 miles in space? Specifics include site and path engineering, frequency assignments, security systems and maintenance and testing. This category required more references than most of the others as it covers so many different technologies. In my view, some key references are *Understanding Fiber Optics* by Jeff Hecht, *AML Seminar Manual* from Hughes, *Broadband Coding, Modulation and Transmission* by Bernhard Keiser, and the NAB handbook.

Category intermission: I have and will discuss some of the references that I found key to obtaining sufficient knowledge to pass the examinations, but important reference sources not to be overlooked are the category-specific tutorial videotapes that are available from SCTE. Each one is taught by an expert(s) in the field, and you benefit from the questions and answers that accompany them. Another key reference that covers some topics in all categories, except Category VII, is SCTE's *Reference Bibliography Reprint Manual*, which pulls together many resource articles published in various trade publications. From satellite/TVRO path analysis to converter operation, this book covers many key topics, and is an easy-to-use source for some hard-to-find material.

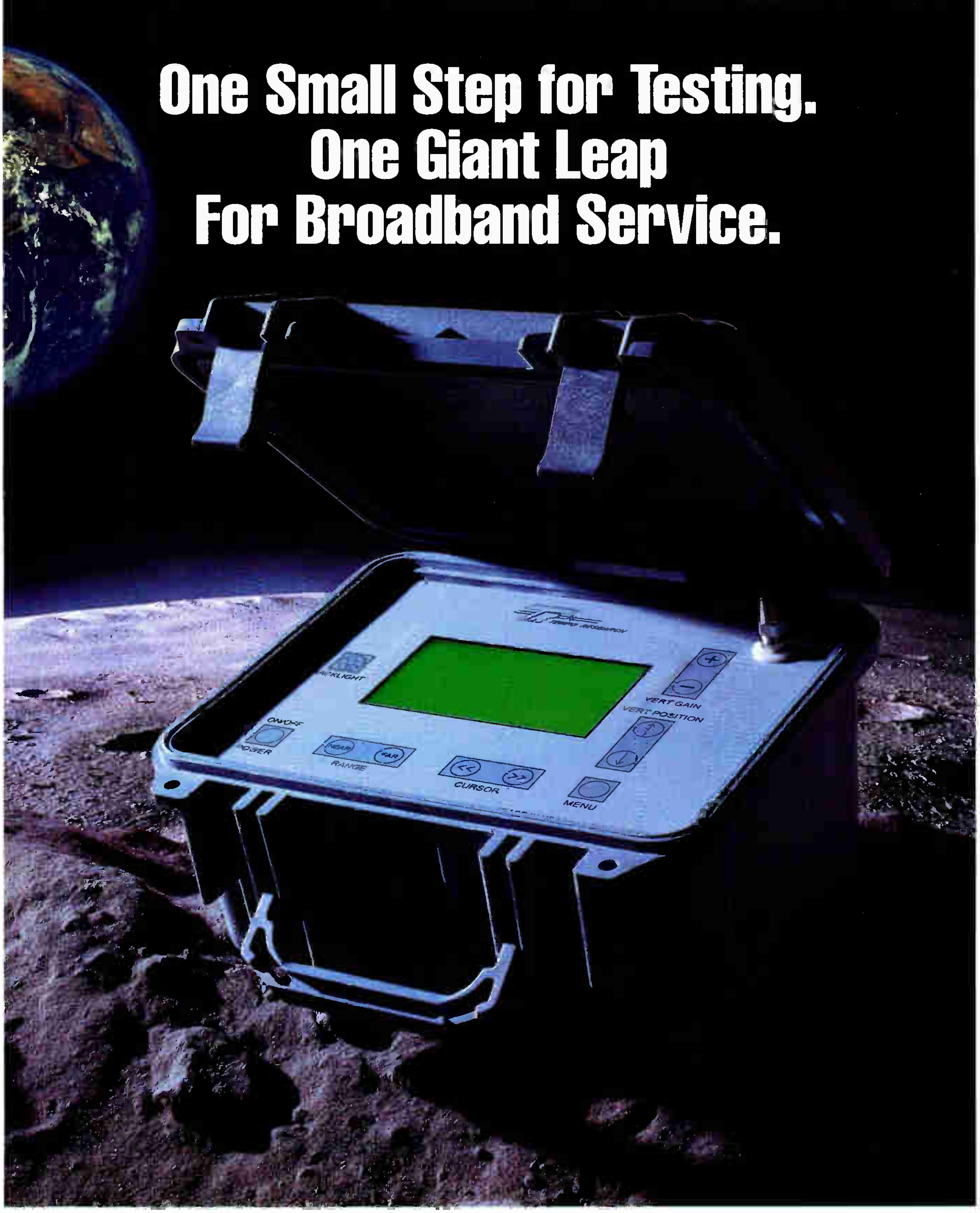
Category IV—Distribution Systems

Q: *How is the seat in front of your boss's desk and 1/4-inch strand similar?*

A: Lots of tension.

OK, all you trunk/line techs. This category is for you. You've been activating, balancing, proofing, repairing and maybe even designing coaxial distribution systems for years, but do you *really* know the science and engineering behind what you do? What is inside that equalizer box? What is unity gain? Why is frequency response alignment called sweeping?

This category begins with calculations, including the origin of the decibel, dBs with references, and formulas with dBs. The category then moves to system design engineering, covering basics such as mapping and graphic symbols, to more advance topics such as system architecture, powering and fiber optics. The heart of the category


One Small Step for Testing.
One Giant Leap
For Broadband Service.
VERT GAIN
VERT POSITION
RANGE
NEAR
FAR
CURSOR
MENU

is within the distribution components section, which covers the cable, amplifiers, connectors, and passives that compose the core of coaxial broadband systems. Category IV concludes with sections on construction techniques and system proof and testing. A couple of key references for Distribution Systems include *Cable Television* by Bill Grant, NEC/NESC handbooks, and Ken Simons' classic, *Technical Handbook for CATV Systems*, which has some of the best coverage of system distortion calculations available.

Category V—Data Networking and Architecture

Q: *How are Buckingham Palace and a video dialtone network alike?*

A: Lots of protocols.

This category is becoming even more crucial as cable operators begin to explore business offerings over their broadband networks such as Internet access, home-to-business networks and CAP/residential telephony. This category begins with the basics; bits and bytes, data standards, ISO/OSI model and modems. It then moves on to cover network architecture and media, including architecture, media, hardware and Internetworking. Transmission systems, the next area, covers the core topics of getting data from one point to another, including modulation techniques, protocols and error checking and correction. Category V concludes with sections on public networks (telephony) and testing and maintenance of data networks. Some crucial references include *Understanding Data Communications* by Gilbert Held and B*roadband Coding, Modulation and Transmission Engineering* by Bernhard Keiser.

Category VI—Terminal Devices

Q: *What is the most likely failure point within the home?*

A: Loose nut attached to the remote.

You receive it at the headend, you ship it over your network, but what do you do with it at the customer's home? Whether it's NTSC channels, BTSC stereo, signal security through encryption or addressable/pay-per-view (PPV) systems, if it is in the home, you'll find it here. Category VI begins with a look at the basics, customer-owned TV sets, VCRs, FM receivers and various interfaces, including digital products, (a little Sega or DMX, anyone?). It moves on to cover set-top devices, from basic converters to addressable decoders, program security, and PPV systems. Next is applicable regulations (have you heard of Part 15?), including the NEC/NESC, FCC rules and independent testing laboratory requirements. The category concludes with the performance testing that is necessary to ensure adequate performance.

A couple of necessary references are 47 CFR parts 17 and 76, and the SCTE's *Reference Bibliography Reprint Manual*.

Category VII—Engineering Management and Professionalism

Q: *How are managers and freeway commuters alike?*

A: They both ignore laws: physics and traffic.

This is the only category that does not assess knowledge with a 50-question multiple choice test. This category really examines your thought processes, decision-making ability, and your awareness of the "big picture," not just the little details of the situation. One may ask, how is this done? It is done by presenting three case studies of situations that one might find himself or herself in, and by asking you to write a brief essay on what you would do if placed there. The *key* point is, the answer may be obvious; what is crucial is your reasoning that allowed you to determine the answer. In addition to your reasoning, you must discuss the scope of the criteria that you considered in your decision-making process. This category fortunately has one of the best reference materials available for any category in the Category VII review course hosted by Wendell Bailey of NCTA. I strongly urge you to get a copy and view it before taking this test.

