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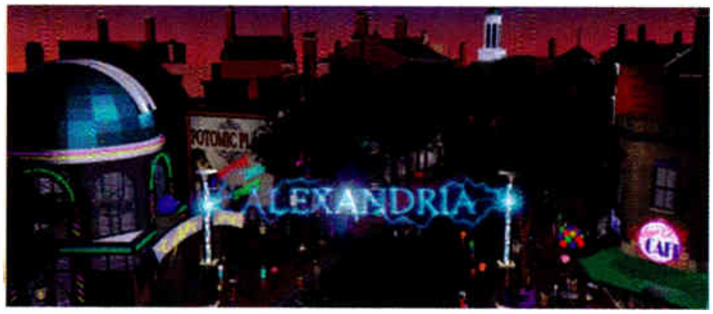

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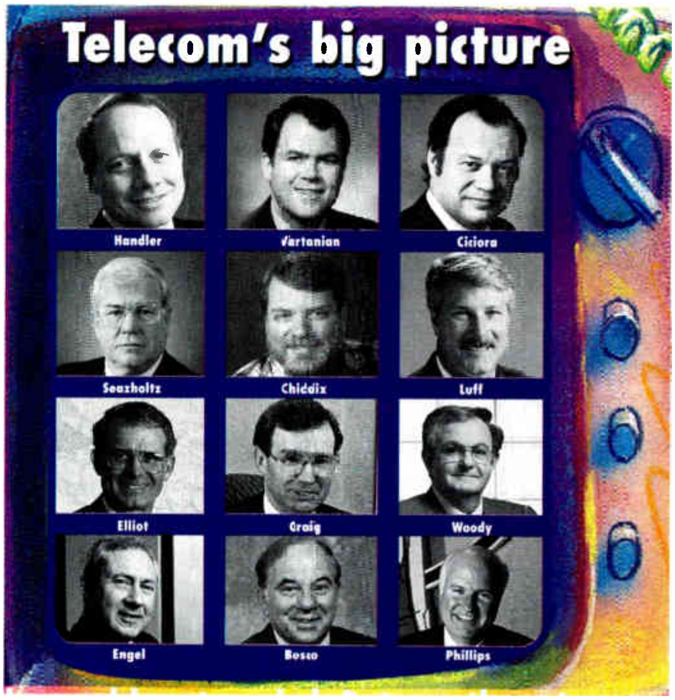

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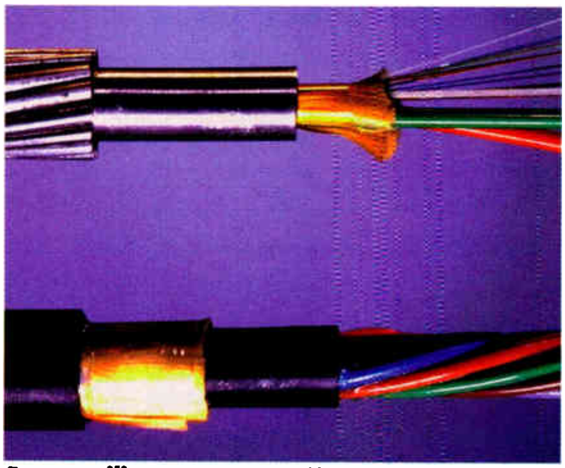

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EDITOR'S LETTER

Let's give them something to talk about

I'm musing about the increasing number of direct broadcast satellite (DBS) dishes I see in every town I visit. Recently I spoke with a gentleman who purchased such a system. When I asked him about his decision to subscribe to the service, he said he knew what to expect in quality from the satellite feed system. He had compared the video and sound of his neighbor's DBS system to his cable reception over a few months. Then he decided to disconnect his cable and switch to DirecTv.

Every time I discuss the comparison of the two services, everyone admits the satellite service is technically *very* superior. But when I talk to cable operators, it seems they aren't interested enough (nor willing to pay the monthly fee for DBS) in rebuilding or upgrading their systems to digital.

"Do you realize DBS has now signed up over 2.5 million customers?"

Which brings up an interesting question: Why can't cable operators find a way to package digital service along with regular cable services? When we first started building cable systems, we would charge high hookup fees street by street, which allowed us to build systems one block at a time. Why can't system operators charge people willing to pay for digital pictures more than regular cable customers? In other words, why not have selective marketing to those willing to pay extra for extra quality?

Are you reading about your competition? Do you realize DBS has now signed up over 2.5 million customers? Do you know they are signing up 100,000 customers a week? Do you know DBS charges $19.99 a month for 40 digital channels? Are you aware that they have a smaller package with 10 basic channels for $10 a month? "Oh," you say, "they are only a one-way system. They can't send anything back with those little dishes."

Well, can your system do that? Is it truly two-way? How much data did you transmit back to the Internet? How many of your customers surfed the Net over your cable system today?

Cable operators need to look more closely at their marketplace. Cable TV has always sold its product based on its ability to provide more channels and better quality. It seems unreal that we are willing to settle as a provider of more but not better.

Rex Porter
Editor

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Hewlett-Packard co-founder dies at 83

On March 26, David Packard, co-founder and chairman emeritus of Hewlett-Packard Co., died at Stanford University Hospital in Palo Alto, CA, at age 83.

Hewlett-Packard, an international electronics giant founded in 1939 by Packard and his business partner William Hewlett, has more than 100,000 employees. In 1995, if recorded fiscal revenues of $31.5 billion.

At Stanford University, where he received academic honors pursuing the newly emerging field of radio engineering, he met fellow engineering student Hewlett; the two agreed someday to go into business together. After a couple unsatisfying years working for General Electric, Packard returned to Stanford to pursue graduate studies. Hewlett, coincidentally, was there doing the same.

The first Hewlett-Packard product was an audio oscillator for sound system testing and development. Built in Packard's garage, the oscillator found its way to Walt Disney Studios; eight of the units were used to develop the soundtrack for the movie "Fantasia".

Hewlett-Packard was incorporated in 1947, with Packard as president. He was named chief executive officer of the company in 1964, a position he held until 1969, when he became U.S. deputy secretary of defense in the first Nixon administration. Returning to Hewlett-Packard in 1971, Packard was re-elected chairman in January 1972. In 1977, then 65, Packard began to reduce his involvement in day-to-day operations of the company, but he remained board chairman until his retirement on Sept. 17, 1993.

Test engineer of the year named

Ken Ballschmieder, test engineering manager for Philips Broadband Networks, was named Test Engineer of the Year for 1996 by *Test and Measurement World*. The award is the highest professional honor in the test engineering discipline.

Ballschmieder worked for several years to convince a manufacturer to develop standards for the F-connector. Despite its extensive use, no standards existed for calibrating vector network analyzers. Ballschmieder is now working with Hewlett-Packard on this project to develop open, short and load F standards that meet Philips' requirements for repeatability and accuracy.

NOTE

- Augat Inc. acquired the fiber-optics business of Porta Systems Corp. The acquisition includes fiber-optic products, technologies and contracts of Porta Systems' Aster and Porta fiber business units.

'96-'97 board members elected

March 28 marked the official closing of the Society of Cable Telecommunications Engineers' annual election to fill empty seats on its 1996-97 board of directors.

The results of this year's board election are as follows: At-Large Director: Ron Hranac, Coaxial International, representing the entire United States; Region 3 Director: Norrie Bush, TCI of Southern Washington, representing Alaska, Idaho, Montana, Oregon and Washington; Region 4 Director: M.J. Jackson, Gilbert Engineering, representing Oklahoma and Texas; Region 5 Director: Larry Stiffelman, CommScope Inc., representing Illinois, Iowa, Kansas, Missouri and Nebraska; Region 7 Director: James Kuhns, Ameritech, representing Indiana, Michigan and Ohio; Region 8 Director: Steve Christopher, Augat, representing Alabama, Arkansas, Louisiana, Mississippi and Tennessee; Region 10 Director: Maggie Fitzgerald, DAVI Communications, representing Kentucky, North Carolina, Virginia and West Virginia; Region 12 Director: John Vartanian, Viewer's Choice, representing Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island and Vermont.

They will join the eight SCTE board members currently serving their 1995-1997 terms: At-Large Director: Wendell Bailey, NCTA, representing the entire United States; At-Large Director: Wendell Woody, Sprint, representing the entire United States; Region 1 Director: Patrick O'Hare, Viacom Cable, representing California, Hawaii and Nevada; Region 2 Director: Steve Johnson, Time Warner Cable, representing Arizona, Colorado, New Mexico, Utah and Wyoming; Region 6 Director: Robert Schaeffer, Star Cablevision Group, representing Minnesota, North Dakota, South Dakota and Wisconsin; Region 9 Director: Hugh McCarley, Cox Cable Communications, representing Florida, Georgia, South Carolina and the Caribbean; Region 11 Director: Dennis Quinter, TWC Berks Cable, representing Delaware, Maryland, New Jersey and Pennsylvania.

Newly elected directors will officially take their seats, beginning their two-year terms, at the next SCTE board meeting, scheduled to be held Sunday, June 9, prior to Cable-Tec Expo '96 in Nashville, TN.

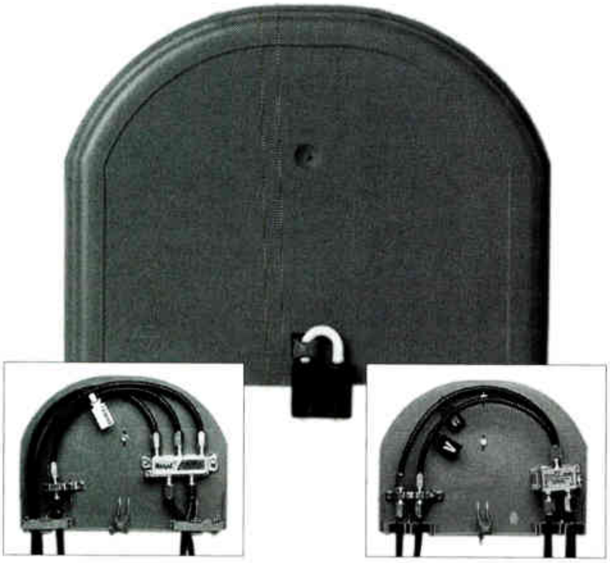
Also in this election, the Society's membership voted in favor of a referendum to change the Society's National Bylaws. Under this bylaw change, regional directors will be required to remain in the region they were elected to represent, Board nominees are required to have had sufficient tenure as active SCTE members and the Board will maintain a broad representation of the industry.

SCTE participates in industry seminar

Over the past year, the Society has participated in promoting the cable industry's public service initiative, "The Future is on Cable." This program was an effort to improve the service and public perception of the cable industry.

After a year of activity, cable systems nationally have reported significant improvement in both customer service and satisfaction. In 1996, the National Cable Television Association (NCTA), the organization responsible for launching the program, plans to take the industry-wide effort even further.

One of these measures is "Putting the Pieces Together," a series of one-day seminars designed to provide cable companies with the information and techniques they need to aggressively compete in today's con-



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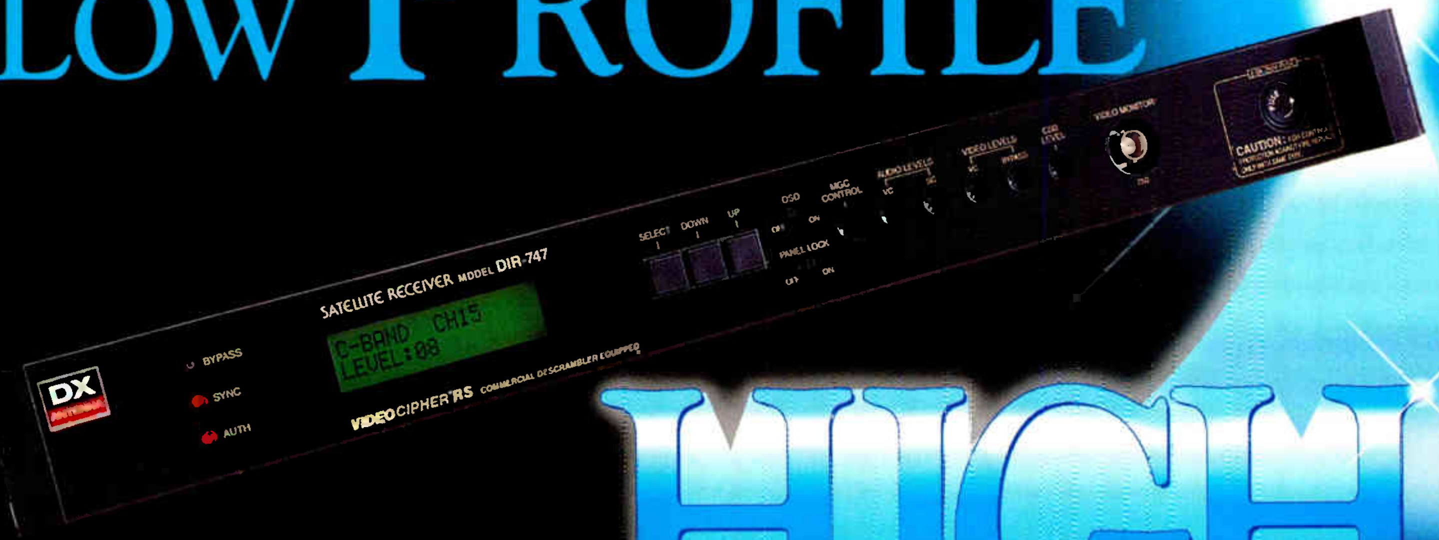

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verging marketplace. Each of these sessions will be led by a team of industry experts who will guide group discussions and demonstrations.

Seminar attendees will:

- Hear research on public perception of the cable industry;
- Learn techniques to promote on-time guarantees and improve customer satisfaction;
- Hear the most current information regarding legislative action and how to take proactive steps to communicate to consumers;
- Learn tactics for training technicians to do their jobs more efficiently and effectively; and
- Solve public affairs problems with ideas from industry experts.

Along with support and participation from SCTE, "Putting the Pieces Together" is presented in cooperation with NCTA, the Cable Telecommunications Association, Cable and Telecommunications: A Marketing Society, the Cable Television Public Affairs Association, the Cabletelevision Advertising Bureau and Cable in the Classroom.

Anyone interested in attending "Putting the Pieces Together" or wanting further information should contact CATA at (703) 691-8875.

Wanted: Director of certification

Due to the recent elevation of Marv Nelson to vice president, technical programs, the SCTE is searching for a new director of certification. The Society believes that those who have participated in the Society's certification programs (for example, Broadband Communications Technician/Engineer — BCT/E) will be the best qualified. The job entails overseeing all certification programs and developing support material for training purposes. The ideal candidate for this position should have a broad technical knowledge base and experience in developing and presenting training programs.

Resumés should be sent to the attention of Marv Nelson, SCTE, 140 Philips Rd., Exton, PA 19341-1318.

Society celebrates HQ grand opening

The Society held the grand opening of its new national headquarters building Feb. 29. The address of the new location is 140 Philips Road, Exton, PA 19341-1318 in the Pickering Creek Industrial Park, only minutes away from the Society's previous location. The phone number remains the same at (610) 363-6888.

The Society had outgrown the building it resided in for the last eight years, and it was time to move to a larger facility to accommodate the growth of the membership and staff.

The almost 100 guests attending the grand opening had an opportunity to see the facility's on-site cable museum, the conference room designed to accommodate board of directors and committee meetings, plus the training room with a cafeteria area designed to accommodate the technical training seminars that will now be offered at national headquarters.

Guests were able to tour the building during an open house, during which they could meet staff members and inquire about departmental activities and future Society initiatives. The grand opening ceremony began with an address by SCTE President Bill Riker, who provided a brief overview of the processes that led to the completion of the facility, then thanked the many individuals that put such a tremendous amount of time and effort into the project.

The Society's president from 1971-1973, Bill Karnes, briefly spoke to the group, as did current Chairman John Vartanian and *Communications Technology* Editor and SCTE Charter/Senior Member Rex Porter.

For more details on the grand opening of the new headquarters see "President's Message" in last month's issue of *CT* on page 94.

By Ron Hranac

In defense of the often blamed F-connector

Oh, the lowly F-connector. It is blamed for so many problems. Typical service call data indicates that a disproportionate percentage of service calls are related to the F-connector. Ingress and other problems in two-way systems are often traced to it. Reliability modeling for advanced services such as telephony via cable is made more difficult because of the F-connector. Some in our ranks have even suggested that we need to revisit the drop interface and come up with something better. But is the F-connector really as bad as we make it out to be?

I don't think so.

When it comes to the majority of F-connector problems, our industry needs to look in the mirror. Almost all F-connector problems are craft related: Loose, not properly weatherproofed (or not weatherproofed at all), crimped with pliers instead of the right crimp tool, the wrong connector put on the cable, or the cable not correctly prepped. Why,

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

then, do we continue to blame the connector?

And why are so many F-connector problems craft-related? Because we don't train our installers. Because we don't have an installation quality control program in place. Because we continue to set our standards low when hiring entry-level personnel. Because we don't give our installers the right tools and equipment. We have no one to blame for these problems but ourselves.

It irks me when I see "help wanted" advertisements in the local newspaper for cable TV installers, with the major job qualifications being simply a valid driver's license and an ability to get along with people. What about some basic electronics or digital experience? How about an understanding of RF? Just how serious are we about cable modems and telephony anyway?

An engineer I work with recently had cable installed in his new apartment. He commented that the installer was very courteous, and had a pretty good understanding of the product. The installer knew how to use the connector prep tool and did a good job putting the connectors on the cable. When asked some basic technical questions, though, the installer was in the dark. After the work was complete and the installer left, my colleague checked the connections. All of them were loose — some only held on by a few threads.

"We need to recruit graduates from two-year electronics programs, from vocational/technical schools and similar backgrounds."