You've studied, you've prepared, and now it's show time!

Whether it is your first examination or your fourteenth, chances are you will go in and face the proctor with butterflies in your stomach, no matter how well you are prepared. In Part 2 of this article in a future issue of *CT*, I will give some general test taking and preparation guidelines from my own experience as well as those of several other BCEs with whom I associate.

Jim Kuhn of Ameritech taught a Category III tutorial at the 1995 Cable-Tec Expo, and emphasized in big, bold, print on the bottom of each page of his handout, "Know your references, know your formulas, know your calculator." This adage is extremely important in its simplicity. You *must* know how to use the three items above, particularly at the Engineer level where many exams include complex multiexpression algebraic or trigonometric formulas. The place to learn where to work them and where the appropriate keys are on your calculator is *not* in the exam room under a three-hour time limit. **CT**

The author wishes to thank Marv Nelson, SCTE vice president, technical programs, for his review of this article.

References

[1]Society of Cable Telecommunications Engineers, 140 Philips Road, Exton, PA 19341-1318, (610) 363-6888 or (800) 542-5040.
[2]SCTE *Interval*, June 1992.
[3]SCTE *Interval*, June 1995.
[4]Kuhns, Jim, "BCT/E Category III Tutorial," 1995 Cable-Tec Expo.

By Wes Berkey

Simple steps to headend troubleshooting

Even the most sophisticated headend system can have an occasional problem. When a problem does occur, it often is up to the cable operator to address the issue, which requires basic troubleshooting knowledge. The best way to acquire troubleshooting skills is through experience. Following are some valuable tips for analyzing possible problems with your headend:

• *Don't jump to conclusions.* Even if you think you know what is wrong immediately, don't skip the important step of fully researching the problem. Who first noticed the problem and how did he or she describe it? What are the symptoms? Are there any status indicators that may offer additional information? Has the same problem (or a similar problem) occurred before and how was that problem solved? Before you go on an expensive and time-consuming search for the source of the problem, you need as much information as possible.

• *Review your documentation.* It is important to review the system architecture so that you may more easily pinpoint the components of the system that may be contributing to the problem. Your system should have documentation that includes diagrams of the headend and distribution wiring. These diagrams will be a valuable tool as you attempt to locate the source of the problem.

• *Check your connections.* When you have an idea of which section of the system or specific system component(s) may be causing the problem, verify the cable connections of the signal path in question, starting at the furthest downstream termination point. The most common cause of headend signal degradation is a poor audio or video termination. Check carefully for mismatched impedance or disconnected cables in the baseband video and baseband audio wiring; they are often the culprit for impaired signals.

Courtesy Fundy Cable

• *Compare levels to spec.* Verify levels both at the combined output test point and at the unit level test point(s) such as the modulator, upconverter, etc. The measured levels should be equal to the headend design levels indicated on system diagrams, and should be compatible with other corresponding signal levels. Oversaturated or undersaturated video signals, or "audio buzz" problems are often traced to improperly adjusted video or audio modulation in the video monitor.

• *Consider the source.* Verify the source signal quality, paying special attention to distortions that may already be present in the source signal. You need to determine whether the system problem is due to the performance of one of the system components or due to the source itself. If the source signal is already impaired before it enters the headend system, there may be no need to look further to solve the problem. Source components to check for signal quality include BTSC stereo encoders, matrix switches, and satellite receivers, as well as the antennas and local origination equipment.

• *Check the scrambling.* If you trace the problem to a video scrambling unit, you can determine whether the scrambler is functioning properly by turning the scrambling off; if the problem disappears, check the scrambler or the scrambler interface. If the problem persists, you may need to look elsewhere for its origins. (Note: Some programming may not be suitable to be "in the clear" (unscrambled) during the troubleshooting process. Bear this in mind before turning off any video scrambling.)

• *Verify power and temperature.* If the problem is intermittent, then examine the power and temperature stability of the headend environment. Often a headend problem can be traced to fluctuations in power or temperature. Other intermittent problems are due to loose or broken

Wes Berkey is a headend system designer with Scientific-Atlanta.

internal components that can fail with vibration.

• *Diagnose power loss symptoms.* If the headend has experienced a power loss, there are several symptoms to investigate. The back-up power system may be noisy upon startup, causing performance problems. Some headend components may latch or "hang up" after a restoration of power and you may need to reset the individual units. Other headend components may fail due to a power surge and subsequently require servicing.

Although some of the system tests listed here may seem time-consuming, it is often more time-consuming to skip a step that seems obvious. Lack of discipline while troubleshooting will only make the process more difficult; if you adhere to logical troubleshooting practices you will successfully find and solve any headend problem.

Common headend problems

If the distributed signal is unacceptably "snowy" at a subscriber location, it is likely that the signal degradation is due to the cumulative effect of broadband noise. A good metric of the broadband noise is the system's carrier-to-noise ratio (C/N). The video signal-to-noise ratio (S/N) is another noise measurement that is useful in identifying causes of signal distortion. I recommend that you use C/N to evaluate your headend system because the system S/N ratio is greatly affected by the source quality, whereas the C/N is more a measure of the system performance.

The first thing to determine in the case of signal impairment due to broadband noise is whether just one channel, a certain group of channels, or all channels are affected. If the whole system is affected by broadband noise, then it is likely that the cause of the distortion is in the distribution system. If only a certain group of channels is affected, then the C/N problem is likely to originate in the combining network. If a single channel is experiencing a problem, then the video modulator for that channel should be examined.

Don't fool yourself while troubleshooting the system C/N. The noise floor of the measurement device (usually a spectrum analyzer) greatly affects the outcome of the C/N measurement, and incorrect measurements can lead you to incorrect conclusions about the cause of the problem. To measure a C/N as high as 70 dB, the carrier level should be greater than 50 dBmV; a detailed procedure is available from Scientific-Atlanta for the measurement of unit-level and combined system C/N.

To determine whether a noisy picture is due to the source video signal or the satellite receiver for that channel, you should measure the video S/N ratio. Measure the S/N ratio at the video output of the satellite receiver for the channel in question. Using a spare satellite receiver, if possible, measure the S/N ratio from the same satellite transponder. If you don't have a spare receiver, you may have to interrupt another channel on the system temporarily to use its receiver for this second measurement. Compare the original measurement result with your subsequent result; if the second result was significantly better, the demodulator circuit within the satellite receiver could be the cause of the distortion.

Troubleshooting equipment shopping list

Finally, while troubleshooting the headend system, it is advisable to have the following pieces of test equipment available at the site:

1) TV/monitor — Used both for baseband signal quality verification and RF signal quality verification.

2) Spectrum analyzer or field strength meter — Used for RF signal level verification, balancing levels, and frequency response measurements.

3) Video waveform monitor — Used for baseband video specification verification.

4) Agile demodulator (or set-top terminal) — Used to demodulate RF signals to baseband to enable baseband signal verification.

5) Oscilloscope — Used to measure audio signal response.

6) Multimeter — Used to check impedance, measure test point voltages, and verify power specifications. **CT**

Cable-Tec Expo program guide

If you're reading this at the Society of Cable Telecommunications Engineers Cable-Tec Expo '96, welcome to Nashville, TN, and the premiere technical trade show in the cable telecommunications arena. With the industry's mergers, acquisitions and new technologies that have been making headlines over the past year, now more than ever it's time to gain insight into the new equipment and ideas that have made all this possible.

What follows is a preliminary program guide for the convention. Check out your show guide for more details and don't miss the *CT/IC Daily*, which brings you the show's breaking news and information on the conference sessions and show floor activity.

June 9:

Preconference tutorials

• *Achieving BCT/E Technical Certification* with Marvin Nelson of the SCTE.

• *Audio Quality in the Multichannel Universe (Part 2)* with Russ Murphy of The Family Channel.

• *Consumer Interface and the New Telecommunications Bill* with Walt Ciciora (consultant for the NCTA).

• *Justifying Technical Training in Your Company's Annual Budget* with Don Oden, NCTI.

June 10:

Engineering Conference

• **Session A:** *Fiber-Related Issues* with Tony Werner, TCI (moderator); John Chamberlain, Norscan; Pawan Jaggi, Pirelli Cable Corp.; and Pete Wagener, Antec Corp.

• **Session B:** *Video Transport* with Nick Hamilton-Piercy, Rogers Cablesystems (moderator); Mark Davis, Cox Communications; Charles Kennamer and Olis Nesco, TCI; Keith Kreager, Antec Corp; Jack Terry, Nortel; and John Thomas, ADC Video Systems.

• **Session C:** *Data Over Cable* with Ken Wright, Intermedia Partners (moderator); Frank Cotter, Rogers Cablesystems; and Bob Cruickshank, CableLabs.

• **Session D:** *Return Spectrum Issues* with Alex Best, Cox Cable (moderator); Brian Bauer, ADC Telecommunications; Jerry Green, H-P/CaLan; Dean Stonebeck, General Instrument; and Bill Xenakis, Wireless and Cable Products.

June 11-12:

Expo workshops

• *Cost Analysis of System Rebuilds* with Dale Lutz of ETG and Scott Shupe of Intermedia Partners.

• *Data Transmission Byte by Byte* with Richard Covell of Texscan.

• *Digital Technology 102* with Megel Brown of Comcast and Don Gardina of Hewlett-Packard.

• *In-Premise Wiring Issues* with Barry Smith of Texscan and Neal Tinggaard of TCI.

• *Making Two-Way Work* with Ron Hranac of Coaxial International and Tom Staniec of Time Warner.

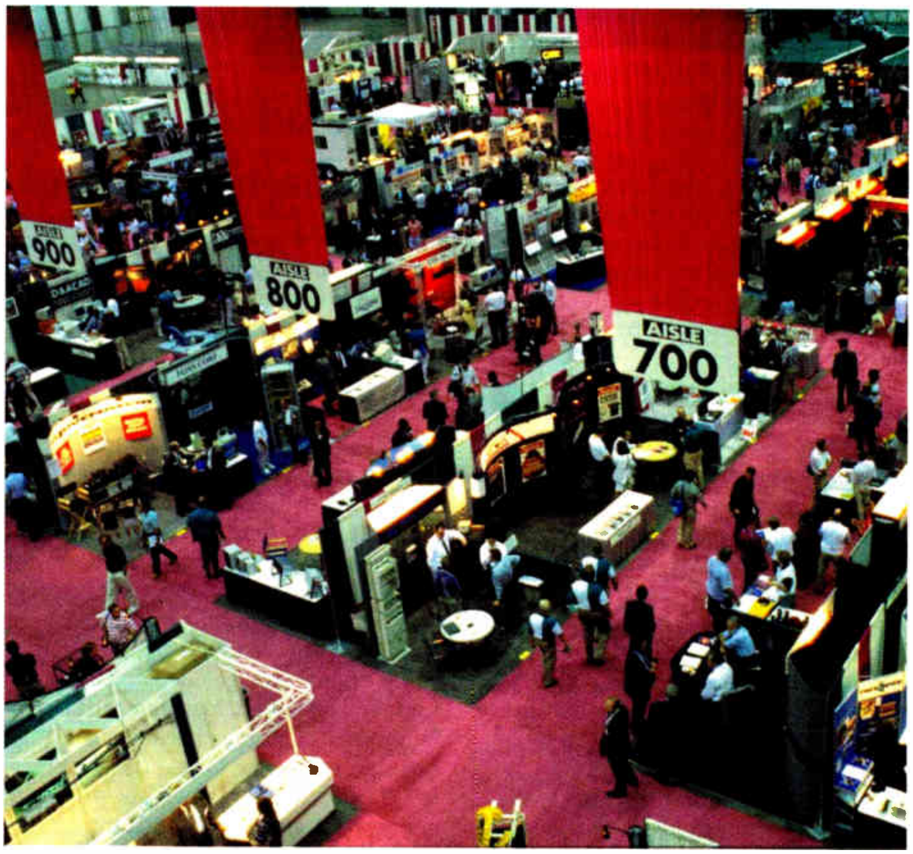
• *Network Architectures* 102 with Kenneth Metz of Integrated Technology and Jeffrey Sauter of C-COR.

• *Network Management (OSS, BSS)* with Pamela Anderson of CableLabs and Terry Poindexter of Integration Technologies.

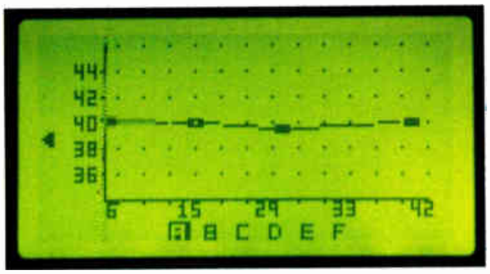
• *Powering Issues* with Tom Osterman of Comm/Net Systems.

• *Regulatory Issues* with Ralph Haimowitz of the SCTE; Steve Johnson of Time Warner Cable; Jonathon Kramer of Communications Support Group; and Frank Lucia and John Wong of the FCC.

• *Telephony 102* with Jay Junkus of KnowledgeLink and Tony Guitierrez of Nortel. **CT**



Finally, Total Return Path Maintenance For 2-Way Distribution Systems



When equipped with the Multiplexer Option, the 9580SST accepts signals from up to 8 separate test points and analyzes sweep & ingress from each individually, returning data to as many as 6 SSR field units (A thru F) connected to it.

Announcing the Trilithic 9580 Sweep and Ingress Monitoring System

More Than A Return Path Sweeper
Displays sweep response, calculates gain and tilt, and measures return path ingress and noise.

Fast and Convenient
Updates all measurements approximately twice per second.

Versatile, Cost Effective
One headend unit supports six field units, and with no loss of speed.

Detailed Troubleshooting Data
One headend unit can monitor up to eight return test points individually.

For more information about the Trilithic 9580 Return Path Maintenance System, or Trilithic's full line of Broadband Test Equipment, dial

1-800-TRILITHIC

http://www.trilithic.com
Reader Service Number 146

Attention installers: Scholarship opportunities available from SCTE

The technology of the cable TV and telecommunications industry continues to grow dramatically. As the face of our industry changes, we can't lose sight of one of the most essentially vital elements of our business: the installer. Before there can be a satisfied customer, there needs to be a competent installer who makes that connection to the customer's service. In many cases, the installer is the first and only real face-to-face contact the customer may have with our industry. It is the installer who must make a good impression with his or her appearance, the manner in which the installation procedure is described to the customer, the knowledge the installer displays about the job, the workmanship in which the installation is done, and the final results, all of which contribute to a quality installation.

How might the industry assist new installers in getting the right instruction from the start? This is a question that the Society of Cable Telecommunications Engineers continues to ask. The SCTE Installer Certification Program is already in existence. In addition to this, the Society's scholarship subcommittee will provide to qualified installer candidates scholarships in the form of training and the opportunity to become certified through SCTE.

The purpose of this scholarship is to encourage the early education of installers entering the cable industry, as well as existing installers. Eligibility for a scholarship is open to all SCTE Installer Members. (Installer membership can be requested at the time of application.) The actual requirements for approval are the same as those existing for other scholarships awarded through SCTE, except the nominee does not need to be National member. (See the accompanying sidebar.)

The scholarship awarded will be the Installer Course offered through the National Cable Television Institute and enrollment into the SCTE Installer Certification Program. An advisor from the SCTE scholarship subcommittee also will be assigned for coaching and encouragement. An additional benefit is industry recognition and a boost to the successful candidate's career.

To apply, the candidate or the candidate's supervisor can submit the scholarship application. For a copy of the application fill out the form below and send it to the SCTE. You also may contact Pat Zelenka at SCTE national headquarters, (610) 363-6888, or stop by the SCTE membership booth at Cable-Tec Expo '96 in Nashville, TN, for further details. **CT**

Scholarship guidelines

When deliberating over scholarship applicants and award recommendations, the student advisor working group and this subcommittee shall consider the following:

- Career goals are consistent with SCTE direction.
- Financial need.
- Lack of educational opportunities beyond SCTE scholarship.
- Supporting recommendations from the applicant's supervisors and references.
- No applicant shall be awarded more than two scholarships in any consecutive 12-month period.

Yes! I'd like more information and an application for the Society of Cable Telecommunications Engineers Scholarship Subcommittee's Installer Award.

Name ______________________

Company ______________________

Address ______________________

____

City ____________ State ____________ ZIP ____________

Phone ______________________

FAX ______________________

Mail to: SCTE, 140 Philips Rd., Exton, PA 19341, Attn: Pat Zelenka, or Fax (610) 363-5898.