That same engineer and I just returned from a trip where we helped a client with two-way problems. The system operator wanted to begin a trial involving two-way technology. After getting through the usual startup issues — activating and aligning the reverse, setting upstream laser input levels, etc. — we still faced a major hurdle: Ingress and impulse noise. To make a long story short, 99% of the ingress and impulse noise was coming from the subscriber drops. A lot of the aerial drops used non-messengered cable (whoops), but the biggest culprit was F-connectors. The worst whoops: the connectors were loose, not properly weatherproofed (or not weatherproofed at all), crimped with pliers instead of the right crimp tool, the wrong connector put on the cable, or the cable not correctly prepped. Hmmm ... déjà vu. Replacing the nonmessengered drops with messengered cable, and tightening a lot of connectors got rid of most of the ingress and impulse noise.

A few years ago I was involved in a multi-MSO laboratory evaluation of most of the F-connectors on the market. We found that the premium sealed connectors worked as intended when properly installed. Somewhat surprising, though, was what we found about the plain vanilla one-piece hex crimp F-connectors. When they were properly installed and weatherproofed, they worked just as well as their more expensive counterparts. Both types can easily give 15+ years of service life if properly installed: The right connector for the cable being used, correct cable preparation, proper connector installation on the cable, adequately tightened on the mating port (generally around 20 inch-pounds, except on TV sets and VCRs), and, if used outdoors, properly weatherproofed.

So, how do we achieve F-connector nirvana? Recommendations follow:

First, we have to set our sights higher when it comes to hiring entry-level personnel. We need to recruit graduates from two-year electronics programs, from vocational/technical schools and similar backgrounds. These resources can provide us with a pool of talent trained in the basics of electronics, as well as a little digital and RF. Oh, yes, they also should have a valid driver's license and an ability to get along with people. No question this will cost us a bit more money up front. But I think the long-term payback will occur via fewer service calls, fewer replaced drops and fewer overall drop-related problems.

"It's a lot easier to blame a 15-cent connector than it is to change the way we do business."

Second, we need to seriously commit adequate resources to effective training. There is no reason why every installer shouldn't go through the SCTE Installer Certification program, or at least an in-house equivalent of it. Our field staff must know how to do their jobs correctly and safely. They need to know how to tighten connectors.

Third, every system should have some sort of installation QC program in place. This means random inspections of 5%-10% of all installation work. Further, such a program must be structured so that every installer has his or her work evaluated on a regular basis. Positive feedback on good work is important, as is remedial training to eliminate recurring quality issues. Accountability is critical.

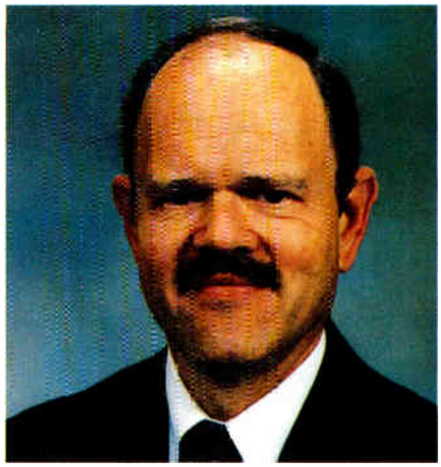
Fourth, our installation staff must be provided with the proper tools and equipment to do their job. If they need crimpers, don't give them pliers. By the way, these recommendations are applicable to in-house installers as well as contract installers.

In a previous column I said we need to stop thinking like cable operators and start thinking like telecommunications providers. If we are to be successful in the provision of nonentertainment services such as cable modems and telephony, we need to undergo a paradigm shift. This shift has to occur in all areas of our business, including the installation department.

Back to an earlier question: Why, then, do we continue to blame the connector? Because it's a lot easier to blame a 15-cent connector than it is to change the way we do business. Fortunately, change is within reach. We just have to recognize where the real F-connector problem is. **CT**

By Justin J. Junkus

What is a central office?



Quite often, people in the cable telecommunications industry will tell me how eager their company is to provide phone service in competition with the local telco or interexchange carrier. Typically, they are excited about the new technology they will be working on, and the possibilities of learning state-of-the-art telecommunications. When I ask one of these people where the new equipment will be housed, the usual response is that it's probably going to be somewhere at a headend, just like the RF equipment.

But is an equipment site for CATV the same as an equipment site for telephony? To help answer that question, this column will take you on a tour of a typical central office (CO).

The CO is the point of termination for a telco's subscriber lines and trunks to the outside world. Like a headend, the CO is typically a building. If it was built anytime before the Bell System divestiture, it's probably readily recognizable as a telephone building by the brown brick exterior, the receptionless entry door, and relative lack of windows. There's typically a parking area for telco service trucks. If that's not enough to let you know this is a telco building, there's always the company insignia prominently displayed on the windowless exterior wall and some reels of cable around the back. So far, it's not too different from the headend.

Now, let's walk into the building. This CO serves a metropolitan neighborhood, a subcommunity with about 30,000 telephone lines. We start our tour in a basement room.

This is where cables containing lines and trunks enter the building. Lines come from both residential and business subscribers while trunks typically go to other COs. In a metropolitan location, almost everything enters from underground cable ducts. The cable containing the twisted-pair copper wires from the subscriber lines usually has a 2-inch or greater diameter. Occasionally, you see a splice case, or perhaps some pressurizing equipment to prevent moisture entry into a cable as it passes through potentially flooded cable vaults on its way to the subscriber. You notice that some of the cables have orange jackets. That's the fiber, which is far outnumbered and outsized by its copper counterparts.

"Changing a headend into a combined headend/CO may not be as easy as it first appeared."

The room we are in is pressurized and the door is alarmed to ensure it remains closed. That's because toxic "sewer gases" could also enter via the cable entry points. No point in lingering down here.

Outside the cable room we find the power for the CO equipment. Commercial AC enters the building and is converted to -48 volts by a bank of rectifiers. What we don't expect is the nearly 50-foot long shelf holding 3-foot high glass cylindrical lead acid storage batteries. (They almost look like those large jugs you empty into the office water cooler.) This power reserve is connected to a bus to the commercial power line and CO equipment. The batteries must power the office for anywhere between two and eight hours. Although they are the last reserve of electrical power, they are continually being charged to maintain readiness.

Close by, in another room, there is a diesel generator. The diesel generator is the first electrical alternative to commercial AC in the event of a power failure. Since the diesel is fully compatible with commercial power, often the telco will run it during peak electric seasons and sell the power back to the electric company grid. Diesels generate toxic fumes, so this room must be properly ventilated to the outside with a system of fans, ducts and filters. Like the batteries, the diesel must be continually ready for emergency use, so it needs to be exercised regularly.

So much for the basement. Our next stop is on the ground floor, where we find the distributing frames. This is the cross-connect point for the lines from the outside world to the CO equipment. Dis-

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.

tributing frames vary depending on the age of the CO.

This CO has an older vintage distributing frame. While the assignment records are computerized, the actual cross-connect work is done by a craftsperson working from a record assignment sheet. The frame has two sides: a vertical side where lines from the cable entry room are terminated, and a horizontal side, where the CO equipment is terminated. As part of the line installation, the craftsperson makes the actual physical cross-connection between the two.

On the vertical side of the frame, certain lines are marked with a red indicator cap. This signifies a critical service, such as fire, police or hospital and the craftsperson knows that these lines cannot be disconnected or moved without following special procedures.

Now that we've seen the interfaces to the outside world, we're excited about getting to the business end of the office — the switch and the transmission plant. We move to the second floor of the building.

The switchroom is somewhat of a disappointment. In the far corner of the room are four rows of what looks like computer equipment, but is actually the digital switch. It's quiet in here. All you hear is the hum of the equipment cooling fans. On closer inspection, we see that the rows of equipment are arranged by functions. The row closest to the wall is the processor portion of the switch, where the system software resides and where the printer and display terminal are connected. This row also houses the hard drives with billing records.

The other rows contain frames of switching modules. Some of them hold circuit cards for line circuits (the equipment connected to the lines on the distributing frame). Others have trunk circuits (similar equipment connected to the rest of the public switched network, possibly to interexchange carriers), and service circuits for announcements, testing and signaling, such as ringing the line.

In some COs, other equipment for special service offerings is put in the switch lineup. One example might be a voice messaging system, to provide the subscribers with an alternative to an answering machine.

What we can't see is the electrical work critical to the functioning of the switching equipment. Special grounding arrangements must be met to ensure consistent voltage levels throughout the equipment and to prevent damaging electrical feedback. If we inspect closer, we also notice the overhead cable racks for the wires going to other parts of the building.

The transmission equipment is similar to the switching equipment in its size, if not its function. There are frames housing channel banks where analog-to-digital conversions take place, and frames for T carrier equipment. There also may be frames for fiber-optic transmission equipment. Trunks connect to the

outside world via cross-connection fields located near the transmission equipment. Cables from the cross-connect fields go to the basement cable room.

Here too, you can notice the effects of new technology. The newest SONET capable transmission equipment is connected to trunks with gigabits of capacity (literally thousands of voice circuits) on a fiber-optic cable. In the past, these trunks would have required several multi-inch diameter cables of coax or even copper pair for the interface to the network.

Now we've seen it all. One thing we have noticed in our tour of the CO is that there is a lot of empty space in the buildings — both floor space and ceiling. With equipment going digital, there has been a corresponding reduction in space requirements. As old equipment has been changed out to the new types, more than half of the floor space has been left empty. Also, the new equipment frames are now usually under 8 feet tall instead of the 11 feet previously required, so there is plenty of excess ceiling room. Electronics instead of electromechanical technology removes the need for mechanical movements to complete calls. Hence,

"It's not a matter of picking any office park and sliding in a switch to get into the telephone business."

the CO is a now a quiet place, where the hum of fan motors has replaced the rhythmic clatter of relays. Even the maintenance functions are remoted and centralized, so that if something does go wrong, a minimal day staff and a dispatched night crew are sufficient to solve most operational problems.

Of course, a CO built from scratch today is designed for today's equipment. While the switch and transmission equipment can fit into a trailer, that is usually still installed in a permanent building because of the requirements for the cables and the power equipment. Environmental considerations have made CO building design less of a "cookie cutter" operation, and it has become more difficult to spot new COs from the street. However, the electrical requirements, air-conditioning, pressurizing and filtering needs are still present, so it's not a matter of picking any office park and sliding in a switch to get into the telephone business. Engineering consultation is still an important requirement, and will continue to be so. Changing a headend into a combined headend/CO may not be as easy as it first appeared.

If you have comments or want to discuss this topic further, Jay Junkus can be reached via e-mail at JJunkus@aol.com **CT**

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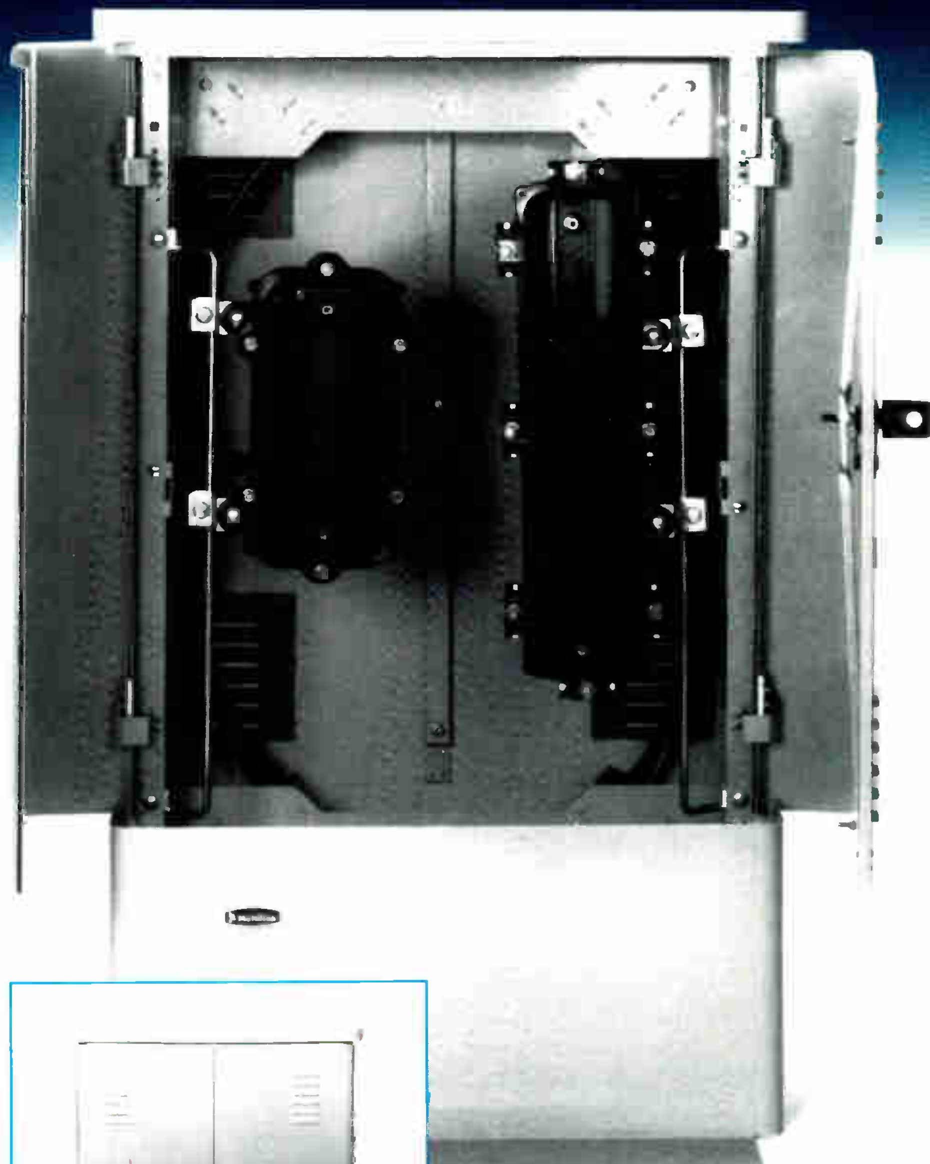

Above Ground Fiber Node Cabnet

- Pedestal consists of one piece continuous frame made up of 12 gauge G-90 galvanized steel and a top, four doors and skirts made up of 16 gauge G-90 galvanized steel.
- Pedestal parts are coated with 2-3 mils of polyester powder after undergoing 5 pretreatment processes.
- All four doors and domed top are detachable using stainless steel slide off hinges (8).
- Front doors are locked with a rod-roller system including a flush mounted 1 piece lock.
- Back doors are also locked internally and can only be accessed from inside the pedestal.
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Reader Service Number 14

By Michael L. Smith

Training for current operations

As a 20+ year cable industry veteran, I have had firsthand experience with various sizes of systems and companies, and at system, regional and corporate levels. The architecture and technology has ranged from conventional tree-and-branch to the latest hybrid fiber/coax (HFC) passive networks being built to handle digital and telephony applications. While the technology of today is new and exciting, and workshops, presentations, articles, etc., tend to focus on these new applications, I feel it is equally important to pause and evaluate the current status of systems and the technical staffs that maintain our current operations.

If you look at current systems, including the major MSOs, what percentage of the technical staffs are really involved with the new technologies? While I'm sure the percentage varies, best estimates range from 10% to 30%. What this clearly shows is that the majority of all technical staffs are continuing to work on basic broadband cable TV issues. My question to each system and technical manager is, "Does your training ensure that your technical staff has the knowledge and understanding of company procedures, federal regulations and equipment use and operation to perform the tasks required to ensure customer satisfaction, minimize service interruptions, deliver a quality signal, and meet local, company and federal regulations?"

Michael Smith is the director of engineering for Adelphia Cable in Staunton, VA. He can be reached at (540) 886-3419.

With only a few exceptions, I sadly feel that the answer is no. This is not meant to say that the industry does a bad job. Surprisingly, most of the time customers are pleased with their service or have at least accepted this level of performance. What I mean to say is that the industry can and must step up to a new plain. Staffs are typically dedicated, but management must provide direction and training to achieve the next higher level of service.

"Staffs are typically dedicated, but management must provide direction and training to achieve the next higher level of service."

Training is just as important as the tools and test equipment provided to meet these challenges. While extensive equipment evaluations are routine, training, more times than not, follows a very erratic course. Poorly structured programs net poor results, which might account for the lack of support from senior management when it reviews cost/benefit reports. Several companies have successfully implemented training programs that achieve positive results and are to be applauded. Likewise, some individual managers at the local level have been able to adjust the priority focus at their systems.

There are a multitude of issues that must be addressed to provide the training needed. The pace of day-to-day operations can no longer be accepted as a reason not to conduct training. (It never was a good excuse, but was used all too often.) If the industry cannot train the technical staffs to satisfactorily perform basic cable TV requirements, how can it expect to be successful with new advanced offerings? While the new services use technologies that will require training, most of their operations are dependent on overall system performance, even down to the drop. If you don't believe me, talk to any system that has launched a digital service (DCR, DMX, etc.) or attempted to utilize its return path. Ask them if the quality of drop installation impacted performance. You bet it does!

Thus far I have stressed the importance of management to provide training. Now let me change gears a little. While I do think that management roles are important, I also feel it is each individual's responsibility to do their best. Every day should be a learning experience and only the highest degree of performance is acceptable. The industry can no longer tolerate mediocre performance or the "good enough" attitude. Do you fully understand the responsibilities, procedures, equipment, etc., required to perform your assigned duties? If not, what steps have you taken?

Have you studied or asked for help or direction? Are you hoping and praying that no customer calls to complain that you have been un-

Training questionnaire

Your position/job responsibility: ______________________________

Review the list of training topics below and indicate whether or not training/certification has been received. In the column to the left of the topic, for any topic checked no, please indicate if you feel training is needed as follows: 1) if training is needed in current position; 2) if training is needed in next 6-12 months for advancement; 3) if training is needed 12 months from now; 4) if training is not applicable.