CableLabs adds modem, telecom staff

CableLabs added staff to its cable data modem expertise in the Operations Technologies Projects department, and to its wireless telecommunications capabilities. **David Harrison**, formerly of **BDM International**, was named project manager, network systems development. He is responsible for the development of network architectures and financial models associated with providing telecommunication services over evolving cable systems. Prior to joining CableLabs, Harrison was manager of information systems at BDM International. He also was an architect of the **Defense Department's** telecommunications network upgrade.

Also, **Brian Reilly** was named staff project engineer; he will focus on cable data modem projects. Prior to joining CableLabs from the University of Colorado, Reilly spent 10 years with **GTE Government Systems Corp.** where he was a member of technical staff. His work there included network design of ATM/SONET systems, circuit and system design of computing hardware, and ASIC design.

Also new to the company is **Thomas Moore**, who was appointed project manager of advanced network development. Moore provides technical and project management support for the design and implementation of laboratory-based cable data modem performance testing and network performance modeling. Prior to joining CableLabs, Moore spent five years as president and general manager of a subsidiary of **Public Service Company of Colorado.**

Pamela Anderson was appointed project manager, enterprise management technologies. She is responsible for the analysis of operations and business support systems required to support the new cable telecommunications environment. Anderson has 11 years of experience in information systems and architecture development, including stints with **NASA, Shell Oil Co.** and **BDM International** where she designed local and wide area data communications architectures and integrated network management system architectures, migration strategies and deployment plans.

Michael Laflin is the new lead member of technical staff on wireless technologies in engineering. In this position, Laflin evaluates the technical aspects for leveraging cable plant for wireless telephony applications. From 1988 to 1995, Laflin was with the **Institute for Telecommunication Sciences, U.S. Department of Commerce,** heading the ELF/VLF research between 1988 and 1991. From 1993 to 1995 he headed the institute's PCS research program.

General Instrument announced that **Woo Paik** rejoined the company as executive vice president, technology, for the Communications Division's western operations. As senior vice president of new business and advanced development until 1995, Paik led the Advanced Development Team developing digital TV technology, pioneering both digital standard and digital high definition TV systems. Dr. Paik is a founder of the VideoCipher Division of GI and was one of the key inventors of the VideoCipher II system that became the de facto standard for satellite video encryption used by virtually all cable programmers including **HBO, Showtime, CNN, ESPN** and **Disney.**

Dennis Schwab, vice president of sales, cable and satellite products for **California Amplifier Inc.**, retired on March 29, 1996. Citing family considerations, Schwab stated, "I have thoroughly enjoyed my 11-year tenure with California Amplifier. The company has experienced phenomenal growth during this period and I am proud to have played an integral role in its success. At this juncture in my life, however, it's time to focus on my family and the community goals we have set for ourselves."

Scientific-Atlanta announced that **Thomas Steipp** has joined the company as vice president and general manager of high-speed data systems, including cable modems. Steipp is responsible for S-A's high-speed data communications systems. He will oversee the introduction of interactive cable modem products, which integrate with the company's transmission and digital headend equipment to provide an end-to-end data communications solution for broadband operators. Previously, Steipp was with **Hewlett-Packard Co.** for 15 years. Most recently he was general manager of the Federal Computer Operation, where he was in charge of winning several new contracts. He also held marketing management positions in Hewlett-Packard's mass storage, telecommunications and networking business units. S-A also named **Patrick Tylka** president, North American and Latin American sales of the Broadband Communications Group. Tylka was previously president of North American sales division. Tylka directs an extensive sales force providing an end-to-end broadband solution of voice, video and data for cable TV, telephone, electric utility and related companies in the Americas.

George Stewart will succeed **Gregory Bicket** at **Tele-Communications Inc.'s** Argentinean **Cablevision SA** as COO. Bicket will oversee Latin American operations for TCI.

Robert Lewis joined **Online Service Systems** board, charged with identifying acquisition targets for the Internet company.

At the **National Cable Television Association**, **Teresa Pitts** has joined the association to help out **Rick Cimerman** in its State Telco Policy Office. Meanwhile, Public Affairs Director **Bridget Blumberg** left NCTA to spend more time with her 18-month old, Corbin.

Reader Service Number 130

Spectrum analyzers

B+K Precision introduced four low-cost spectrum analyzers designed for a wide variety of applications. The units are stable, relatively drift-free, and feature wide dynamic range, large maximum signal input, tracking generators and audio demodulation.

The company says all four models' stability and dynamic range are equal to that of spectrum analyzers costing thousands of dollars more. The units can measure low-amplitude signals with a measurement range of over 113 dB (-100 to +13 dBm) with 80 dB being displayed on the screen at 10 dB/division. Maximum input level is +20 dBm.

The new units are guaranteed to drift less than 0.15 MHz per hour. Two optional accessories are available: a battery pack and a 75-50 ohm impedance-matching adapter. The battery pack makes these analyzers truly portable, while the impedance-matching adapter extends the analyzers' usefulness to 75 ohm applications.

Models 2615 and 2620 are designed for applications up to 500 MHz. Both models include a scan width selector that can adjust the frequency display width from 50 kHz to 50 MHz per division. Both models include a four-digit numeric LED readout that can selectively display either the center or marker frequency. Frequency measurement is made by adjusting a needle-like cursor to the point of interest on the display and reading the four-digit marker frequency value.

Model 2620 also includes a tracking generator that permits a four-terminal measurement that is useful in network and filter passband analysis. The tracking generator is a frequency synchronous signal source with a range of 100 kHz to 500 MHz that is controlled by the frequency of the spectrum analyzer. The output level is adjustable from -50 dBm to +1 dBm in four 10 dB switchable steps in addition to an 11 dB rotary variable attenuator control.

Models 2625 and 2630 have AM and FM audio demodulation to allow the user to listen to and identify RF signals. Model 2630 also includes a tracking generator. Fine and coarse center frequency controls, combined with a scan width selector, enable simple frequency domain measurements from 100 kHz/division to 100 MHz/division. Both models include a four-and-a-half digit numeric LED readout that can selectively display either the center or marker frequency.

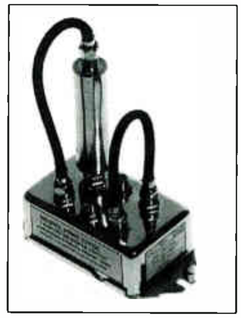
All models are suitable for precompliance testing during development prior to third-party testing. An optional near-field sniffer probe set can be used to locate cable and PC board emission "hot spots" and evaluate EMC problems at the breadboard and prototype level. The company says the spectrum analyzer/sniffer probe combination is an excellent solution for RF leakage/radiation investigation, CATV/MATV system troubleshooting, cellular telephone/pocket pager test and EMI diagnostics. There is an optional measurement output for a PC that makes result documentation easy and affordable.

The Model 2630's tracking generator has a range of 1,050 MHz. Output level is adjustable from 50 dBm to +1 dBm in four 10 dB switchable steps in addition to an 11 dB rotary variable attenuator control.

Reader service #312

Coax transfer switch

The new Model 7001 voltage operated coaxial transfer switch from Communications & Energy Corp. has two selectable "loop circuits." When activated, the switch transfers one loop into the line while disconnecting the other loop. Either an RF device or a coaxial jumper may be used in either of the loops. Hence the switch will connect or disconnect a variety of devices either into or out of a coaxial cable line.



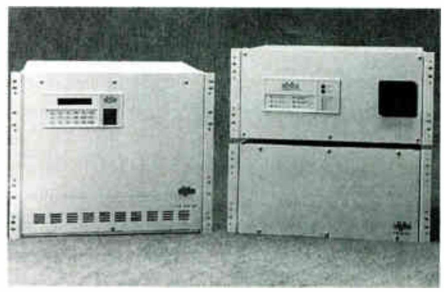
The transfer switch operates on 12 VDC and requires 90 mA. Passband is 0 to 1 GHz with an insertion loss of 0.5 (typical). Maximum passband insertion loss is 1 dB. Isolation is 50 dB (minimum). Connectors are 75 ohm Type F. The unit measures 2 x 2.5 x 5 inches and weighs one-and-a-half pounds.