General

____	OSHA compliance	Yes____	No____
____	First aid	Yes____	No____
____	Safety	Yes____	No____
____	Customer relations	Yes____	No____
____	Company policy/procedures	Yes____	No____

Installation/service

____	Pole climbing	Yes____	No____
____	Ladder handling/safety	Yes____	No____
____	Installation procedures and equipment	Yes____	No____
____	Use of basic test equipment	Yes____	No____
____	Basic troubleshooting	Yes____	No____
____	Aerial bucket use/safety	Yes____	No____
____	Construction practices/procedures	Yes____	No____
____	Coaxial cable splicing/testing	Yes____	No____
____	Amplifier theory/operation	Yes____	No____
____	Basic system testing	Yes____	No____

Maintenance/headend

____	Advanced troubleshooting	Yes____	No____
____	Advanced system testing	Yes____	No____
____	FCC proof-of-performance testing	Yes____	No____
____	Headend operation/testing	Yes____	No____
____	Analog/digital theory	Yes____	No____
____	Digital signals/testing	Yes____	No____
____	Fiber-optic splicing/testing	Yes____	No____
____	Telephony	Yes____	No____

Supervisory

____	Supervision skills	Yes____	No____

On a scale of 1 -5 (5 being the highest), how would you rate your system's training program? _____

Would additional training improve your performance and system operation? Yes____ No____

Optional: Your name ______________________
Company ______________________
Address ______________________

Return to: Michael Smith
Adelphia Cable Communications
11 Middlebrook Ave.
Staunton, VA 24401

able to resolve the issue to his satisfaction or that the customer will accept that it is the best he can expect? All too often in this industry, personnel have been promoted to positions based on tenure, not on


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Reader Service Number 57

qualifications or experience. How many of you hold a position yet are unable to meet the requirements outlined by the job description, or at least know someone who falls in this category? I thought so.

The accompanying questionnaire on page 28 lists training topics I feel are important to ensuring that broadband industry technical staffs receive the knowledge and understanding required to maintain current systems and provide the basic platform to

"I encourage each individual to take the initiative to pursue every opportunity to become better trained."

launch new offerings. I would appreciate you completing this questionnaire and returning it to the address shown. Additionally, please forward a copy to your technical manager or training coordinator. It might help identify training needs they could focus on in the near future.

While I hope that companies will focus on meeting the training needs of the industry, I encourage each individual to take the initiative to pursue every opportunity to become better trained. Learn everything you can about a piece of equipment, not just enough to hopefully get by. Ask questions. There is no such thing as a dumb question, only dumb answers. Indicate your interest and ask if other training sources are available. These might include vendor training, industry workshops, National Cable Television Institute courses, Society of Cable Telecommunications Engineers local or regional meetings, SCTE regional training classes, etc. Most importantly, take pride in your work and accept only the highest degree of results from yourself and your coworkers.

Thanks for your attention. Until next time — read on! **CT**

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Reader Service Number 210

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Reader Service Number 103

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Time Domain Reflectometers.

Test equipment can sometimes be complicated, difficult to operate, and hard to interpret. Operators are often intimidated by the complexity of the equipment or frustrated to the point of mistrust in themselves or the equipment.

Historically, time domain reflectometers (TDR) have been one of the least understood field test instruments available. A TDR is used infrequently; therefore, the operating procedures are easily forgotten. In addition, many TDRs are expensive and complicated to operate. Senior techs find themselves continually demonstrating and redemonstrating the use and procedures of a TDR. Valuable time and money are wasted. There has to be a better way!

In 1981, Riser-Bond Instruments and the first digital numeric TDR (Model 2901A) were both born because of this problem. A TDR was created that was able to locate major cable faults yet was extremely accurate, rugged, reliable, and user-friendly, leaving nothing to the interpretation of the operator.

Today, Riser-Bond Instruments still produces a similar Model 2901C, with over 15 improvements. It remains the workhorse of the industry.

One in every truck.

The Model 1000 was developed with a "one-in-every-truck" concept. Model 1000 (priced at only $695) is an even smaller, hand-held digital numeric TDR.

Model 1000 is ideal for testing customer drops and other short runs, as well as inventory control.

Waveform TDRs today.

Although the concept of a simplified digital TDR is accepted and widely used, there are still technicians and engineers who prefer the more sophisticated TDR that displays a signature of the waveform.

Riser-Bond addressed this problem by introducing waveform type TDRs that are moderately priced, simple to operate, and contain many unique and exclusive features.

Because TDRs are not generally used on a daily basis, simplified operation is very important. The operator must be comfortable with the equipment in order to get fast and accurate test results.

Riser-Bond designs it's TDRs with all of the operational functions located on the front panel keypad. Every key has a function and every function has a key.

High tech simplicity.

Simple ideas can generate new products and make existing products even better. In the case of Riser-Bond Instruments, a simple idea turned into a philosophy that is still the foundation for ideas and growth of an entire company. High tech simplicity in cable test equipment is a combination of the latest technology and the desire to make the most user friendly equipment possible.

What makes Riser-Bond Instruments' products so popular?

The answer is *simple*.

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Envisioning the future o

Tomorrow's revolution for the Information Age

Trying to sort the hype and hyperbole from the realities of building true multimedia delivery networks is something both the cable and telco technical communities are dealing with every day. Cable's into the telephony biz, telcos are into cable, everyone's into data delivery and each wants a peek into the others' bag of engineering tricks. Add to that all the new technology exploding onto the scene and you might feel like if you blink, you're going to miss the next big communications revolution (or at least the next bout of superhighway hype).

The following is the first installment of a two-part special report in which *Communications Technology* spoke to some of the top technically oriented executives in both cable and telephony. Surveying the nature of today's communications networking as well as where it's headed, they touched on the realities of convergence, the passage of the Telecom Bill, promises of high-speed cable modem data delivery, training issues and more.

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

"The (high-speed Internet access) opportunity is even greater when coupled with standardization of modems so consumers can own them. The buying attitude of computer owners is a willingness to spend money."

— Walt Ciciora, consultant

Convergence

The question facing cable operators and telcos today is no longer if convergence will occur, but how, and how fast. With the passage of the Telecom Bill, industry boundaries have evaporated and the pace of convergence is destined to accelerate.

With this new-found freedom and competition, cable and telco operators must foresee the future and act on that vision now. A wait-and-see attitude could be the kiss of death. In the past, the convergence of these technologies was driven by "network cost efficiencies," says Ian Craig of Nortel.

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

telecommunications

By Eric Butterfield, Laura Hamilton and Alex Zavistovich

"Today, however, the ability to deliver multiple services is fundamental to many companies' outright survival."

The challenge facing each industry, says Craig, is how to leverage its current infrastructure to accelerate time-to-market without selling itself short in the delivery of future interactive multimedia services.

Tomorrow's business opportunities will require flexibility and wide-ranging expertise. Convergence and combined telecommunication services will result in more telco/cable joint ownerships — new alliances that will necessitate a new business philosophy: Companies will need to navigate a variety of business scenarios, being competitors and partners, as well as each other's customers. To survive in major market areas, says Sprint/North Supply's Wendell Woody, you will need to be a full-service provider.

To do that, says Harry Bosco of Lucent Technologies, applications must be access infrastructure independent. That is, regardless of the access technology used, each application needs to present itself to the subscriber in the same fashion. This assumes that the subscriber interface device is common across all access technologies. "The desired long-term favorite is all-passive fiber-to-the-home."

Bosco says client-server software architecture will play an increasingly important role in providing new applications over evolving networks. "Subscriber devices used to interface with applications will vary widely — ranging from low-cost low-intelligence devices to mid-ranged intelligent devices (slightly more processing and graphics and memory) to very intelligent higher end devices."

Ameritech's Joel Engel foresees markets where voice, video and data will be provided by one company over coax, by another over twisted-pair, and by a third over microwave radio. But for some companies, he says, it might make sense to use a family of technologies rather than just one. He also thinks telcos might elect to put video over coax and leave voice on twisted-pair if they've already installed fiber deep into their network.

The Telecom Act

The Telecommunications Act of 1996, despite all the revolutionary rhetoric, hasn't anticipated change. It merely recognizes trends that were already well under way, according to our experts.

"This is not the starting gun of the race — that gun went off some time ago," says Jim Chiddix of Time Warner Cable. "Many (cable) operators have already begun to get involved in the telecommunications business." Many states already had deregulated telecommunications, ahead of their federal counterpart, he said.

Overall, the consensus is that the Telecommunications Act will be good for the cable industry. "Removal of rate regulations will allow cable to increase investments in their distribution systems, encourage new services and expand programming," says John Vartanian at Viewer's Choice.

"Information seems to be more and more an asset to both business and social life, so the major opportunities for the telcos comes from expanding from voice into data and other multimedia services — accessing information."

— Gary Handler, Bellcore

"It presents us (cable TV) with a whole host of opportunities," says NCTA's Rich D'Amato, most especially cable's ability to compete in telephony.

What we'll see, says TV/COM President Bob Luff, is a lot of repositioning in the industry that will trigger the most robust period of partnerships, strategic alliances,

Terminal of the future

The home of the future is up for grabs. What the terminal will look like, and how much technological crossover there will be, depends on who you ask. Everyone is looking to pipe high-bandwidth information to and from the home. Once it gets there, the question is what it will be viewed on.

"It's the age-old question," says Seazholtz. "Is the terminal of tomorrow the TV or the computer? And the answer is yes."

"The distinctions between what's a computer and what's a TV set — those distinctions are crumbling," says Engel.

What's also crumbling is the distinction between work and home. What's driving it, says Jim Ducay, NYNEX's managing director of data networking services, is that "there's a mix of communications devices in the home now that goes beyond a telephone — it's the computer, it's the fax machine, it's the cellular phone. They're all going to play roles."

The proliferation of personal computers offers an enticing platform, in large part because of its increasingly affordable price, says Phillips. "It already comes equipped with memory, processing capability, keyboard and mouse capability. It's already there, unlike the TV set."

Pac Bell's Ross Ireland thinks the customer terminal ultimately will migrate to something that looks more like a computer with a TV-like screen "capable of handling both high-quality entertainment video as well as computing technologies."

"Wherever you are, your den or your office," says Ireland, "you'd have the option of scanning the Internet or playing the 5 o'clock news on the same instrument."

Jim Phillips of Motorola likewise foresees multiple offerings through the PC of voice, data and, at some point, video. He sees this happening over the next couple of years, with increasing integration of PC and TV platforms.

According to Ireland, the video terminal must be capable of handling analog video for a lot of years to come. "I think that's different than some of my counterparts believe. I think analog video is going to be around for a very long time ... My best guess is at least a decade."

Of digitization, he notes that almost all of the digitization going on today is being done in a passband manner, being sent over an analog signal.

As for an all-in-one future terminal, US West's Bud Wonsiewicz isn't convinced. "In the early days of appliances, they thought there'd be a washing machine that would dry your clothes and wash your dishes. It just hasn't happened."

Ian Craig at Nortel agrees that no one single terminal will win general acceptance for all applications. "Where consolidation is certain to happen is amongst the communications ports these appliances plug into," he says. "It is not difficult to envision a single home controller serving as an access control point for all appliances. No longer will there be a need for a dedicated modem or set-top box per appliance."

Phillips also foresees this trend toward portability in the house, a high-bandwidth connection, such as the coax pipe, that will enable the downloading of tremendous amounts of information, such as electronic books. Along the way, he says, network computers will emerge, offering Internet access to the masses. "You'll see very inexpensive PCs supported by high-bandwidth connections to servers."

This opens up the possibility of a whole new level of services and creates a second entertainment appliance: a very low-cost interactive terminal.

If an ATM stream is being delivered into the home, it doesn't make any difference whether the information is going to a TV or a computer, Bell Atlantic's John Seazholtz says. "You can mix video and data all together and the network interface sorts it out."

"The distinctions between what's a computer and what's a TV set — those distinctions are crumbling."

— Joel Engel, Ameritech

As for total integration of the TV sets and computer, Seazholtz balks: "If you want to print a report, you don't want to do that out of the TV set in your living room. Who the heck wants to have a printer clunking away in the living room? On the other hand," he continues, "if I want to watch a movie, I don't want to look at it on some little rinky dink PC screen."

Bellcore's Gary Handler's main concern is the difficulty in rewiring. "The phones are not in the same place as the TV sets, so I think there are some practical complications to that convergence."

Handler does agree, however, that people will want more and more to view information in all three communication mediums, but says that the integration of the PC and telephone for multimedia will be much more pronounced than television going in that direction.

As for the ultimate futuristic vision, Phillips imagines a scene that sounds like something out of Ray Bradbury's *Fahrenheit 451*.

"This may be 10 years out," he says, "but you'll see premium homes do this: flat panel displays around the house with voice recognition. And you'll walk up to that panel and say 'computer' and you'll get a graphic interface that looks much like a home page. And if you say 'TV,' it'll give you some type of electronic program guide, and you'll say 'HBO' and you'll get it."

These flat panel displays could be hung anywhere in the high-bandwidth home of the future. The ultimate question is, of course, who will be providing those services. — *EB*

buyouts and mergers to date. This in turn will create enormous new revenue potential.

"For cable operators, their net worth will go up by multiples of their cash flow," says Luff. "Relatively small enhancements to their cash flow will result in rather large increased valuation."

The new legislation will affect the cable industry in two ways, says Hranac of Coaxial International: First, competition from telephone companies, and perhaps power companies, getting into entertainment

"If we can team up with the AT&Ts of the world, I think we'll see consumers accept some of these advanced nonentertainment services from cable more readily than they otherwise would."

— Ron Hranac, Coaxial International

"If RBOCs (regional Bell operating companies) are allowed to go after long distance, they will do that first," says Walt Ciciora, a consultant. "There is more money there, and it is closer to the business they know."

The bad news, he says, is that it steals a lot of the appeal cable had for going into telephony. The good news for cable is that it may take pressure off its video business.

"The RBOCs who do go into video need to be countered with a strong cable push into telephony," says Ciciora. "By offering stiff competition in telephony to the RBOC, the cable company will prevent the RBOC from raising telephony revenues to subsidize an attack on cable's video business."

Cable's lower cost structure should be a big help, he says. On the other hand, if telco companies' telephony business goes unchallenged, they'll raise prices, increase profits, and cross-subsidize their push into video, which will seriously harm the cable operator.

Chiddix thinks the act will stabilize investment in cable and make it easier for cable companies to raise capital, which will be vital to compete with the deep pockets of the telcos. The strong financial resources and better debt rating of local telephone companies are certainly formidable.

Motorola's Jim Phillips thinks both telco and cable operators will have 25% to 50% of their business at risk over the next couple of years. "The telcos are going to try and figure out the quickest way to activate video platforms," he says.

Local telcos are going to seek revenue replacement in both wired and wireless video, says Janet Burton of Sprint/North Supply, both inside and outside their current territories. With all the increased competition, cable operators need to figure out what is going to distinguish them from their competition in the future. No one seems to doubt cable's technical ability to deliver the goods. The biggest challenge seems to be marketing the services.

When all is said and done, the ultimate winner will be the consumer, rewarded with a lot of choice and a slew of advanced telecommunications services. The key to the consumer, says Phillips, is increased capital investment to deliver these services.

MMDS and DBS competition

Despite their market advantages, cable and the telcos aren't the only ones in the game. Everyone agrees that direct broadcast satellite (DBS) and wireless are true players in the market and that DBS is cable's more serious competitor. In the case of DBS, says Vartanian, cable needs to match DBS offerings such as large channel capacity, near-video-on-demand (NVOD) and high signal quality.

"DBS signal quality is excellent," says Vartanian "but so is cable's when fiber has been deployed deep into the system."

To combat DBS, Hranac stresses cable network operation and maintenance to deliver service that is comparable or better than DBS.

Ciciora says it's not as much a technical issue as a question of resources. "There's not much a technical person can do if the resources are not there."

Cable's best asset will be its two-way capability. Both MMDS and DBS lack significant return capabilities, says Chiddix. "They are much better at store and forward with telephone return."

Although multichannel multipoint distribution service (MMDS) digital compression may have addressed the technology's minimal channel capacity, Luff says its two-way capability is still limited by fairly narrow return bandwidth.

Luff says MMDS' main problems of propagation and flat terrain requirements will continue to exist because of installation limitations.

As for downstream bandwidth, there are 100 million DBS homes sharing one satellite spectrum, which means sparingly limited bandwidth per household. "If you wanted to deliver different content to every home," says Joe Wetzel of US West Multimedia Communications, "how many homes could you support? Not many."

Of MMDS capability, Wetzel says, "Maybe there's 50,000 homes sharing that same bandwidth. Well, that's still a lot of homes. This isn't even counting the return path. This is just the downstream direction."

A much higher degree of interactivity can be imagined over cable plant, which may serve anywhere from 1,000 to 500 or even fewer homes sharing the same downstream bandwidth. Also in cable's favor is that both DBS and wireless require expensive electronics.

"Every TV set hooked up to the service needs another $400 satellite receiver or decompression box," says David Fellows, senior vice president of engineering and technology, Continental Cablevision.

This additional subscriber investment is something cable can definitely exploit, says Chiddix. "We can transport the broadband spectrum directly to TV sets."

As well, DBS lacks a cable operator's localism. Vartanian says cable should emphasize its local content and ability to connect multiple sets, without expensive home equipment.

Wireless hasn't had much of an impact to date, says Vartanian, but that could change as telephone companies buy up MMDS operations. Especially if they seriously market their services, says Hranac, and adopt advanced technology like compression to increase their channel capacity.

The telcos may not be a direct competitor, says Burton, but they have deep pockets and are in for the long run. Bailey acknowledges the money behind the telcos and their robust technology. "But the point is that we do these things too," he says. "We can offer any of these packages and that's our strength: our ability to offer what the customers want."

Where wireless and DBS are major threats to cable TV's core business is in plants where cable operators are not doing a first-class job. "Where cable system management is on top of their game, DBS and wireless are having a tough time making inroads," says Elliot. "Good customer service, good quality pictures and *no* outages are the answer."

CableLabs President Green agrees that wireless could be a threat in a market where the cable system has been neglected. But, it does have its technical disadvantage in some cases. For example, Green says, "MMDS works better where there are fewer trees, like out west."

Cable has to get back to flawless execution of its core business, says Luff: answering the phone on time, having installers show up on time, and being courteous to customers. "Those things impress customers as much if not more than our futuristic plans to do things the public today may not appreciate or understand."

The credibility gap: Training is still lacking

As the competition heats up between the cable and telco industry, it may be prudent to keep an eye on how well your loyal opposition is learning the trade. It may also be comforting to note that the grass is not always greener on the other side.

Jim Phillips of Motorola recounts his experience in having an ISDN line installed in his home: "I asked for an ISDN circuit and it took me six weeks to get it. Then I got a huge bill with it." He was still not out of the woods, though. "It took them a couple weeks to figure out how to install it in my house," he says. "And this was from an RBOC, so it's not like they're there yet, either (in terms of personnel training)."

What does Phillips see as a trend in training? In particular, the training of personnel across traditional boundaries. "Right now on the cable side you have a lot of multimedia-trained people, especially in terms of video," he explains. "On the telco side you have people who are very telephony/data-oriented, and so you're going to have cross-training and swapping of labor forces, and competition for those labor forces."

Phillips also touched on a potential hot button for the cable industry: the highly publicized dark comedy "The Cable Guy," in which Jim Carrey plays a deranged cable installer. "The cable companies are scared of this movie, and they're going to have to avoid that image," says Phillips. He cautions, however, that "the way to avoid that image is not going to be by marketing around it, but by training and having a highly disciplined work force." — *AZ*

Which comes first: Data or telephony?

In the lucrative business of wooing consumers to multimedia offerings, the next question *CT* posed to the experts was which technologies would drive the race. Which technology will develop most quickly for cable: data delivery or telephony? Most experts believe that a large potential market for both cable and telco companies is data delivery.

While many agree that data delivery, made possible by cable modem technology, may be a big revenue generator in the near term, they also point out that it may just be a stepping stone on the way to delivery of more traditional telephony-oriented services over cable. For some, cable telephony has already arrived; others see the two revenue streams developing simultaneously. Experts are divided over the potential of revenue from data delivery. The reason seems to be that the size of the market for Internet access is unknown, while the telephony market is readily quantifiable — and huge.

It's important to note that, for many, telephony has come to mean more than just getting a dial tone and completing a phone call. Telco's leading thinkers now see themselves more purely as information providers, and as such have confidence in their competitive networking and data communications skills. It's clear that telco experts see the future as being about information delivery — a service they've long provided, and for which video delivery is just a missing piece.

It is the video component that many cable experts believe is the advantage to delivering data over their hybrid fiber/coax (HFC) networks. The data throughput capability of cable's HFC lines makes it perhaps the fastest way of building the elaborate graphics provided on the World Wide Web.

There's some concern as to whether a large enough consumer base will want to spend money on Internet access. If cable modem technology becomes readily con-


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sumer-available (for purchase, rather than lease), at least one expert believes the business will be more likely to take off. In the meantime, others feel that a good hedge of bets would be to focus on software that has the capability of providing a variety of customer applications through a home computer connected to a network access protocol with reliable switching gear.

The speed advantage

Cable companies' HFC networks 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 "2.4 minutes on a dial-up modem, 35.6 seconds using ISDN (integrated services digital network), 1.31 seconds using ADSL (asymmetric digital subscriber line), and only 0.5 seconds using cable TV." That makes Internet access an attractive opportunity for increased cable revenue. Woody points out, however, that the market for on-line services over cable is unknown. Although some 12 million people are already on line and another 10 million may be expected to come on in the near future, "There's some question whether people will pay $25 to $35 a month just for this high-speed access."

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. The buying attitude of computer owners is a willingness to spend money." Ciciora says even companies without two-way capability can get involved in data delivery, by using telco lines for the return path. He advocates involvement in telephony services only to protect market share from RBOCs making an entry into video delivery.

Motorola's Jim Phillips agrees that "a major market in 1997 will be high-speed data access over HFC networks," which he believes will have "lower provisioning costs" than other delivery means, such as ISDN or ADSL. He disagrees with the notion of telco return. "The idea that you market a modem that needs another modem — an analog modem on top of it to do a telco return — you lose a lot of the features and operability associates with a high-speed interactive network. Plus you tie up a line, and if it's a line in the house that's used for voice, that'll be a real problem."

That position is not held by Pacific Bell's Ross Ireland, however. While Ireland acknowledges "there is a lot of energy" surrounding cable modem technology for data delivery, he says there are a number of challenges associated with bringing that technology to market on a large scale. For Ireland, telcos' moderate-speed ISDN offering may compete favorably with cable modems. "I think you'll see us expand the bandwidth of ISDN fairly dramatically, competing with the bandwidths of cable modems," he says. →

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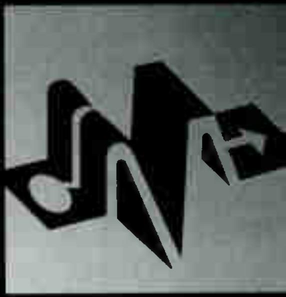

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Cable modem technology has focused attention on two-way data delivery, says TV/COM's Bob Luff. "Cable modems have been the catalyst for robust deployment of telephony," he adds, noting "the things you have to do to the network to use modems are exactly the same things you have to do to activate the network for telephony." Still, he cautions, "you can't put too much emphasis on advanced tiers of service; you first have to have a basic subscriber before you can sell up."

"The recent technical developments in cable all take advantage of digital communications. Those who don't understand how digital signals are changing their businesses will be left behind."

— John Vartanian, Viewer's Choice

"Internet is a good stepping stone toward telephony," says Continental Cablevision's Dave Fellows. "If you have a network capable of supporting data, it's probably also capable of supporting telephony." Fellows notes that "telephony has already developed first," adding that his company has 20% of teleport communications, with its recent consolidation with US West. Although Fellows concurs that the market for high-speed Internet access is as yet undetermined, he points out that with data delivery, cable companies have "an extension into communications, associating cable's image with that of advanced telecommunications."

Wendell Bailey at NCTA also points out that "there are actually people making telephone calls on cable plant in this country." Bailey does not believe cable modem technology would cause data delivery to overshadow telephony. "If I were to guess, I'd say that we'll see more cable modems pretty quickly because it's something we can do pretty quickly. We'll see telephony because it's something we want to and can do."

CableLabs President Richard Green agrees. "The pull is going to be stronger for data than telephony but I would not say the promise of cable modems will completely overshadow cable telephony," he says. "I think the two technologies will develop together for the cable TV industry."

However, in general, Internet connectivity by cable modems was seen to be easier to implement than telephony by many. John Vartanian of Viewer's Choice says, "the asymmetric nature of data on the Internet can be an advantage for cable. Transmission on the reverse path, which is more susceptible to interference, can use more robust modulation schemes. Data communications can also withstand temporary disruptions in the upstream path, but these same problems would be very disturbing in telephony."

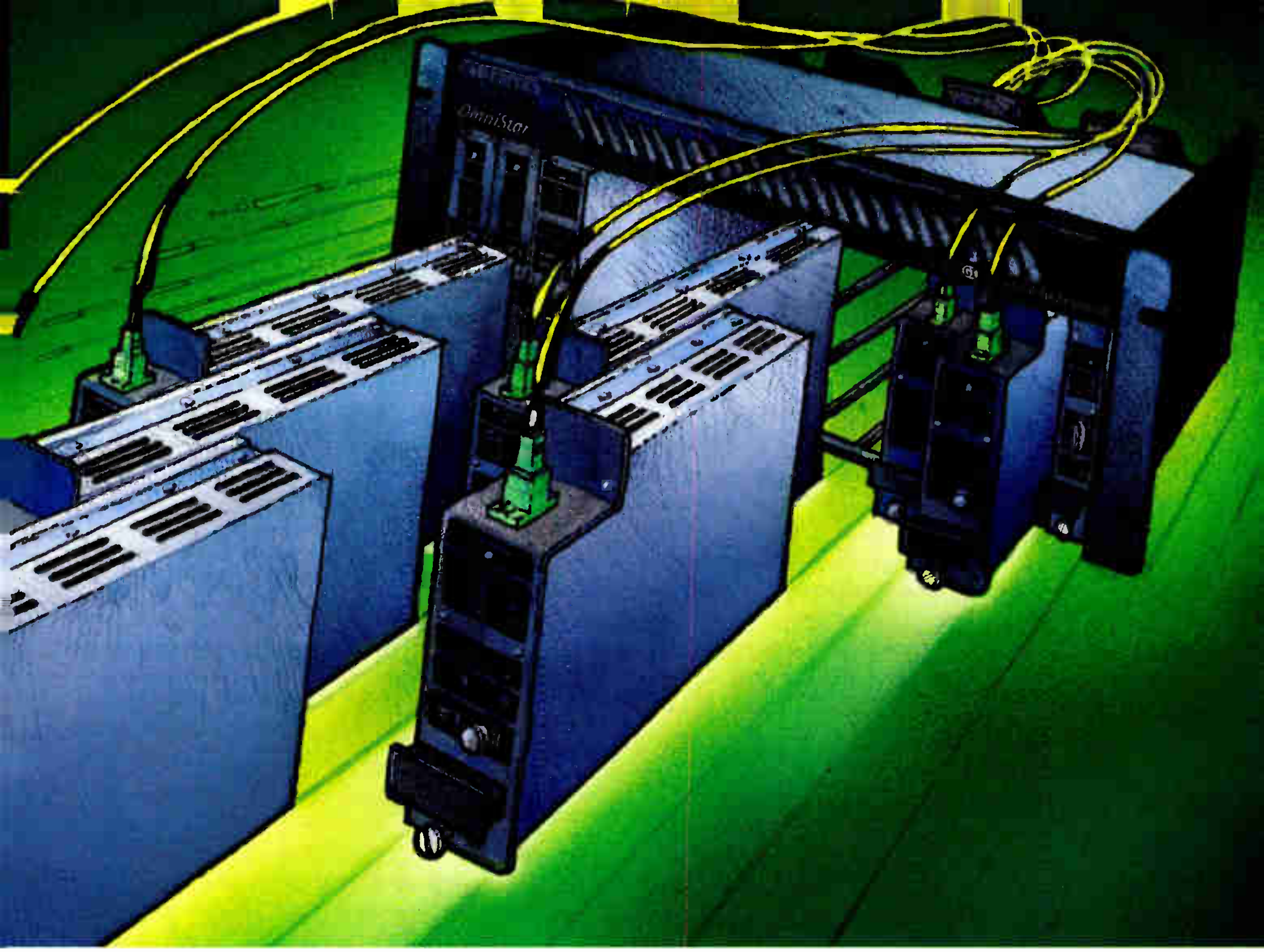
Time Warner's Jim Chiddix also agrees that "Internet connectivity will develop most widely first, because there's a ready market. The telephone business will also develop rapidly, but it is more demanding operationally and in terms of plant reliability." He points out that telephony and data delivery development "are not serial things; they happen at the same time." Operators who have been slow at upgrading their plant will be at a real disadvantage in going after any of these businesses, Chiddix says.

Regardless of whether data delivery or telephony will develop first, there are issues related to how the return path is used, agree Bud Wonsiewicz and Joe Wetzel of US West. As Wetzel puts it, "for telephony services, of course, you would use telephony for return plant. On the data side, there's the marketing issues of having to still maintain some available telephone capacity for upstream while you're using cable for downstream."

An academic distinction?

For some, drawing a distinction between telephony and data delivery may be academic at best. 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. It's the opportunity to provide targeted service based on customer's needs." Cable operators are advancing in the alternate access business, and are working to deploy their own telephony switches, she says. "I think by 1998 you'll see lots of cable people in the telephony business."

In fact, telco experts have looked at telephony for some time now as more than just completing a phone call. Gary Handler of Bellcore embraces the idea of the Information Age as a model for telephony service. "Information seems to be more and more an asset to both business and social life," he says, "so the major opportunities for the telcos comes from expanding from voice into data and other multimedia services — accessing information." Handler adds that, in terms of delivery of information, "it will be hard to tell after a while between a CATV and a telephone company." →



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Joel Engel at Ameritech notes that, "It used to be telephone was just for two people talking. It still is that, but in addition you've got people accessing data bases. The amount of traffic and the amount of things people do over a telecommunications network has increased drastically." Engel comes down neither on the side of data delivery nor telephony as the next big money-maker. Instead, he says consumers are looking for intelligent network capabilities and "more wireless or tetherless communication."

John Seazholtz at Bell Atlantic says, "Clearly, we're in the data business and the voice business; we've been there for decades." The new piece of the puzzle, he adds, is the video component. "Offering video information is a new business for us, and one that we'll be aggressively pursuing." Seazholtz says the major issue in that market is the implementation of ATM protocol. "You can already buy a high-end workstation that has ATM. The strength of ATM is its variable bandwidth. It can do anything. It can deliver data traffic, which can experience delays, as well as video and voice, which cannot tolerate delays."

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. "Internet access and telecommuting have already made their presence known to the public telephone network. Telcos are installing second lines at a record pace, and average network hold times are slowly increasing as more and more subscribers log-on to browse the World Wide Web." Telephone and cable industries will each need to focus on providing high-speed (broadband) switched access to the Internet, he says.

For NYNEX's Jim Ducay, opportunities for telcos come from bringing value and creating value from their networks. "It's going to be indifferent whether it's voice or data," he says, "because we're talking information networking — we're talking bits moving over a pipe. From that standpoint, when you look at voice, and transitioning from analog voice to digital voice, it really comes down to what bandwidth do you need and how do you manage it." 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.

"Only the great 'consumer services-oriented' companies will likely survive the test of time."

— Ian Craig, Nortel

Lucent Technologies' Harry Bosco cautions that, regardless of whether telephony or data delivery services develop first, client-server software for telcos must develop at a pace with networking technology. "Virtual enterprise networks, Internet access, telecommuting; anytime/anywhere personal communications, will begin initially as narrowband services, but will evolve to broadband in time, based on integrated wireline/wireless networks using a client/server paradigm for services and increasingly intelligent end user devices."

The entrepreneurial spirit

Regardless of the view telephone companies have of their role in providing information, cable companies would be best advised to look to data delivery for near-term profits, while establishing more sophisticated two-way capabilities for traditional telco services.

Ron Hranac at Coaxial International says, "Cable modems have good potential as sources for incremental revenue. We will see, at least initially, a lot of growth in data transmission and cable modem technology. We'll see some opportunities in providing point-to-point data communications for individuals and businesses." Hranac adds that there is also possible growth in the area of "demand-side management — working with power companies to help businesses and residences more carefully manage the use of energy."

The problem with cable's delivery of these services is that cable has unfortunately developed a negative reputation among customers for network reliability. Hranac and others agree that it may take some time to overcome that perception. One way may be by brand identity. "If we can team up with the AT&Ts of the world, I think we'll see consumers accept some of these advanced nonentertainment services from cable more readily than they otherwise would," says Hranac.

The market pull is going to be stronger for data than telephony, according to Richard Green at CableLabs. For Green, the promise of cable modems will not completely overshadow cable telephony; the two business areas are, for him, developing simultaneously. TCI's Tom Elliot shares that view, while noting that, "in the immediate term, we (cable operators) are the only ones that can supply high-speed, two-way data services. This seems like a natural place to focus."

Ultimately, when cable operators reflect on telecommunications services, the key is not if, but

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when. As Elliot puts it, "We will certainly be a driver in any new business. It's not just that our companies are entrepreneurial, but our networks are entrepreneurial. This is an extremely important point that will stand us in good stead as this exciting communications explosion develops."

Training for the future

With all this talk of new technologies, that naturally leads us to the topic of training. Cable's technical personnel live "a life of change," according to Bailey. For Bailey, good installers and engineers take classes on their own in order to handle this change. "Most of them are going to make the move, and a few won't. That's the way it's always been."

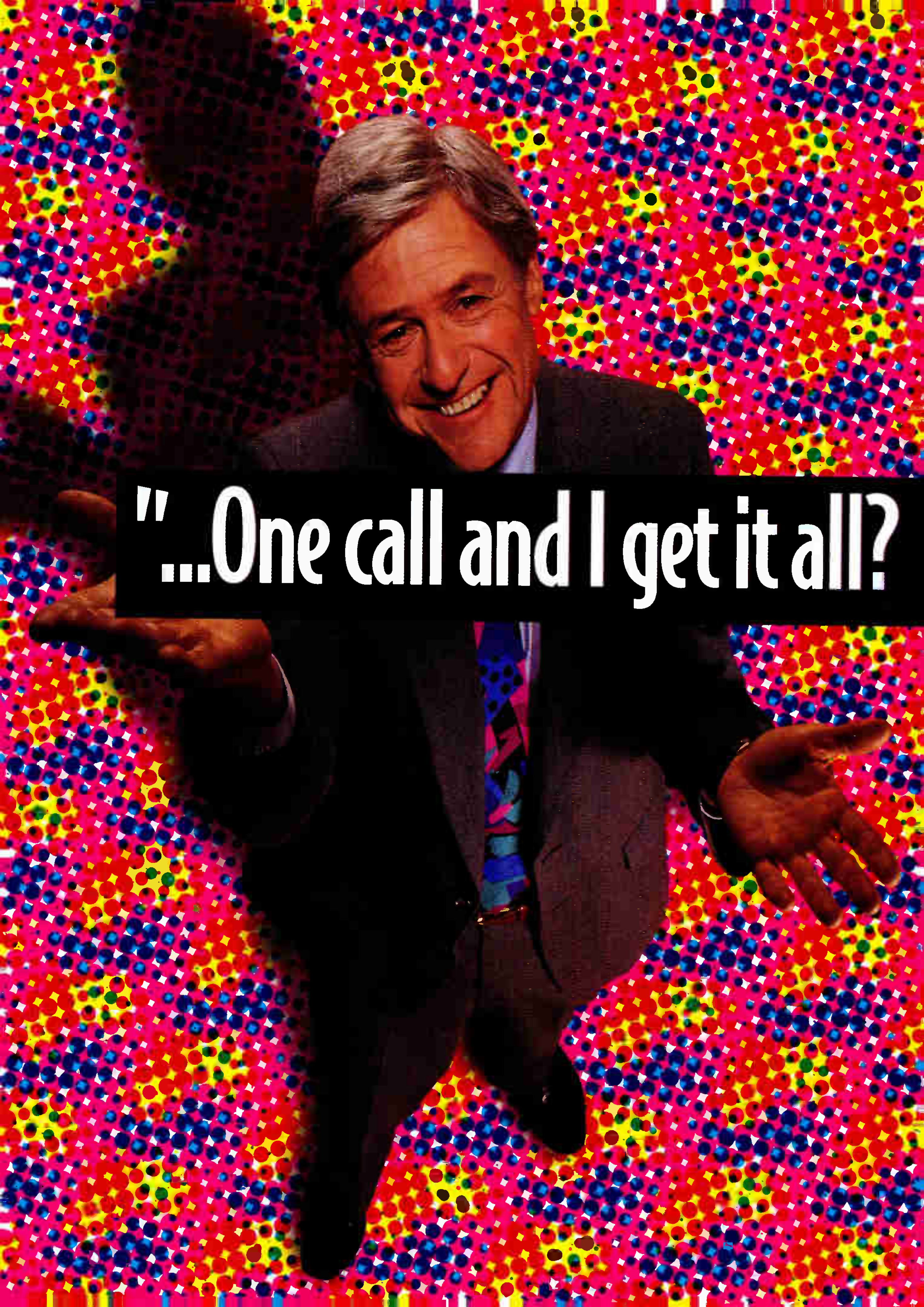
Technical personnel must assume responsibility for their own success, according to Tom Elliot. "We must get on with doing the best possible job of delivering high-quality pictures to our customers." He adds that people must also adopt the attitude of "getting it right the first time." Walt Ciciora agrees, "Technologists need to self-educate." Proactive training efforts from cable technical staff is important for customer service, he says.