Reader service #311

Rack-mount UPS

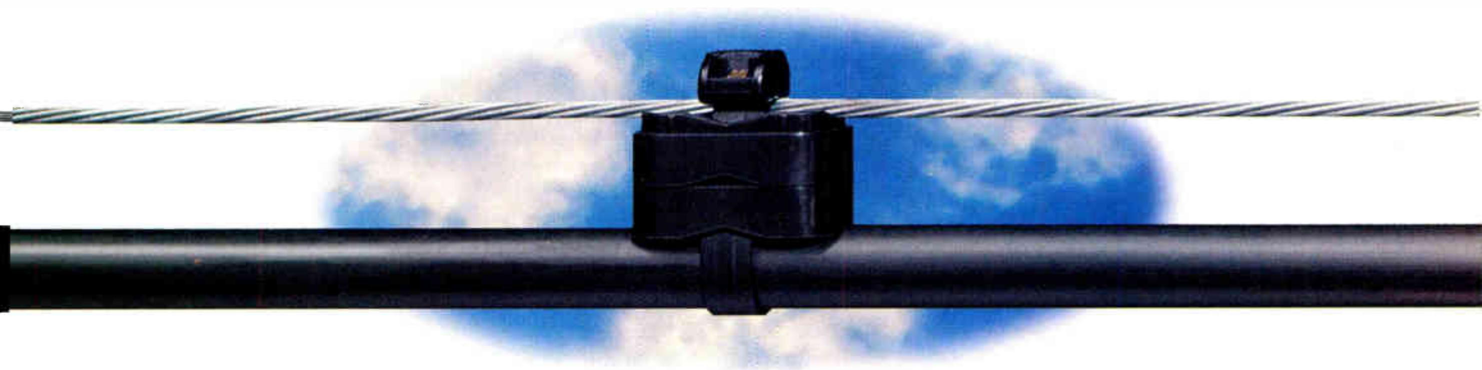
Alpha Technologies expanded its line of uninterruptible power supply (UPS) products to include rack-mount versions of its CFR Series UPS systems.

These rack-mount UPS systems employ the company's controlled ferroresonant technology, which further enhances the ferroresonant transformer's already natural isolation, surge and spike rejection characteristics. This is accomplished without the step-load or nonlinear load response problems associated with other hybrid technologies.



In addition, the CFR Series corrects for load-generated poor power factor and nonlinear current waveforms without costly add-on transformers or electronic correction packages common in PWM designs.

The company says the systems also feature superior isolation and noise attenuation, as well as 19-inch or 23-inch front or mid chassis rack-mounting brackets. Also, these systems provide extended backup times in excess of eight hours. →



IT TAKES THE "STALL" OUT OF "INSTALL."

The Deltec® Cable Support System from Thomas & Betts can make a real difference in your installation time. It installs with just a single wrap. Saving you time *and* money.

Here's another difference -- it's not metal, it's homopolymer acetal. A material that has more than proven itself in 20 years of harsh outside plant testing.

What's more, the Deltec System has no sharp edges or points. So it's easy on your hands. Easy to hold on to. And easy on coaxial, fiber optic, and twisted pair cable. All of which makes the Deltec System easy to work with. And of course, it's fast, too.

Last but not least, the Deltec System is versatile. It supports cable either horizontally or vertically.

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ISO 9000 Registered

Thomas&Betts

Reader Service Number 107

The CFR-RM Series UPS systems are ideal for use in telecommunication equipment racks, cable TV headend facilities, broadband communication networks or any mission critical electronic system with rack-mount requirements. The new systems are available in power ratings from 1,500 VA to 5 KVA.
Reader service #309

Broadband drop amp

Toner Cable Equipment introduced the TDA-112 drop amplifier, a low-cost solution for long subscriber drops or multiple outlets. This simple and reliable 1 GHz, 12 dB gain amplifier is a versatile way of eliminating service calls due to marginal signal levels.

The unit is compact—the size of a two-way splitter. Power is supplied by a 12 volt DC plug-in transformer, either 110 volt or 220 volt. This power supply is connected with a 6-foot piece of RG-59 cable (included).
Reader service #310

Continuous duty winch

General Machine Products Co. Inc. introduced the Adams CD Lite continuous duty winch, computer designed to capably handle innerduct and hybrid fiber/coax placing requirements.

The company says the winch's smaller cube and reduced weight make it fit perfectly in today's downsized fleet. Performance specifications include: 7,400-pound maximum bare drum line pull, 2,500-pound top layer line pull (SAE J706), and 2,500-foot drum capacity of 5/16-inch wire rope, underwound.

The winch also features an instantaneous full load brake that is spring-applied and hydraulically released, and a free-spool caliper drag brake. It is powered by a single-section gear-type motor, which is rated at 2,300 psi and operates at 24 gpm maximum.

Other features include a mechanical level-wind, built-in drum guard, air shift clutch with sensor indicator lights, an SAE-rated design including bolt-on mounting kit, and many valuable equipment options.
Reader service #308

Curb markers

VIP Products has designed and field tested a line of curb markers that can be applied to either the top

or sides of a curb, using a one-part adhesive. These resilient curb markets provide a warning to utility companies and contractors of the presence of underground fiber-optic or CATV lines. Cable routes and road crossings can be permanently marked with these low profile markers instead of a more obtrusive sign and post.

"Fiber optic telephone" and "CATV" are two standard stock legends available for same day shipment. Curb markers can be customized for copy, color and size, and can include a company name, logo or phone number.
Reader service #306

Line extender amp

Scientific-Atlanta Inc. introduced a line extender amplifier with improved performance and reliability, and lower installation and operation costs. Instead of conventional silicon hybrid circuits composed of discrete components, the LE III is the first to utilize smaller, more efficient Gallium Arsenide (GaAs) integrated circuit technology, according to the company.

The amp will meet the increasing demands of broadband operators to support an array of interactive services such as Internet access and telephony. The unit provides: improved performance and reliability that reduces subscriber outages and costly truck rolls for operators; lower up-front capital purchases because fewer LE IIIs are needed compared to current hybrid technology; lower operating costs because of lower current draw and fewer active components; and telephony powering requirements of 15 amps.

This is the company's first application in broadband RF amplifiers. The company says the amp was developed to address near future concerns, including meeting emerging market needs for bandwidth beyond 750 MHz.
Reader service #304

Cable simulator

Microwave Filter Co. introduced the Model 11649 cable simulator. The unit simulates a 200-foot length of RG-59 cable, with 5 dB insertion loss at 50 MHz and 20 dB loss at 750 MHz.

The compact design is convenient for bench top testing. The unit has an impedance of 75 ohms and comes

with Type F male/female connectors. Other types of amplitude equalizers available are cable equalizers, amplifier tilt equalizers and fixed attenuators. The unit is approximately 4 x 1.5 x 1 inches in size and weighs approximately 3 ounces.
Reader service #305

Optical power meter

Siemens added a new model to its K2701 hand-held optical power meter line. This unit is optimized for analog CATV and other applications that incorporate high-powered lasers. Although power levels exceeding a few milliwatts are not accurately measured by traditional power meters, this new model accurately measure signals from 100 mW (+20 dB) to 1 nW (-60 dBm), according to the company.

This wide measurement range makes it useful for virtually all applications, including cable TV, long distance and local telephony, and customer premise/LAN environments.

A versatile fiber-optic tool for field use, the unit accurately measures end-to-end loss of systems, transmission system

power levels, power levels at nodes, and can be used for troubleshooting and maintenance. Its combination of practical features, simple operation, field performance and rugged design make it perfect for both analog and digital transmission technology found in CATV, telephony and emerging hybrid fiber/coax transmission.
Reader service #303

Optical node

ADC Video Systems announced the ISXII, a low-cost optical node for broadband network video transmission specifically designed for networks that initially require a low volume of two-way services or one-way services only.

With the optical node, users can deploy units in an 80- or 110-channel, 750 MHz or 860 MHz architecture; add two-way services such as status monitoring, pay-per-view, Internet access, near-video-on-demand and status monitoring, as needed, on a node by node basis; interface to network management systems, as needed, on a node by node basis; and choose the number of RF outputs required (two, three or four) .

The ISXII is a modular optical distribution platform. The unit is composed of an RF tray base. Optional features include 860 MHz bandwidth capacity, reverse path transmitter and status monitoring. Best of all, if the future needs of the network change and require optical redundancy, block up conversion or other capabilities of the ISX, the electronics can be modularly exchanged to convert the node without disconnecting it from the cable plant. Since the network can be upgraded in place without any physical plant modifications, the service provider's capital investment is protected.
Reader service #302

Cable modem forecast

Fueled by competitive DBS and MMDS challenges to their core video delivery business and market position as the low-cost supplier, U.S. cable operators are embracing cable modems in their face-off with premium service broadcast satellite operators and telephone companies to deliver higher bandwidth services in the many megabits per second range to residential customers.