US West's Bud Wonsiewicz stresses that cable technical personnel should focus on "how to produce high reliability high-quality networks, which the telephony and data side of the industry will place a high premium on." The company'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 also is advocated by Pacific Bell's Ross Ireland, who stresses that technical personnel learn the Internet protocols. He also recommends training in fast-packet technologies such as ATM. "Fast packet technologies are going to be the wave of the future," says Ireland. Still, he stresses that "RF skills and RF engineering will continue to be a highly valued capability for the future."

At Ameritech, Engel says training is an ongoing process that has been enhanced with high technology: "We have a CD-ROM program called Installermax. It's something like a TV game." The interactive Installermax program is a training tool that allows technicians to practice basic installation procedures at the computer.

For Luff, "battle lines are shifting to the front line of customer contact: installers and technicians." Technology has moved too fast for personnel to learn the basics of subjects such as two-way communications, he says. Luff also stresses "a need to learn efficient troubleshooting, status monitoring and preventive maintenance." Engineering basics have been overlooked in the past, comments Coaxial International's Ron Hranac. "It's not unusual to have our front-line technicians lack basic electrical concepts," he says. Hranac's view is that the industry has to develop a baseline skill level, then define future require-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ments and provide training in those fundamentals.

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 underscores the value of the SCTE's Installer Certification program, and echoes Elliot's sentiment that the industry needs to learn about "doing it right the first time."

"Training in network operations management will be critical to maintaining, operating, identifying, troubleshooting and resolving subscriber and network problems," says Bosco. Telco engineers, he says, must learn to build high-bandwidth networks; cable engineers must compete with the customer satisfaction perceptions built up by the telco industry. Network training and network design also are important skill sets for Bellcore's Gary Handler, for whom "any technician or engineer ought to get familiar on how to use the Internet."

For Vartanian, training in digital communications is essential. "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."

Chiddix says cable's knowledge gap in the digital, computer networking and telecommunications worlds may be filled by "bringing new people aboard." That view also makes sense to Phillips, who says, "(Telcos) are trying to get expertise on the HFC, and I think they'll do that by hiring people with cable backgrounds." He says cable companies also are hiring telco engineers to provide telephony experience.

Seazholtz says video delivery has been simplified for telcos with the advent of digital technology. "We don't really deal with RF in our transport system, because that's really being handled at the cable headend, which converts it from the radio frequencies down to digital and we carry it through the network digitally."

Vendors will be important in continued training, with programs like the Scientific-Atlanta Institute helping keep up with technological advances. Fellows notes that "cable operators will have to provide a lot of training with our suppliers to get ready for this new world."

Embracing changing technology while remaining customer-focused is crucial, says Woody. "Whether you are an installer, technician or engineer, work as hard and as fast as you can to become proficient in all the new technologies." Meanwhile, Craig urges telco and cable companies to adopt a "customer first" philosophy. "Only the great 'consumer services-oriented' companies will likely survive the test of time." **CT**

By Terry Poindexter

Broadband network management from the ground up

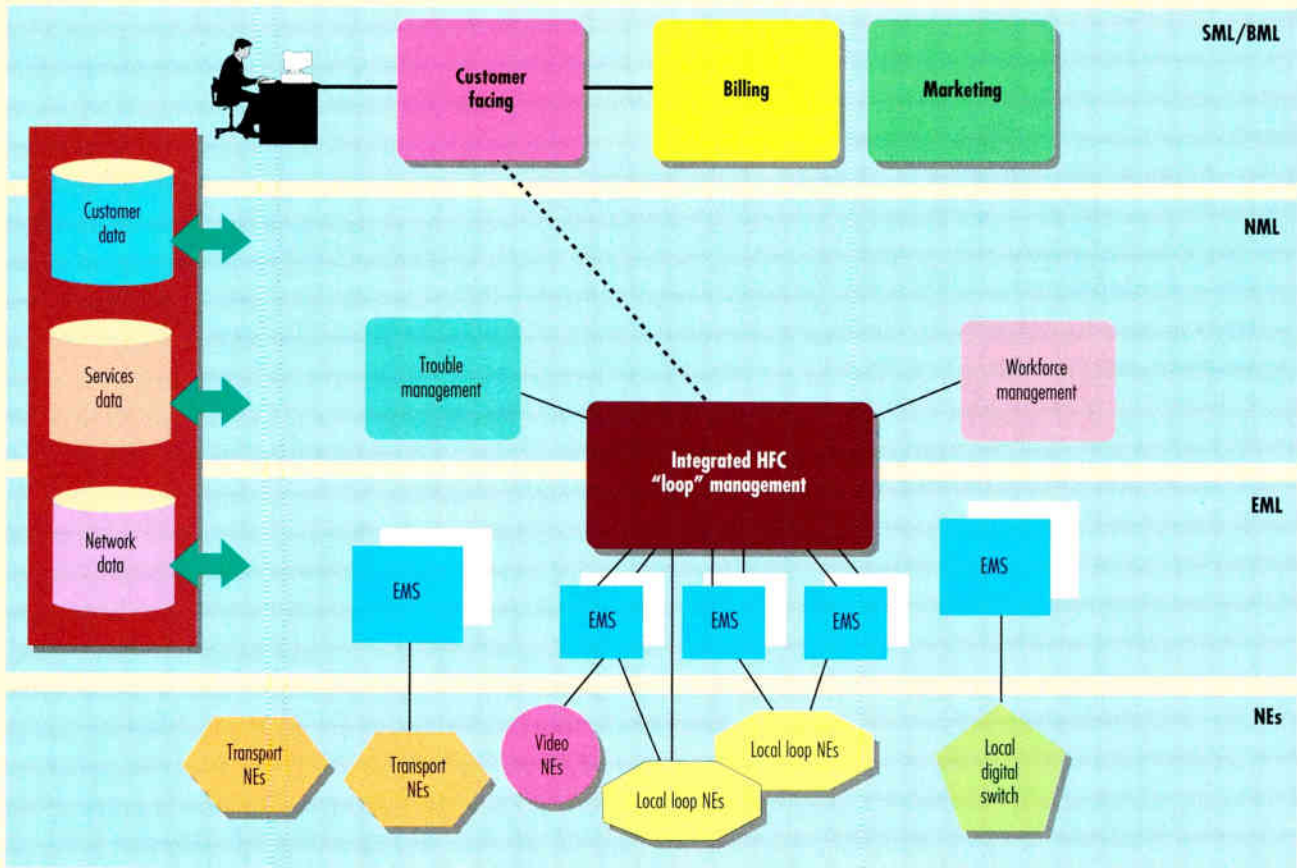
Implementing network management and operations support systems (OSSs) is one of the key challenges facing the cable community today. While a relatively new concept to the industry, broadband operators beginning their transition from one-way, forward-only broadcast entertainment services to two-way, interactive video and telecommunications are now looking not only at the data and telephony products coming onto the market, but how they can effectively manage, provision and maintain a much more complex network in the future.

Terry Poindexter is director of software solutions for Integration Technologies of Denver, CO.

"This (is) not a good position to be in if you are trying to take over market share from an incumbent service provider."

A practical strategy for an enterprisewide network management solution begins at the local "market" or division level. The first step is tying often nonexistent or, at best, proprietary status monitoring and element manage-

Figure 1: A TMN solution for digital services via HFC



ment systems (EMSs) into a cohesive and integrated higher-level system that can be used to control and maintain operations in the residential hybrid fiber/coax (HFC) plant. Using an advanced automation platform based on open and standards-based technology, building an integrated, advanced operations support environment begins at the physical network infrastructure and continues with the "layering" of higher level systems based on the information available about the network's elements. Ultimately, this network data will be used to analyze and manage the emerging broadband network, from the services through the corporate business levels.

"A practical strategy for an enterprisewide network management solution begins at the local 'market' or division level."

Facing the problem

In many cases, each network element has a localized, individual means of reporting its status. More sophisticated equipment may come equipped with an element management system, but currently these EMSs lack critical functionality required to enable integrated, remote network operations. Thus, operators are unable to achieve adequate operational control and information about the status of the network. They can't, for example, effectively configure a piece of equipment without having a technician go to the device and perform the task locally. Some EMSs perform only a single, selective operation, such as reporting whether a device is working or not. Operationally, this translates into manual procedures that are expensive, slow to implement, and error-prone — not a good position to be in if you are trying to take over market share from an incumbent service provider.

Operations support system software technology has advanced tremendously in the past few years, and the cable industry is fortunate to be in the position to take full advantage of the latest technologies. Today, "object-oriented" technology allows distributed software applications to effectively communicate via data "objects" related to the network, customers or services across multiple sources. For example, object-oriented technology allows an operator working on a real-time network management application to easily identify information, such as the physical location of a specific network element, regardless of its location in the automated system.

Information about a multiport tap, for instance, may be contained in different application data bases, but the system is able to share this data via an industry standard communication mechanism as if the data were stored within its own data base. Additionally, all related information, such as the tap's initial date of service, its last service date, when it last failed and the customers being served by this tap, are available to the operator.

This type of technology is particularly attractive because of the layout of the cable infrastructure and the high volume of objects within the network that need to be monitored, controlled and provisioned. Object-oriented technology is equally important in helping integrate many different status monitoring and element management systems together since standard "object definitions" can be created regardless of the protocols used to communicate with the device or the attributes used to define the characteristics of each individual network element.

Figure 1 on page 56 illustrates the first step in implementing a real-world telecommunications management network-compliant management solution for division-level operations control of advanced digital services over an HFC network.

This initial step calls for a network management system/element management system (EMS) application — generically known as an HFC subnetwork or domain manager — to be put into place to augment the missing functionality in the various vendor-supplied EMSs. This HFC domain manager integrates management functions across multiple network element types to provide the operator with a complete view of the network through a common graphical user interface. Based on a technically sophisticated technology platform, this HFC manager will help meet not only the division-level operational needs of today's cable systems; it is equally capable of integrating various EMSs in a common and flexible system that can

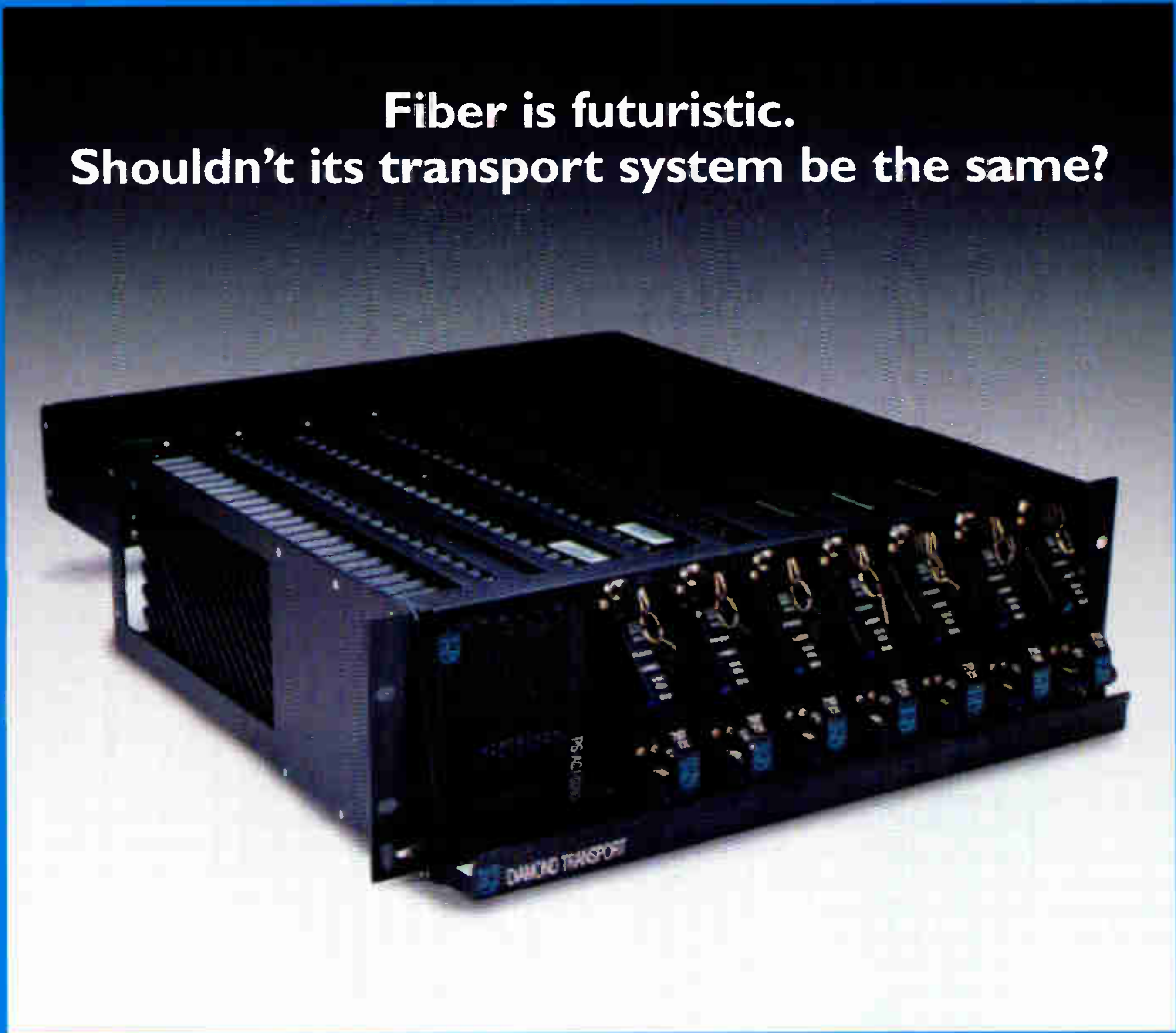


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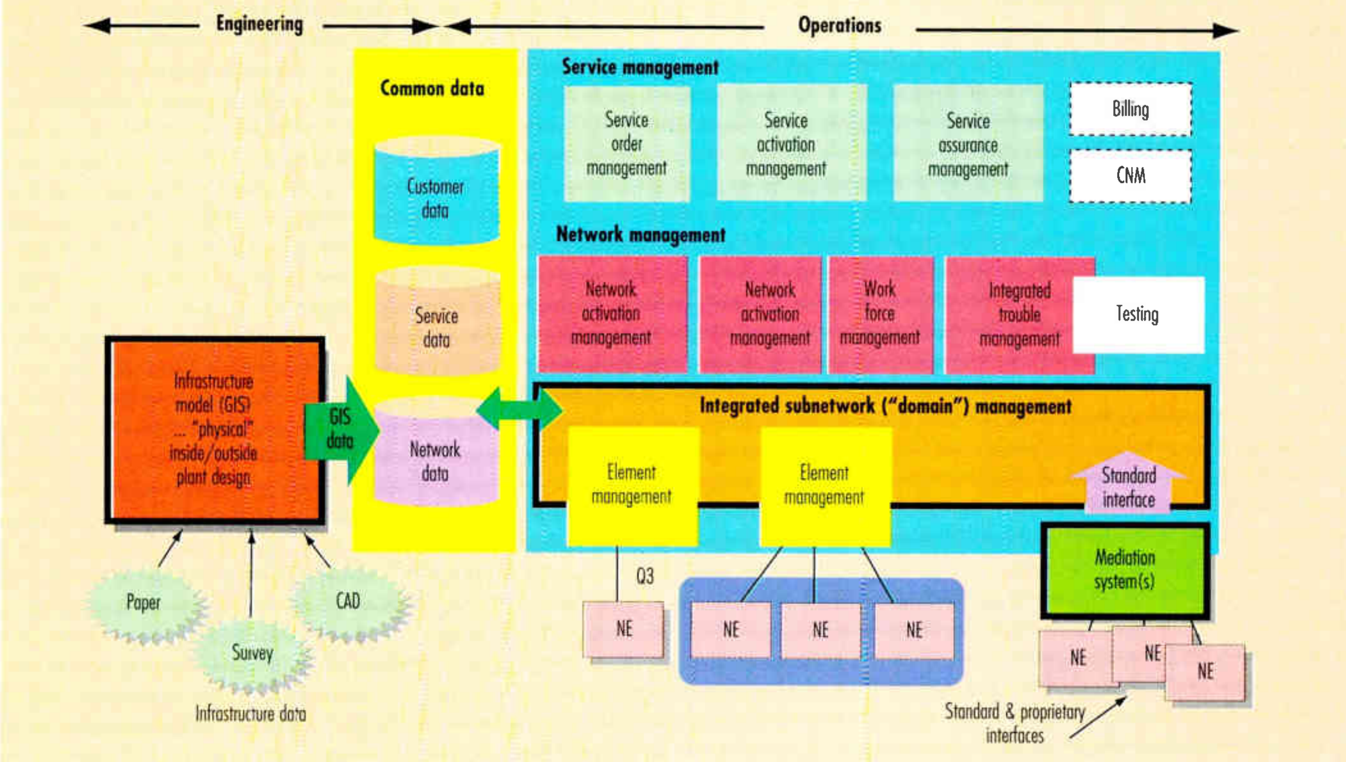
Figure 2: A broadband operations support environment



grow in functionality over time.