Probe Research's study, *Cable Modems,* reports that by 2004, 58.3 million cable TV homes and 7.4 million local exchange carrier homes will be capable of using high-speed modems. Of the 58.3 million U.S. cable homes, more than 42.3 million will be able to use cable plant for both forward and reverse path communications, while up to 15.9 million will require telephone plant for the return traffic.

The study also reports that by the end of 1996, 51,000 U.S. cable homes will be using two-way cable modems, while 124,000 will be using hybrid modems (HFC for downstream communications and telephone plant for upstream signals).

In addition, it forecasts that at least 51% of U.S. cable plant will have been converted to HFC, passing more than 58% of all accessible homes by 2004. Forty-two percent of all U.S. homes passed by cable operators will be operating in full two-way mode, while another 16% will be served by upgraded HFC plant that has not been activated for two-way operation.
Reader service #301

SONET

Nortel introduced the newest addition to its SONET transmission family, the S/DMS TransportNode OC-3 Express. This low-capacity SONET product can accommodate 155 Mb/s transport. This size is perfect for headend interconnection for initial cable data and voice backhaul.

The unique architecture of the OC-3 Express allows any of the shelf locations to support up to 155 Mb/s interfaces. This versatile architecture allows cable providers to hub multiple video servers from a single shelf for maximum efficiency transport on the "network" side. Also, each shelf operates as a cross-connect for bandwidth management of data or voice DS1 signals.
Reader service #300

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.

☛ *New Technologies and Their Effects on the Subscriber*—This program, featuring Claude Baggett, Vito Brugliera, James Farmer, Judson Hofmann and Michael Smith, discusses consumer demand for delivery of other types of communications services, the challenges they pose and the revenue potentials they promise. Topics covered include: legislative impacts, consumer electronics influences, computer industry impacts, telephone company competition, new consumer interface technology, new set-top technology and whole house descrambling.(75 min.) Order #T-1139, $45.

☛ *Pay-Per-View Technology Update*—This program, featuring Paul Harr, Paul Levine, Geoffrey Roman and Terry Wolf, addresses what services will look like in the future with video moving into the digital age. Topics include: digital compression, fiber optics, video-on-demand/movie–on–demand, possibilities with digital compression, head-end logistics and control options. (1 hr.) Order #T-1140, $45.

☛ *Safety: NEC, NESC and OSHA Regulations*—Your system is subject to heavy fines if you don't have a written policy concerning all aspects of general safety, as well as a hazardous materials program. Ralph Haimowitz, Jim Stilwell and Chris Story discuss safety, NESC and NEC requirements. Topics covered include: steps to OSHA compliance, required record keeping, OSHA inspection, most often cited OSHA standards, NESC spacing, ice/wind loading, Span Master program and NEC overview. (70 min.) Order #T-1141, $45.

☛ *Outage Reduction Techniques*—What are our current customers telling us about their need for greater reliability? This presentation by Scott Bachman, Chuck Harris and Mike Miller reports on research conducted by CableLabs and major MSOs. Low-cost techniques for better predicting and identifying potential outages/problems also is discussed. Topics covered include: link between outages and customer satisfaction, number of outages, and automated detection and tracking. (70 min.) Order #T-1142, $45.

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

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

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AD INDEX

June

4-7: Siecor training course, fiber-optic installation for LANs, Seattle, WA. Contact (800) 743-2671, ext. 5539.
4-7: Siecor training course, fiber-optic installation for LANs, Norfolk, VA. Contact (800) 743-2671, ext. 5539.
5: SCTE Bluegrass Chapter seminar, Frankfort Plant Board Clubhouse, Frankfort, KY. Contact Max Henry, (502) 753-6521.
6: SCTE Great Plains Chapter testing session, BCT/E and Installer exams to be administered, Bellevue, NE. Contact Randy Parker, (402) 292-4049.
6: SCTE Miss/Lou Chapter testing session, BCT/E exams to be administered. Contact Austin Matthews, (601) 374-5904.
6: SCTE Miss/Lou Chapter technical program in conjunction with Mississippi State Cable Show, Grand Casino Hotel, Biloxi, MS. Contact Austin Matthews, (601) 374-5904.
6: SCTE New England Chapter seminar, high-speed data, Best Western, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.
6-7: Antec FiberWorks training course, broadband cable TV technology, Antec technology center, Atlanta. Contact (800) FIBER ME.
10-13: SCTE Cable-Tec Expo '96, Opryland Hotel, Nashville, TN. Contact SCTE national headquarters, (610) 363-6888.
11-13: Scientific-Atlanta technical training seminar, 8600^{x} system operation and maintenance, Atlanta. Contact Bridget Lanham, (800) 722-2009, press 3.
11-14: Antec FiberWorks training course, fiber-optic system training, Antec technology center, Atlanta. Contact (800) FIBER ME.
11-14: Siecor training course, fiber-optic installation for LANs, Keller, TX. Contact (800) 743-2671, ext. 5539.
11-14: Siecor training course, fiber-optic installation for LANs, Jacksonville, FL. Contact (800) 743-2671, ext. 5539.
13: SCTE Satellite Tele-Seminar Program, "CLI—Now and Tomorrow (Part II)" and "Painless Technical Speaking (Part I)," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
17-20: Siecor training course, fiber-optic installation for LANs, Hickory, NC. Contact (800) 743-2671, ext. 5539.
18: SCTE Desert Chapter seminar, BCT/E and Installer exams to be administered, Colony Cablevision, Palm Desert, CA. Contact Bruce Wedeking, (909) 677-2147.
18-20: General Instrument training course, digital network engineering training, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
18-21: Siecor training course, fiber-optic installation for LANs, Santa Ana, CA. Contact (800) 743-2671, ext. 5539.
19: SCTE Inland Empire Chapter seminar and second annual chapter/vendor golf tournament, Cox Communications, Spokane, WA. Contact Roger Paul, (509) 484-4931, ext. 230.
19-20: Antec FiberWorks training course, introduction to digital communications, Sheraton Suites Hotel, Elk Grove Village, IL. Contact (800) FIBER ME.
20: SCTE Michiana Chapter seminar, antenna and tower design and BCT/E and Installer exams to be administered, Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.
20: SCTE Northern New England Chapter seminar, data/cable modems, Ramada Inn, Portland, ME. Contact Bill DesRochers, (207) 646-4576.
20: SCTE Razorback Chapter seminar. Contact Jack Trower, (501) 327-8320.
23: SCTE Old Dominion Chapter seminar, BCT/E tutorial on Category III: Transportation Systems, and BCT/E and Installer exams to be administered, Cox Cable, Roanoke, VA. Contact Margaret Fitzgerald, (800) 231-0237.
23-27: Supercomm '96, Dallas. Contact (800) 2-SUPERC.
25-26: Scientific-Atlanta technical training seminar, migration to digital networks, San Francisco. Contact Bridget Lanham, (800) 722-2009, press 3.
25-27: Antec FiberWorks training course, digital networks, Sheraton Suites Hotel, Elk Grove Village, IL. Contact (800) FIBER ME.
25-28: Siecor training course, fiber-optic installation for LANs, Bakersfield, CA. Contact (800) 743-2671, ext. 5539.
26: SCTE Smokey Mountain Chapter seminar, emergency alert/data access, Quality Inn, Johnson City, TN. Contact Roy Tester, (615) 878-5502.
27: SCTE New England Chapter seminar, high-speed data, Best Western, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.
29: SCTE Llano Estacado Chapter first annual vendor day with technical workshops and Cable-Tec Games, Lubbock, TX. Contact David Fielder, (806) 793-7475, ext. 4518.

Planning ahead

Oct. 13-15: Atlantic Cable Show, Baltimore, MD. Contact Cable Television Association of Maryland, Delaware, DC, (410) 266-9111.
Dec. 11-13: Western Cable Show, Anaheim, CA. Contact (510) 428-2225.

July

1-2: Antec FiberWorks training course, compressed video concepts and transmission, Antec training center, Denver. Contact (800) FIBER ME.
8-11: Siecor training course, fiber-optic installation for LANs, Hickory, NC. Contact (800) 743-2671, ext. 5539.
8-12: General Instrument training course, broadband communications network design, Toronto, Ontario. Contact Lisa Nagel, (215) 830-5678.
8-12: General Instrument training course, headend maintenance and performance testing (week one), Toronto, Ontario. Contact Lisa Nagel, (215) 830-5678.
9: SCTE Desert Chapter seminar, safety training. Contact Bruce Wedeking, (909) 677-2147.
9: SCTE Mid-South Chapter testing session, BCT/E and Installer exams to be administered, Time Warner Cable office, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
9: SCTE Penn-Ohio SCTE Chapter third annual golf outing, Conley Resort Golf Course, Butler, PA. Contact Marianne McClain, (412) 531-5710.
9-11: General Instrument training course, digital network engineering training, Toronto, Ontario. Contact Lisa Nagel, (215) 830-5678.
9-12: Siecor training course, fiber-optic installation for LANs, Pittsburgh, PA. Contact (800) 743-2671, ext. 5539.
10-11: Cable Telephony '96, The Radisson Hotel, Chicago. Contact (312) 787-2900.
10-12: WCA '96, Colorado Convention

Center, Denver. Contact Wireless Cable Association, (202) 452-7823.

11: SCTE Satellite Tele-Seminar Program, "Painless Technical Speaking (Part II)," Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

11: SCTE Great Plains Chapter seminar, personal communications services. Contact Randy Parker, (402) 292-4049.

11: SCTE Rocky Mountain Chapter seminar, telephony, Denver. Contact Mike Phebus, (303) 795-1699.

11-12: Antec FiberWorks training course, broadband cable TV technology, Antec training center, Denver. Contact (800) FIBER ME.

15-16: SCTE regional training seminar, introduction to data communications, Seattle. Contact SCTE national headquarters, (610) 363-6888.

16-19: Antec FiberWorks training course, fiber-optic system training, Antec training center, Denver. Contact (800) FIBER ME.

17: SCTE Chaparral Chapter seminar, BCT/E exam tutorial, TVI, Albuquerque, NM. Contact: Rick Padilla, (505) 761-6290.

17: SCTE Golden Gate Chapter seminar. Contact Mark Harrigan, (510) 927-7060.

17: SCTE Oklahoma Chapter testing session, BCT/E exams to be administered, Norman, OK. Contact Oak Bandy, (405) 364-5763, ext. 249.

17: SCTE Piedmont Chapter seminar, fiber-optic basics, system design, operation and management systems and BCT/E exams to be administered, Raleigh, NC. Contact Mark Eagle, (919) 220-3889.

17-18: SCTE regional training seminar, introduction to telephony, Seattle. Contact SCTE national headquarters, (610) 363-6888.

18: SCTE Gateway Chapter seminar and BCT/E exams to be administered, Overland Community Center, Overland, MO. Contact Chris Kramer, (341) 579-4627

18: SCTE Greater Chicago Chapter seminar, BCT/E tutorial on Category IV: Distribution Systems, Holiday Inn, Willowbrook, IL. Contact Joe Thomas, (815) 356-6105.

22-26: General Instrument trining course (week two), headend maintenance and performance testing, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.

23: SCTE Desert Chapter testing session, BCT/E and Installer exams to be administered. Contact Bruce Wedeking, (909) 677-2147.

23: SCTE Sierra Chapter seminar, system powering. Contact Andy White, (707) 448-7478.

25: SCTE Lake Michigan Chicago Chapter seminar, telephony, Days Inn, Grand Rapids, MI. Contact Steve Kuk, (800) 544-5368.

27: SCTE Big Sky Chapter testing session, BCT/E exams to be administered, Days Inn, Grand Rapids, MI. Contact Marla DeShaw, (406) 632-4300.

27: SCTE Old Dominion Chapter annual "You're Appreciated" celebration, Busch Gardens, Williamsburg, VA. Contact Margaret Fitzgerald, (800) 231-0237.

27: SCTE West Virginia Mountaineer Chapter testing session, BCT/E exams to be administered, Triax Cablevision office, Milton, WV. Contact Steve Johnson, (614) 894-3886.

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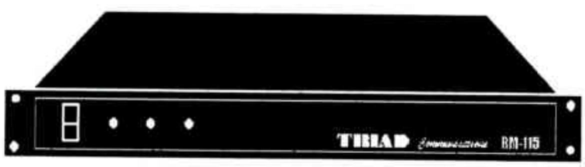

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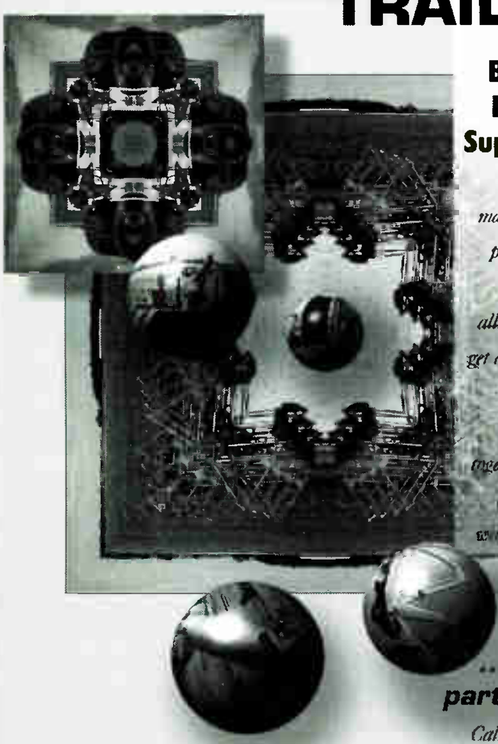

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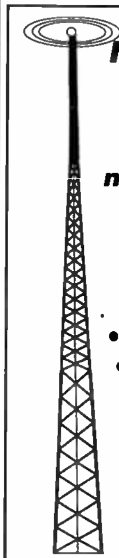

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By Rex Porter

Trivia quiz #8

Our historical guru (aka Editor Rex Porter) has provided us with these trivia questions on the cable industry. Answers to the last set of questions appear first. (The last "Cable Trivia" ran on page 124 of the May issue.) Look for answers to this month's questions in a future issue (along with a new set of 10 questions). The person supplying the most correct answers (see additional requirements below) will be awarded a special Trivia T-shirt.

Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 1900 Grant St., Suite 720, Denver, CO 80203; fax: (303) 839-1564; e-mail: CTmagazine@aol.com. To be in the running for a prize, your answers need to be postmarked, faxed or e-mailed to us by the 20th of the month of the issue date that the specific trivia test appears in. The first person who sends in the most correct answers will be the award winner. Good luck!

Trivia #7 answers

1) Able Cable
2) Anaconda
3) 237F
4) Cerro
5) Communicom
6) Spencer Kennedy Laboratories
7) Dolphin
8) Weatherscan
9) *Fort Worth Star-Telegram*
10) CBS

Trivia #8

1) The only Society of Cable Telecommunications Engineers Broadband Communications Technician/Engineer (BCT/E) category that has no program outline, its candidates are asked to write an essay as a response:
A) Category I
B) Category III
C) Category VII
D) None of the above

2) Single-mode and multimode would more than likely refer to the following:
A) RF tubes
B) Optical fibers
C) Insulators
D) Capacitors

3) He founded an early lashing wire manufacturer, Aberdeen:
A) Irving Kahn
B) George Acker
C) Don Mansell
D) Newton Minnow

4) On a construction crew, the person who threw items up to the person on the poles and who also pulled the lasher was know as the following:
A) Framer
B) Lineman
C) Grunt
D) Runner

5) He was the first person in cable to receive "full" SCTE BCT/E Certification:
A) Tom Elliot
B) Bob Luff
C) Wendell Woody
D) Ron Hranac

6) The first president of the SCTE, elected in 1969, was:
A) Bill Karnes
B) Ron Cotton
C) Bob Bilodeau
D) Charles Tepfer

7) Named after the Greek word meaning "brother," kept afloat in financially hard times by a loan from one of its own employees, this Pennsylvania-based MSO is:
A) Marcus
B) Adelphia
C) Omega
D) Harron

8) Twenty-five years ago, Monty Rifkin gave up the reins as president of ATC. He named as his successor:
A) Trygve Myhren
B) Joseph Collins
C) David Van Valkenburg
D) Michael McCrudden

9) The son of a coal miner, he borrowed $400 on his Volkswagen and purchased a cable system in Georgetown, CO. Today, he is listed in *Forbes* magazine among the wealthiest Americans. He is:
A) Glenn Jones
B) Gene Schneider
C) Monnroe Rifkin
D) Bill Daniels

10) His father was the inventor of the Model T's wheel lock. He pioneered how to successfully acquire major city franchises and make them profitable. He is:
A) John Malone
B) Chuck Dolan
C) Glenn Jones
D) Irvin Kahn

And the winner is ...
Jack Connolly of Cox in San Diego sent in the most correct answers to last month's trivia. Congratulations Jack!