This higher-level domain manager translates information coming in from various EMSs through several different communication protocols and use this information based on a standards-based object definition of the network and its associated behavior. Because the domain manager "talks" in these various protocols, it effectively integrates the reporting information of each EMS into a cohesive system, thus giving the operator a one-stop place to view the network, its operations and problems while having access to a common set of tools that controls the network regardless of the network device. The key to the system lies in its flexibility because it will be important to operators to have the ability to modify how network information is used.

Follow the data

Critical to implementing a network management application such as an HFC domain manager is building the initial data model of the network itself. Or, to put it simply, first you have to know what it is you're managing. Fortunately, broadband operators already have the means to effectively gather and document this plant information during the network design and construction phases.

To date, many operators manually map such information and most state-of-the-art network designs are recorded in some electronic form, typically a computer-aided design (CAD) program. CAD software initially streamlined the data acquisition and engineering process and provided a relatively inexpensive, easy system to record the infrastructure base and as-built information.

The problem is that information stored in a CAD drawing is in a proprietary format that is not readily usable by any other application, except via the CAD program itself. In other words, CAD doesn't possess the capability, without significant custom programming, to interact with other information systems, such as the domain manager or other automated operational support systems.

Using this CAD-based approach to record infrastructure

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and plant information hadn't been an issue when the goal of this process was only to engineer and build the network. Once the network was built, this information typically went into a file drawer and wasn't required again until the next network upgrade.

However, once the network is built, we must manage it. The information collected during the initial design and construction phase is now extremely valuable to the network management/operations group. Therefore, we need to reexamine the technology used during this network engineering process to ensure that this information is usable beyond the life cycle of constructing the network.It's a valuable asset to the ongoing operations of the business as well.

Which technology?

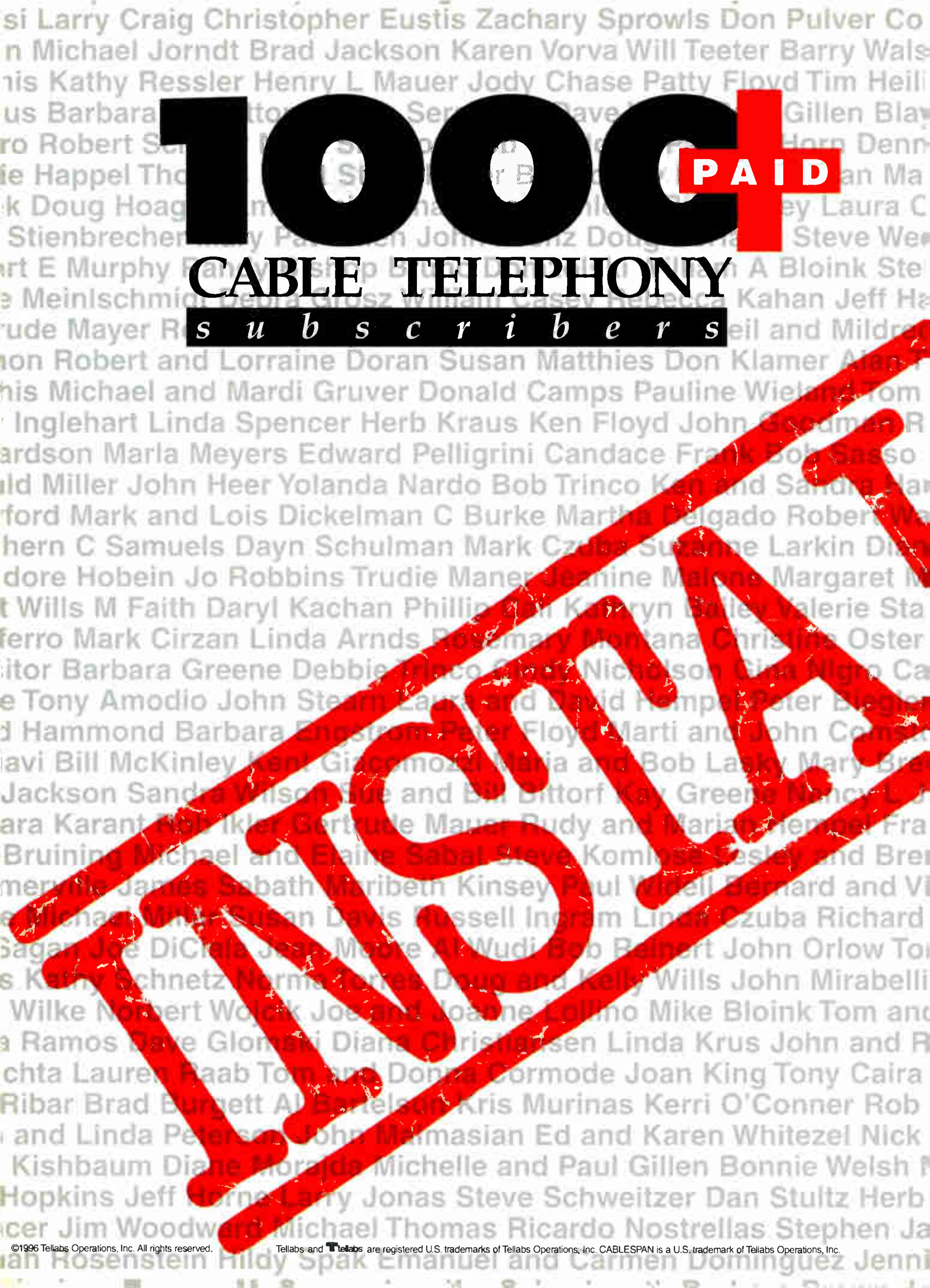
When viewed as a key information asset to operations, formatting this data becomes similar to that of all other operations support applications: The data should be available via a standards-based, open data base technology.

The solution to integrating this critical information base with network operations comes in the form of an object-oriented geographic information system (GIS) technology. Traditional GIS technology took the concept of CAD and extended it to enable information to be recorded in a data base that would drive the graphical display of this information. The results often look just like a CAD system display (and often are), but the key difference is that the information is stored in a data base, as opposed to a graphic drawing file.

> **"Operators should look more closely at the overall role the network design phase plays in the operation of the business."**

Even so, traditional GIS systems have the inherent limitation of sharing information since many don't use an open, standards-based interface that integrates easily into the technology driving today's network operations applications.

There is, however, a new generation of GIS technology that has been built from the ground up utilizing 1990s technology. These new GISs are object-oriented and standards-compliant. →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In addition to storing the physical infrastructure and network model in a form that is directly usable by applications such as the HFC domain manager, new GIS technology can incorporate the existing data available from other CAD systems and immediately provide a useful object data model of the network.

From this GIS object model, the software builds graphical maps that represent the physical detail of the network. GIS technology relieves operators from managing drawings to managing and updating the network information as it actually exists in the real world. But more importantly, this technology enables the sharing of data "objects" that define the network and are directly available to the real-time network management system for the HFC network.

Figure 2 on page 62 illustrates how this integration forms the basis for the broadband operations support environment. As new elements are added to the broadband network, new "objects" can be easily added to the GIS data model that are then immediately available to all other management applications requiring this information.

This new GIS technology marks a real opportunity to integrate the network engineering and network operations processes and, subsequently, streamline support of the broadband network.

Network design

This new approach to network management deployment means operators should look more closely at the overall role the network design phase plays in the operation of the business. As an entry point to gather detailed information on the various network elements within the cable plant, new GIS technology allows operators to record precise information on the broadband plant design and network elements; it also amortizes the use of this information over the broader context of operations support and helps maximize the benefits derived from the funds expended during this phase.

By taking this first important step and building the operations support from the network infrastructure up, operators can address their operational requirements today, while minimizing the risk of deploying an enterprisewide system that won't meet the functional requirements at the division level tomorrow.

Network management is a complex issue that will continue receiving a lot of attention. But with a strategy that makes full use of the latest technologies and automated systems, operators will be well-positioned to lay the groundwork that will pay dividends tomorrow. The approach outlined here provides the foundation for deployment of a long-term operational support system that can be used to integrate the network's daily operations with longer-term corporate information requirements. **CT**

By Mark Boxer

Basic guide to power utility/cable TV joint ventures

Traditionally, the images of the electric power and cable industries have been as far apart as the Cleaver clan is from the gang from "Friends."

Over the last five years, however, and especially over the last couple of years, the power utilities have started to open up operations and deal with the new realities of increased competition. Tremendous opportunities have opened up for cable TV companies to work together with public utilities in many different ways.

The utilities have recognized the significant asset of their right-of-way (ROW) and are taking a more active role in ROW utilization. As is noted in Figure 1, the power grid is designed to reach residential customers in much of the same manner as a cable TV network. Major long distance providers, "carrier's carriers," competitive access providers (CAP), and some cable companies have been utilizing the "supply zone" of utilities' ROW poles for years. The maturation of fiber optics opens many more opportunities for power utilities to use ROW to rapidly provide bandwidth to themselves and other telecommunications providers.

Mark Boxer is an applications engineer for Alcoa Fujikura Ltd.

Cable opportunities

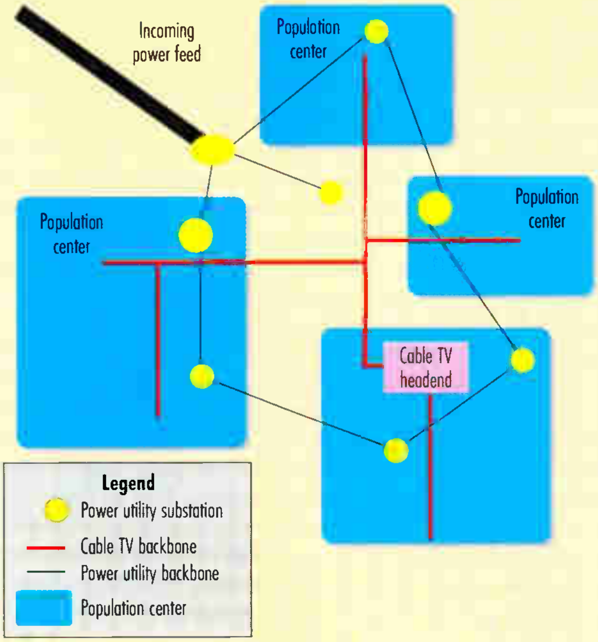
According to Gary Barrows, technical manager of Shaw Cable in Kelowna, British Columbia, their partnership with West Kootenay Power (the local power utility) has been a "win-win" situation. The venture has enabled Shaw to utilize the power ROW to connect distant headends. "We have been able to consolidate our technical operations in Kelowna, improve the quality of our existing services, and introduce exciting new services to our customers in Penticton and Vernon," said Barrows.

In addition, a cable provider's existing fiber/coax network is often a perfect complement to the utility's network, and provides a vehicle for the utility to reach into the customer's home to offer future services — an additional source of revenue for both the utility and cable company.

Other publicized joint ventures include Virginia Power and Cox Communications, and Comcast and Public Service Gas and Electric in New Jersey. In California, several trials are under way, including PG&E, TCI and Microsoft, as well as Southern California Edison and Cox Communications. These trials have focused on providing customers such services as itemized electricity bills, control of home electricity through a TV interface, and special channels with programming devoted to discussions of electricity. Terry Coe of Southern California Edison has stated that the cable company's broadband network offers the power utility "an exciting resource to offer new services and products."

A cable group that has seen the opportunities for synergy is CableUCS, a consortium including Comcast, Continental Cablevision, Cox and TCI. CableUCS was formed to promote strategic relationships between cable operators and utilities. According to Les Larsen, strategic planning consultant for TCI, "The opportunities for packaging energy with telephony, entertainment and information products could be very attractive to both industries."

Figure 1: Power utility backbone network and cable TV backbone network comparison



Network technologies

When working with a power utility in a joint right-of-way sharing environment, the fiber-optic cables, as well as cable placement location are often not the same as those traditionally employed by cable TV operators. Most often employed by the utilities are optical ground wire (OPGW) and all-dielectric, self-supporting (ADSS) cables (Figure 2), which are specifically designed for aerial deployment on power line structures. The cables use specifically designed hardware.

A popular design for upgrading existing power lines to include fiber is ADSS cable. An ADSS cable is almost always a traditional loose tube cable design with aramid yarns used to provide additional strength for the cable. Although traditionally used by the power utilities, this cable design is increasingly being deployed by other service providers because the installed cost of ADSS cable is often less expensive than stringing a messenger strand and cable.

A number of parameters must be identified when specifying an ADSS cable. Fiber count, fiber type and attenuation requirements are specified similarly to more conventional cables. In

Figure 2: OPGW and ADSS cables

addition, the maximum span for the cable, expected weather loading factors, and any special sag or electrical stress requirements also should be specified. In a joint venture, the power utility partner will be able to specify these values in cooperation with the cable manufacturer. A good source of information for specifying an ADSS cable is the Institute of Electronic and Electrical Engineers draft standard for ADSS cables, P-1222.

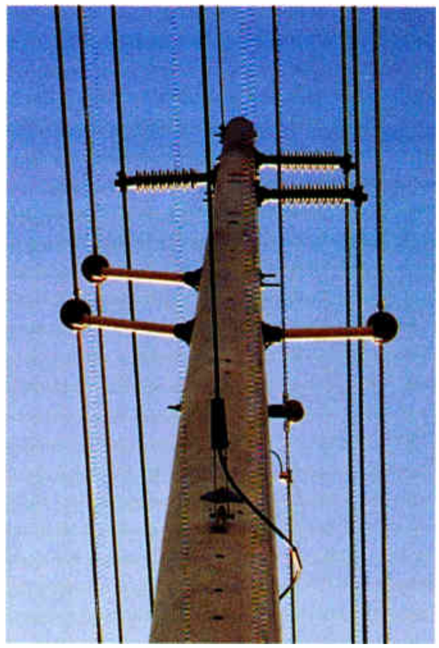
Cable can include fiber on a new power line route with OPGW, which consists of a ground wire, also known as a "static" or "shield" wire, with fibers contained inside. This cable is most often placed at the top of the towers and is generally used in electrical transmission systems of 69 kV and above, although cables are available for installation on electrical "distribution" circuits.

In addition to an OPGW cable's fiber count, specifications to consider include diameter, current carrying capacity and sag/tension performance. A widely recognized standard for OPGW is the IEEE-1138 standard, which can help ensure the appropriate cable used for the application.

For any service provider, reliability is of the utmost importance. A reliability study performed by Alcoa Fujikura Ltd. found that cable reliability in the power grid is extremely high. The power grid is generally not subject to cable dig-ups, and the cables used for these applications are placed higher on the poles than in the traditional zone deployed by cable TV and telephone, removing them farther from vandals or incidental contact.

Organizational structure

A power utility team in a joint venture will likely include members of the transmission design group, communications group and construction representative. The transmission design engineer is responsible for ensuring that the integrity of any structure is not compromised by placing the cable on the structure. This engineer often provides input as to the mechanical specifications of the cable. Communications engineers are charged with providing the utility with its own communications network, and will often help to determine fiber count, fiber type and any optical requirements.



No longer employed just by power utilities, ADSS cable is increasingly popular with other service providers.

When deciding route design and cable specification, all the players should discuss finalization of the route, condition of the poles, splice and drop-off points, cable technologies, purchasing procedures, installation techniques and responsibilities, and maintenance of the route.

In joint-use agreements, the cable often is placed higher on the poles, out of the standard communications zone, eliminating many of the make-ready charges that drive up installation costs of cables underbuilt in the communications zone according to code.

For the actual installation, the power utility transmission engineer will determine the most appropriate position for the cable on the poles and draw up a work order for the line crews.

Depending on the crew and the route, installation speeds of 5 km/day (usually faster than an installation of messenger strand and cable) are not unreasonable, with higher than 10 km possible when deployed by helicopter.

In summary, today's business environment provides an excellent opportunity for partnership between cable TV operators and power utilities. The current business environment is right, and the right-of-way provides a ready-made conduit to the customer. **CT**


In a future
where everything converges,
ACCESS
IS KEY.

By Harry Tankin

Distilling optimism from hype with practical network management

The North American telecommunications industry is in the midst of tremendous business, regulatory and technological upheaval. Carriers, be they local exchange carriers (LECs), interexchange carriers (IXCs), competitive access providers (CAPs) or cable multiple system operators (MSOs) will seek new geographic and demographic markets in a spirit of open competition and entrepreneurship. Although this is a period of unbridled excitement and opportunity, it also is the moment for industry players to catch their breath, reassess the nature of the market, and distill optimism from hype.

"The design and deployment of network management systems ... should be accomplished in a phased or incremental approach."

Nature of the market

Today, carriers provide essentially static services (whether telephony, video entertainment or data transport). Service definitions, features and content are fixed and scheduled. Hence, the underlying provisioning and support systems are by design limited and specific to a given service type. For example, the vast majority of video entertainment services offered by the MSOs consists of packaged, scheduled programming. The key support system for this service is the traditional subscriber management system (SMS). All SMS products have been designed around a core function: billing. Additional SMS features such as telemarketing, customer service and account management are complements to the product's billing core. However, that billing capability was designed around the traditional scheduled programming model, be it tiered packages or pay-per-view (PPV).

With the advent of video-on-demand (VOD), near-VOD (NVOD) and trials for innovative services such as interactive shopping and interactive gaming, the nature of billing takes a dramatic turn. One can no longer simply bill against a predefined event, but must take into account on-demand entertainment. The status of the traditional SMS product takes another turn when one considers that for NVOD and VOD services, the interruption of a video stream caused by a network or server fault may have to be reflected in a near real-time adjustment to the subscriber's bill. Hence, the billing model in general, and the billing system in particular, must reflect customer sensitivity to network performance.

Current broadband service trials indicate that to be responsive to consumer demand, carriers are moving from static service offerings to those that are by nature on-demand and highly dynamic. Further, all carriers are experimenting with a business model of bundled or complementary services: telephony, video, interactive gaming; and home shopping, data communications, Internet access, and telemetry. Bundling allows carriers to offer subscribers the convenience of "one-stop-shopping" for all communications services; it also aims to stimulate multiple subscriptions per household. This in turn results in increased network traffic and faster recovery of capital investment in distribution plant and program content.

Although there continues to be considerable debate over network architectures and distribution technologies, it is clear that North American network operators are expected to spend substantial sums on plant and infrastructure. While estimates are fluid, some figures have pegged carrier expenditure in excess of $75 billion over the next five years. The cost of distribution and content must be recovered from two sources: 1) residential and business subscribers, and 2) advertisers.

Due to the cost and nature of some high-bandwidth distribution architectures, cost recovery from subscribers is significant. No longer will the model of homes passed be an acceptable metric. Instead, a model of the inverse pyramid emerges — penetration with regard to multiple service subscriptions per household with multiple households per neighborhood, followed by clustered or congruent neighborhoods. Winning subscribers by clusters of households or neighborhoods not only applies an appreciable economy of scale to reduce the cost of new technology but guarantees consumer access to carrier services. Hence, the biggest battlefield among the carriers for subscriber dollars will be the local loop or access to the network.

Consumer selection of network operator and carrier service will become less of a technology issue, and more

Harry Tankin is senior business manager at General Instrument's Communications Division.

of a reflection of programming content, service availability, service quality, service flexibility and cost. Services will be of a commodity nature with content changed frequently. Therefore, the ultimate challenges for the carriers will be to provide these services (telephony, video, gaming, shopping, data and telemetry) at competitive costs, minimize subscriber churn and keep service areas intact.

Will revenue from residential subscribers alone be sufficient to earn profit on massive investments in distribution technology and content? Probably not. While telephony and data services to the business community are attractive to just about every carrier, it is questionable whether competitive pricing alone is sufficient to court these customers to alternate network operators. Since the lifeblood of most businesses depends on telephony and data services, a move to an alternate carrier must be met with a guarantee of service quality and reliability.

For the traditional LECs, IXCs and some CAPs, this may not be much of a challenge. For the MSO community at large, however, the ability to control and manage network resources against acceptable levels of service availability and quality will be a new dimension to the competitive contest. Promoting telephony and data services based on a network that lacks appropriate management technology and operational practices may be a perfect example of getting all dressed up with no place to go.

The impact of advertising revenue and the expectations of the advertising community often appear to be overlooked when discussing broadband service networks. Without question the advertising community will have a significant impact on the profitability of every network operator. Some carriers estimate that advertising will account for approximately 30% of all network generated revenue.

To earn advertising dollars, each operator should assume the need to prove its capability to have content aired over the network and viewed by subscribers with acceptable levels of quality and reliability. Further, with the introduction of new generation ad insertion and narrowcasting technologies, the ability to monitor and manage network resources to ensure the timely delivery and quality of content becomes even more important.

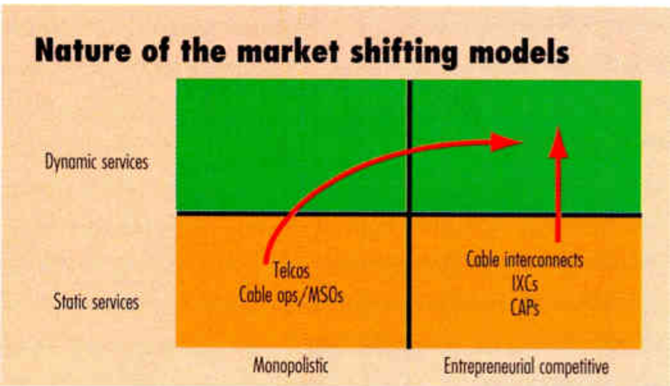
To take this reasoning a step further, the need to ensure the timely delivery of ads against targeted markets will necessitate some degree of highly available or fault-tolerant headend and distribution platforms. Although such platforms need to be monitored and managed by appropriate support systems, any systems-based management approach should include ad insertion capability and scheduling software to detect a fault and adjust accordingly. In some instances the application of management technology is not simply a matter of managing network devices, but service-specific application software as well.

A parallel to the potential role the advertising community may play with regard to service quality and reliability is the influence the Fortune 500 companies have had upon the LECs and IXCs for telephony and data services starting in the mid-1980s. During that time, major corporations willing to lease facilities and subscribe services from the "telcos" began to insist that:

- The carrier guarantee specific levels of service quality, reliability and availability against stiff financial penalties;
- The carrier demonstrate that it had management systems and practices in place to ensure that if services degraded swift problem resolution by the operator would minimize consequences affecting the subscriber; and
- The carrier offer to the subscriber access to specific support systems allowing CIO/MIS management to observe network and service performance against agreed upon service contracts.

Although the advertising community may not initially place such stringent requirements upon emerging broadband carriers, it must be recognized that precedent of expectations has already been established and accepted by many network operators for traditional services.

As the accompanying figure indicates, the telecommunications industry is in a state of transition. A collection of network operators representing a cross section of skills, talents and market expertise is seeking to win a finite subscriber base having limited disposable funds (personal income or operating budgets) for commodity telephony, video, data and telemetry services. How these services are created, provisioned, delivered and supported will contribute directly to which class of carrier in general (and network operator in particular) prospers.



The need for net management

The management of broadband networks and network services is a prerequisite for success. All carriers, regardless of network management experience, will be required to develop and deploy new generation management systems due to the cost of distribution technology, the competitive environment, network and service complexity, and increasing treatment of services as commodities.

Telcos (LECs, IXCs and some CAPs) possess a depth of knowledge and experience associated with design, operation and management of networks. It is not a foregone conclusion, however, that they can offer network management as meaningful competitive weapon amongst themselves or the MSO community.

To begin with, operating and managing a telephony network in a regulated environment with guaranteed rates of return is one thing. To apply the same technologies, standards and level of engineering in a truly competitive market of emerging services and untested network technologies is a vastly different situation.

Although the telcos will continue to promote the same level of service quality and network reliability to subscribers of broadband services as they have with their telephony customers, how they accomplish this is another matter. It is highly unlikely that the over engineering associated with support systems in a regulated industry will contribute to the profitability necessary in a more competitive market.

Further, the telcos will go through a learning process for broadband video technologies, and what they learn will have a gradual impact on the network management architecture that eventually emerges. In addition, with the need to keep overall network costs under control, there is a greater likelihood that telcos will embrace the use of customizable, off-the-shelf tools and management products as opposed to the reinvention of hardware and software solutions.

The MSO community's experience with network management is almost the inverse of the telcos. Historically, management was limited to as-needed implementations of status monitoring systems focused primarily on the distribution plant — essentially standalone systems and predominantly reactive. Operating as monopolies in a regulated market, the MSOs never faced the obligation of providing exceptional service availability, quality or reliability (especially for nonlifeline services). However, industry re-regulation and eventual deregulation that began in 1992 introduced such a need. The emergence of new competitors, including telcos and direct broadcast satellite (DBS) providers — coupled with the desire by the MSOs themselves for telephony and data services as new revenue streams — positioned service availability, quality and reliability as critical requirements.

Several MSOs have made great strides over the past few years in improving network service. Recent studies by Chilton Research, Unisys and others, however, indicate a severe competitive gap between the MSO community and the LECs/IXCs with regard to customer service, service reliability, billing and competitive prices within their respective industries. These studies indicate a willingness by a majority of MSO subscribers to switch to an alternative provider of video programming.

Any attempt to employ network management must be done against defined criteria, including the following:

- Improve operating efficiency and profitability.
- Improve revenue by making the network more attractive with respect to both new service introductions and new subscribers.
- Adhere to industry standards with regard to computing, networking, and management technologies.
- Use a systems approach that permits the gradual introduction and evolution of increased management sophistication on an as-needed basis by the carrier — also known as investment protection.
- Integrate key management functions and systems with other new and legacy support systems such as trouble-ticketing, work force administration, billing and customer service.
- Employ fundamental operations, administration,

maintenance and provisioning (OAM&P) functions.

• Support multi-vendor, multiple product environments.

• Support single-vendor, multiple product environments.

The TMN model

Management systems need to be developed in the context of an overall model as a means to define how data gathered from the network can be assembled into useful operational and business information. The deployment of isolated or element-specific management products may solve an immediate problem only to compound difficulties later. The task of any effective network management system is the application of a wealth of network events or data to improve network operations to satisfy business objectives. One of the best contexts for doing so is the telecommunications management network (TMN) model supported by carriers and equipment manufacturers worldwide.

The TMN model is a layered approach for the gathering, processing, and distribution of network and operations data to assist with the implementation of business management functions. At the same time, the model supports the concept of articulated business goals being fulfilled through the technical capabilities of the network and underlying operation support systems. In brief, the tasks associated with each TMN layer include:

Element management layer: Provides management and coordination of sets or domains of network elements through the collection of events, alarms, and performance data from the devices themselves. Management commands from this layer are implemented by the elements.

Network management layer: Provides end-to-end view of the network based upon event, alarm and performance data supplied by the element management layer. Collects and maintains statistics on overall network, circuit specific and domain-specific performances. Primarily concerned with real-time and near real-time network administration and control as well as supplying information for network planning and engineering functions.

OSS and service management

OSS application	Customer facing	Network facing
Customer service	•	
Billing	•	•
Subscriber management system	•	•
Sales and marketing	•	
Service creation and positioning	•	•
Circuit design and assignment		•
Network management		•
Network diagnostics		•
Work force administration/dispatch	•	•
Trouble-ticketing		•
Plant/facilities mapping		•
Network inventory		•
Network performance/measurement		•

• *Service management layer:* Consists of service development and service provisioning tasks against service level agreements established by the subscriber and carrier consistent with requirements of the business management layer.

• *Business management layer:* Establishes overall business and operating objectives as a profit-and-loss center using the network as a revenue generator.

Recently, the TMN service management layer has garnered increased attention throughout the telecommunications industry due to the leadership role undertaken by the Network Management Forum. According to the NMF, overall service management objectives are to reduce cost as part of the process of creating, provisioning, and supporting services; to improve speed of service introduction and delivery; and to meet or exceed customer expectation with regard to service quality, service availability and service reliability.

Key service management components include customer facing systems (which manage service delivery and the relationship of a given service with a particular subscriber), and network facing systems that transform the network's technical attributes into a commercially useful service or subscriber application. The accompanying table provides examples of how given operation support systems (OSSs) could be positioned in a service management/network management environment. Subsequently, there is a logical relationship between network management and service management that should be accepted by network operations personnel and serve as the basis for any network management design effort.

The design and deployment of network management systems for broadband services capable of supporting a fundamental level of service management is commercially feasible. Further, this can be (and should be) accomplished in a phased or incremental approach to reduce risk and ensure meeting system objectives. Carriers, both individually and collectively, should insist not only on the use of standard network management protocols, but the development of standard application program interfaces (APIs) between management platforms and critical OSS. This is particularly significant as vendors have begun to address TMN implementation more from telephony and data communications perspectives, and less as broadband video services.

Practical technical challenges remain, especially with regard to monitoring and managing current generation of broadband network equipment, and the timely distribution of network data to key OSS for trouble-ticketing, work force administration and billing functions. However, how network data can and should be shared across appropriate OSS poses another challenge: the need to define the business processes and information work flow that will characterize a useful management environment. **CT**

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Reader Service Number 71

By Laura Hamilton

The road less traveled: How ingress affects data's return path

Promises of cable modem ultra-velocities being fired across the bow of telcos' Internet connections has many hoping the days of 14.4 and 28.8 are numbered. Hate-to-wait "Netizens" — that is, serious "Internet citizens" — are drooling over the potential of 10 million bits per second (bps) and theoretically 100 million bps. That leaves telephony's typical 14.4 and 28.8 thousand bps, and even potential ISDN offerings of 64 thousand bps, sputtering.

Jones' Alexandria, VA, system is successfully using a passive HFC network for its Jones Internet channel.

But as some in the cable engineering arena warn, all the excitement over high-speed cable modems demands the technical community think about its two-way systems as a whole new animal. One of the foremost challenges laid before system engineers is avoiding sludgy return paths and making certain they don't become "the paths of no return" for sensitive data zipping down the pipe. According to engineers interviewed for this article, even systems that have had two-way capabilities up for a while are going to encounter new challenges with noise characteristics and the transmission capability of the reverse when it comes to data delivery, not to mention telephony.

Ask the people tweaking and upgrading their systems right now and they'll probably point out that even constantly and carefully maintaining your system, using quality components, and training your installers and techs to do things right the first time isn't always enough to keep leakage down and maintain a reliable return path.

So where's the ingress getting into the system and where's it coming from? Tom Staniec, director of network engineering at Excalibur Group, a Time Warner Co., says in his experience, 70% of all the garbage that shows up in the system comes directly out of the individual subscriber's home and 25% comes from the drop cable from the tap port to the ground block at the side of the house.

So fully 95% of all the ingress and other problems that get into the network come from between the tap and the TV set through the house, he says, and "the remaining 5% has to do with the quality of the RF hard coax portion of the plant."

Staniec maintains that the cable operator needs to be aware of these problems, troubleshoot and repair them before seriously contemplating two-way service. However, he points out that part of the problem is rather more dynamic than the house itself. That's the subscribers inside it.

The potential nightmare subscriber

"Ten minutes after you complete the installation, the customer conceivably could have bought an off-brand product with poor cable shielding. They don't have proper crimp tools or the proper installation tools. They could do (the installation) in any number of different ways that breaches the shielding of that cable, which now means you've got a great long-wire antenna system."

And of course that antenna system picks up ingress and throws it right back into the network. Staniec says that leakage anywhere in the system could damage a system's high-speed data delivery plans, and this might leave customers, even though they are part of the problem, fretting in front of their computers. They'll also be fuming, not too quietly, about their network provider no matter how speedy the system is when it does work.

Add to this that unless subscribers' installs are leaking enough for you to play your Federal Communications Commission cumulative

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leakage index (CLI) trump card, there are not a lot of options. If they are causing CLI problems you can demand they fix things or let you clean them up, but that won't always be the case, says Staniec.

Jones' Paul Schauer, senior staff engineer, broadband access platforms, agrees that the sub drop could mean mayhem in the return.

"There's the wild card of the subscriber," he says. The nightmare customer armed "with a butter knife and a poor-quality two-way splitter hacking up the install is something the industry might very well always have to deal with," he adds.

Schauer was chairman of CableLabs Network Integrity Working Group, which performed two-way field test measurement and analyses in several cable systems and produced an extensive report, "Two-Way Cable Television System Characterization." The report is available to Labs' members and recommends guidelines as to appropriate network topologies and operational methods to guarantee reliable digital transmission.

Schauer says that many of the engineers participating in the study were "surprised that the reverse path acted so differently from the downstream," but was quick to add that the group's work shouldn't discourage any MSO from providing two-way services, whether it be data delivery or telephony.

One system participating in the two-way CableLabs study was Charter Communications in St. Louis. The system is planning on extensive data delivery tests this year, taking an area off a node or taking a single node and upgrading it to 750 MHz, says Charter Director of Engineering Bill Gast.

Gast gives a nod to the fact that customers hooking up poor-quality equipment that generates interference will be a constant challenge, but also mentioned component quality and system maintenance as areas of concern when you're considering leakage affecting return path capabilities.

His disdain for the constantly beleaguered F-connector is very evident: "The F-connector as we know it is going to have to disappear. That's probably the sorriest excuse for a connector in existence," he quips. "In the beginning of this business it worked quite well, but for what you're trying to get in now and the complexity of this business, you need a connector you can totally weatherproof."

(Editor's note: In defense of the F-connector see "Hranac's View" on page 16.)

Return path amplifiers are another problem, says Gast. He believes the distortion specifications are nowhere near as good in the reverse circuits as they are for the forward, "Therefore they go into cross-mod and beat problems quicker than your forward does."

As for system maintenance, especially in the return, Gast thinks operators need to step up their efforts because the maintenance status quo will just not cut it in the brave new world of two-way.

That brings up other questions. If the reverse is new to so many in the industry, how do you know if you're even operating and maintaining it properly? What are the specs? What kind of test equipment do you need?

Time Warner's Staniec says, "Up until a very short time ago there was no manufacturer that shipped any type of documentation with a design that would indicate to you how the return system was supposed to operate."

Staniec maintains that lack of documentation and guidance is quickly changing as system engineers tell manufacturers what they need to get a network prepped. He also says that test equipment providers are avidly listening to cable engineers and developing better products that will help set up return systems properly: "There are some manufacturers that are probably within minutes, days, hours of having either beta or prototype equipment that can be brought out and works."

Taking on the return challenge

The return may be a challenge, but if you take a look at all the MSOs launching high-speed cable modem data service, it's obvious the opportunity is being tackled head-on, and immediately. Already, Time Warner has its Linerunner service, TCI has @Home, and Comcast has unleashed Comcast Online.

Jones Communications, which just changed its name from Jones Intercable to better reflect its move into new services, recently joined the race when it went from a test stage to adding paying customers on its Alexandria, VA, Jones Internet Channel. The system's Vice President/General Manager Jeff Spiegleman is very positive when he talks about the return path. He cites hybrid fiber/coax (HFC) architecture as the main boon to return robustness.

"With a passive HFC network you really get past the extra effort that it takes to maintain a tight operating window, particularly on the return path for data. It's very stable. Once it's properly set, it seems to hold the parameters very well," says Spiegleman.