By the National Cable Television Institute

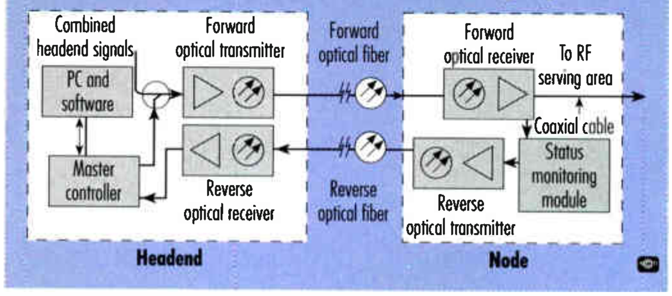
Optical node status monitoring: Part 1

Welcome to this new monthly department from the NCTI. Its purpose is to provide useful information complemented by training suggestions to reinforce the material in a classroom or field setting. The top portion is excerpted from the "Optical Node Return Operations" lesson in NCTI's Fiber Optic Technician Course. The hands-on training suggestions are modeled after NCTI's new facilitator training courses for administering the hands-on labs. © NCTI.

Increasing broadband cable system channel capacity, adding data services and offering alternative access to customers requires maximum communication network reliability. Node status monitoring maximizes this reliability. While the operation of node status monitoring is similar between manufacturers, the parameters of the node status monitoring module determines the types of data monitored. Therefore, to properly select, set up and maintain a node status monitoring module, it is important to know: 1) the improvements in status monitoring systems; 2) how the status monitor module receives and transmits monitored data; 3) the optical, RF, power, temperature and other parameters monitored by optical node status monitoring modules; and 4) the ranges for those parameters.

Node status monitoring systems are now very reliable, because optical fiber itself and fiber-based topologies have simplified and improved return path communications. A higher standard of signal transmission reliability is required for digital video, voice transmission, data transmission and personal communications services (PCS). Therefore, status monitoring is absolutely essential with these types of digital signals.

Signal flow in status monitoring system



Headend-node status monitoring communication

Node status monitoring modules are elements in the status monitoring system (see accompanying figure) that include: 1) a master controller for communicating with the node status monitoring module; 2) a personal computer (PC); and 3) software program for analyzing the monitored data.

A status monitoring module is a transponder in an optical node that: 1) receives signals from the headend PC and master controller containing status monitoring instructions; 2) collects monitored data from modules and switches in the optical node; and 3) routes the collected monitored data to the node reverse optical transmitter module for transmission on the reverse optical fiber. The optical signal is received by a rack-mount optical receiver, demodulated, and sent to the master controller. The master controller decodes the monitored data and sends it to the PC for analysis.

Next month's installment will cover status monitoring signal reception/transmission in the optical node.

Hands-on performance training

Proficiency objective: *Identify major components on a block diagram showing signal flow in a status monitoring system and describe their functions.*

Discuss the importance and benefits of status monitoring in today's evolving broadband communications networks.

Use the block diagram to identify the major elements in headend-node status monitoring communication:

- PC
- Master controller
- Forward optical transmitter
- Forward optical fiber
- Forward optical receiver
- Coaxial cable to RF serving area
- Status monitoring module
- Reverse optical transmitter
- Reverse optical fiber
- Reverse optical receiver

Describe the function of all the major elements involved in headend-node status monitoring communication.

Use the block diagram to show signal flow to and from major elements in a node status monitoring system.

Have pieces of equipment/components to show to students while describing their functions.

Verify that each student can identify the major elements in the headend-node status monitoring communication process and describe their functions. **CT**

By Bill Riker

Hot time for technology at Expo

June brings the Society of Cable Telecommunications Engineers' annual Cable-Tec Expo and plenty of exciting news from national headquarters as well. First of all, I'd like to announce that the Society has two new engineering subcommittees to address cutting-edge technical issues. Our Data Standards Subcommittee will advance the cable industry's interest in and knowledge of medium- and high-speed data delivery and develop standards for hardware interoperability. With cable modems becoming such an important topic, this group will undoubtedly have many important issues to discuss, debate and develop. The subcommittee plans to coordinate its efforts with the activities of IEEE 802.14, DAVIC and CableLabs.

The second newly formed subcommittee, the Digital Video Subcommittee, will explore the need for SCTE involvement in the development of standards for digital video signal delivery through the coordination of its efforts with National Cable Television Association, the Federal Communications Commission and other related organizations.

These two new additions to our five existing technical subcommittees, all operating under the Society's Engineering Committee, will meet for the first time during Cable-Tec Expo '96 on Sunday, June 9, from 2 to 5 p.m. I encourage all interested parties to join Continental's David Fellows, chairman of the Data Standards Subcommittee and General Instrument's Paul Hardy, chairman of the Digital Video Subcommittee, at these initial meetings. Both subcommittees will be involved in standardizing new technologies that will shape the future of broadband telecommunications, so I am certain many of you will want to get in on the ground floor of their activities.

Anyone interested in participating in these groups or any of the Society's other engineering subcommittees, should contact SCTE Director of Standards Ted Woo at national headquarters, (610) 363-6888, ext. 228.

Other Expo events

Another exciting highlight of Cable-Tec Expo '96 will be the participation of NCTA President and CEO Decker Anstrom. He will deliver a keynote address to attendees during the Society's 1996 Annual Engineering Conference on Monday, June 10.

Decker's address is slated to take place at approximately 2:45 p.m. in the Opryland Hotel Convention Center's Delta Ballroom. He is expected to discuss new opportunities the recently enacted Telecommunications Act provide for the cable industry, as well as the industrywide on-time service guarantees and public affairs initiatives that are part of the "The Future is on Cable" program. He also will stress the importance of technical excellence in the telecommunications industry's future as NCTA takes on a more vocal role in promoting the increasing necessity for well-trained service personnel.

With regard to special Expo events, plans for this year's Expo Evening, (traditionally the social high point of any Cable-Tec Expo) have been finalized. "Expo Evenin' on Hickory Ridge," will offer attendees a hospitality reception set in a small mountain town with the Great Smokey Mountains as a stage backdrop. Of course, no Expo Evening would be complete without the finest in entertainment, food and beverage.

Even though Expo '96 will offer this type of social function, we all know that the main objective of any SCTE conference is training, and this year's Expo will offer it in abundance. I'm sure you'll agree with me that the technical program we have assembled for this year's Annual Engineering Conference and breakout Expo Workshops is progressive, substantial and sure to be of great interest to the broadband telecommunications world's technical community.

Our four engineering conferences will allow industry notables to delve in

detail into crucial topics currently facing today's engineers and technical personnel. The four sessions, "Fiber-Related Issues," "Video Transport," "Data Over Cable" and "Return Spectrum Issues," will feature representatives from leading manufacturers and MSOs exploring and debating these new and emerging technologies and related issues.

Our Expo '96 workshops will be just as current and vital. Hot technical topics to be covered in these intensive workshops, which are offered during six periods conducted over the course of June 11 and 12, include data and two-way transport, regulatory issues (featuring presentations by representatives from the FCC), network management and in-home wiring. Additional workshops will be devoted to telephony, digital technology, powering issues, network architectures, system rebuilds and how to make two-way work.

Cable-Tec Expo '96 is certain to be a high point of the year, with record-breaking attendance and an exhibit floor packed with the industry's top vendors and service providers. I am looking forward to seeing many of you at the show, and for those who are unable to attend this year's festivities, remember that the *Cable-Tec Expo '96 Proceedings Manual*, a trade paperback collecting papers presented at the 1996 Engineering Conference and Expo Workshops, will be available from SCTE national headquarters by calling (610) 363-6888. In addition, it's never too early to begin making plans to attend Cable-Tec Expo '97! **CT**

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

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