He compares that to the system's not-so-successful trials of data delivery over its plain old coax network: "We've been providing Internet access over our traditional coax network at two libraries and three schools in Alexandria for the last two years using the traditional cable return paths. Our experiences have not been nearly so positive and it's been very labor-intensive to keep things working properly."

Another benefit of his HFC network, says Spiegleman, is that the two-way is not running through amplifiers other than the laser transmitter, the return transmitters and receivers. "So that's an entirely different world that we're operating in than the traditional tree-and-branch cable system with line extenders, bridgers and trunk stations."

He notes that in the traditional system, every 1,000 feet or so you might have an amplifier where you'd have to maintain reverse levels. "With a (passive) HFC network that variable is removed," says Spiegleman.

As for problems at the subscriber drop, Spiegleman points out that

(Continued on page 123)

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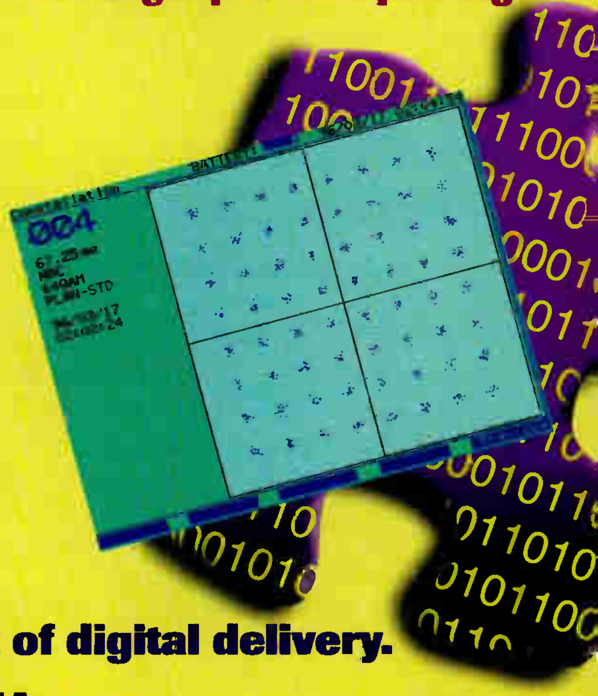

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By Ernest Tsui and Michael Meschke

Digital testing: QAM fundamentals

If the success of compact discs, video discs, digital video for computers and direct broadcast satellite (DBS) are any indication, the digital TV market looks very bright indeed. The transmit environment of these technologies is relatively benign compared to that of digital cable and even more so when compared to broadcast advanced TV (ATV) and digital multichannel multipoint distribution service (MMDS), which go through a complex (though mostly well-engineered) communications link to get to the subscriber. The communications link is shown in Figure 1. The well-documented weak link in the chain is the subscriber wired/drop environment. [1,2,3]

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

It is imperative that the drop environment's impact on digital transmission be thoroughly understood by providers rolling out new services. New installations and maintenance calls must be handled in a timely and efficient manner in this competitive market following the passage of the Telecom Bill.

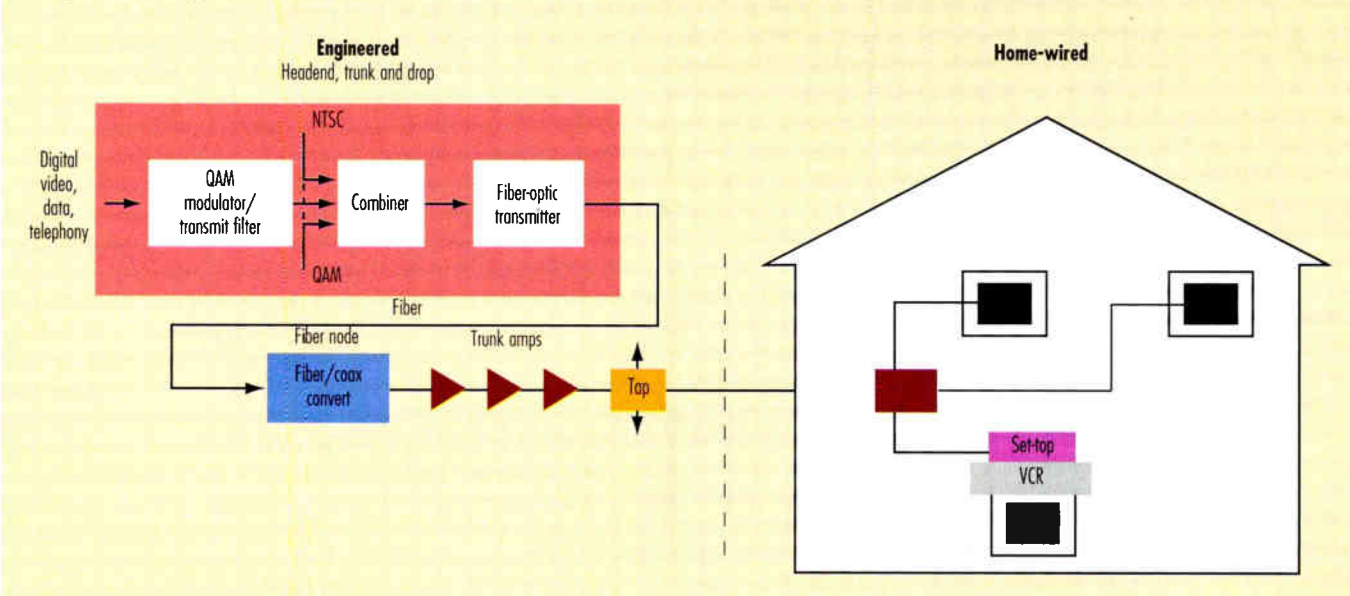
"As digital signals become increasingly complex, ingress will be increasingly difficult to infer from a simple spectrum analyzer."

To accelerate the introduction of digital cable TV, telephony and data delivery with cable modems, the industry needs to deploy digital signals over existing networks or rebuild the networks, partially or completely. Clearly, for cable companies, the less rebuild, the better the time-to-market. So the questions arise: What is necessary for successful transmission of digital signals? How can digital networks be better serviced and maintained in order to prevent customer turnover?

Analog vs. digital testing

It is well-known that NTSC signals degrade gradually with increasing levels of impairment while digital signals exhibit the "waterfall effect." They operate with near perfection, up to a point, in spite of

Figure 1: Digital communications link



impairments. Further increase of the impairments above a certain threshold (link design-dependent) will cause catastrophic degradation (freeze-frame video) similar to rolling over the "falls." In order to avoid these problematic effects, digital signal networks must be maintained such that there is sufficient margin above this threshold. The impairments impacting the system margin must be identified and their levels measured. Digital signal test procedures will differ significantly from analog procedures.

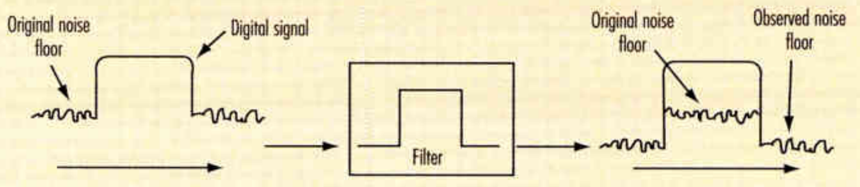
Testing differences

The following is a comparision/contrast between analog and digital impairments, powering, carrier-to-noise ratio (C/N), frequencies, redundancy, processing and upstream capability.

Analog: Impairments and noise can be clearly observed and diagnosed even so far as to estimate impairment level on the TV set for NTSC. This is possible because there is a linear (additive) relation between interference and the signal.

Digital: Impairments seen on the TV sets are not readily diagnosed because of nonlinear translation of the impairment to the compressed picture for MPEG. For example, the same undetected bit error placed in different areas of the video compression frame will cause markedly different effects on the picture. Also, the process of interleaving or randomizing the bits prior to transmission to mitigate the effects of pulse noise will "camouflage" the effects and timing of any pulsed interference on the picture.

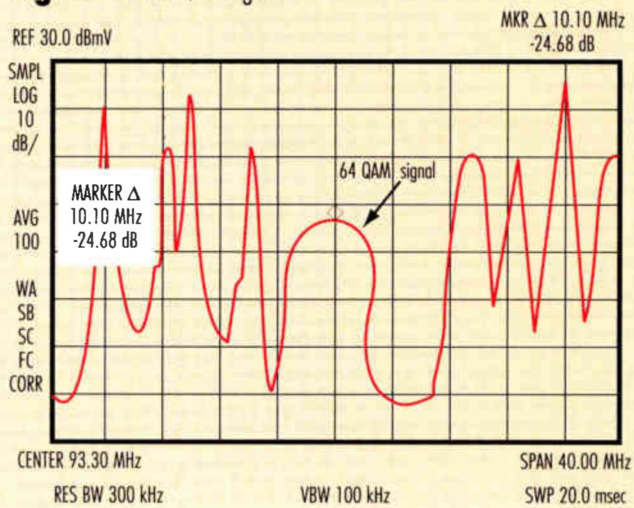
Figure 2: Noise floor masking via filtering

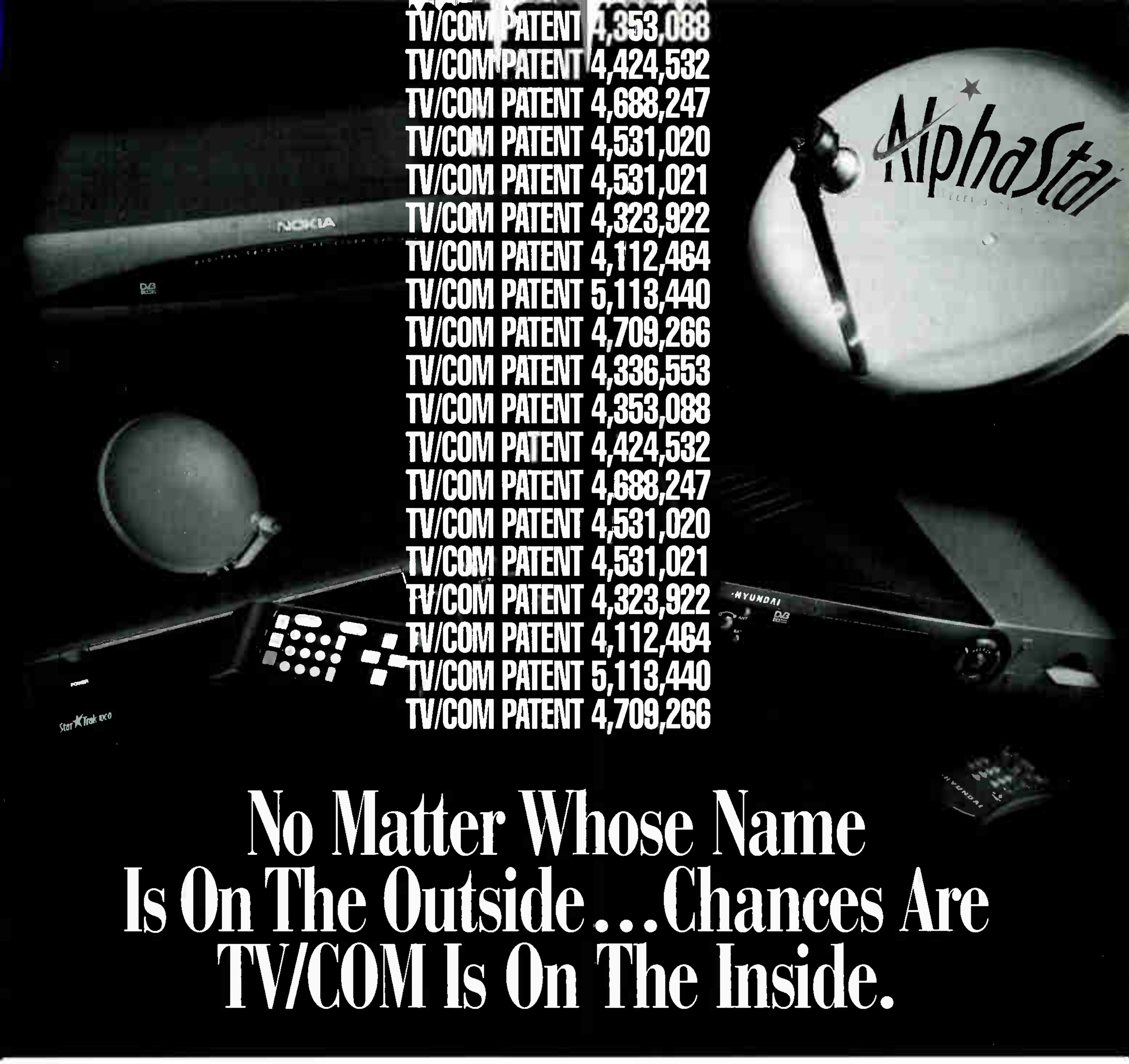


Analog: Power measurements are based on peak sync power and are readily available on signal level meters (SLMs) or spectrum analyzers.

Digital: To avoid overloading amplifiers, the digital signal will be transmitted at a level 6 to 10 dB below the NTSC. The digital signal also is normally characterized by *average power*, which is 6 dB below peak power. Thus, the digital signal will have a significantly lower signal-to-noise ratio (S/N) than the analog signal. Care must be taken to accurately measure and understand the digital C/N to ensure that there is proper margin available. →

Figure 3: 64 QAM signal





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Analog: C/N measurements can be conveniently measured on the side of the video carrier that carries no video information.

Digital: C/N measurements may be difficult when the digital channels are all loaded since nearly all the spectrum is used to carry the signal. For example, there is no area where noise can be observed and measured unless it is out-of-band. The spectrum analyzer resolution bandwidth can serve to mix adjacent signal power with the noise power producing inaccurate noise floor results. Another difficulty is that because of filtering, the noise can be buried inside the signal and be unobservable. See Figure 2 on page 84 for an illustration of the filtering that could cause this phenomenon. Figure 3 on page 84 shows an actual example. Also, it must be taken into account that certain sweep signals are commonly placed in between the channel slots, further complicating the noise floor observation on the analyzer.

Analog: Frequencies typically are in the 50-450 MHz range.

Digital: Signals will be transmitted at 550-750 MHz. This will incur more cable losses (several dB per 100 feet), and connector leakage could be a concern as well.[4] Again, this will impact the digital signal S/N ratio that might cause problems if sufficient margin is not available.

Analog: There is much redundancy in the transmitted signal so that the loss of pixels (or even lines) caused by noise or interference is not readily noticeable since they are constantly repeated or retransmitted. For example, a large noise spike-caused error will only affect one pixel or so.

Digital: There is little redundancy in the compressed digital video signal. Thus, undetected errors can eliminate substantial parts of the picture. For example, a single undetected bit error in a discrete cosine transform coefficient could cause a significant "block" (16 x 16 = 256 pixels) or checkerboard error in the picture that also could repeat in subsequent frames.

Analog: Signal processing is generally done via simple AM detection for video and simple FM detection for audio.

Digital: Digital signals will be processed by sophisticated circuits that will attempt to adaptively remove gain, phase and group delay impairments imposed by the channel. Also there will be robust forward error correction and detection circuits to mitigate the effects of burst and random bit errors. Detected erroneous Moving Pictures Expert Group (MPEG) frames will be masked using the correct frame. This processing capability requires testing methods that understand when a digital signal is in trouble caused by impairments and when it is OK.

Analog: There is little (very low data rate for advanced analog services) or no upstream capability at this time.

Digital: Upstream communications will be key for telephony, cable modem and interactive revenue generation applications such as home shopping, pay-per-view (PPV) and video-on-demand (VOD). The data rates required also could be relatively high for cable modem file transfers and future video telephony/conferencing applications.

From the issues raised, it is clear that there will be significant differences in the testing and maintenance of digital signals vs. NTSC signals.

For NTSC signals the key impairments can be observed in the TV picture, and the system can be corrected using conventional SLMs and spectrum analyzers or time domain reflectometers (TDRs) when necessary. This visual check is an effective test method since it tries to minimize the picture artifacts that are objectionable to a viewer and attack the degradation problem directly. The quality of the picture must be acceptable to the technician and the subscriber.

Digital signal impairments cannot be inferred from the TV picture, as can NTSC signals, and

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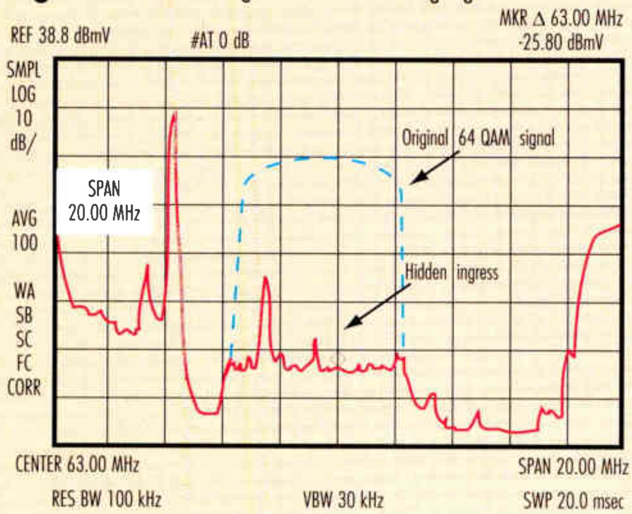
Figure 4: 64 QAM signal removed showing ingress



must be diagnosed from other features of the digital signal itself. Simultaneously, the digital signal C/N needs to be accurately computed in order to verify system margin.

Significant ingress into digital signals also can be masked by the digital signal for complex modulation formats. Figure 3om page 84 illustrates an example of this: an FM radio station interfering with a 64-QAM (quadrature amplitude modulation) carrier. The level (spectral) of the FM radio signal can be 10 dB lower than the QAM signal and still cause significant degradation (24 dB carrier-to-interference ratio — C/I). In this case, the ingress is typically masked by the spectrum analyzer spectral variation, as shown in Figure 4. On the other hand, another digital modulation type used on cable, a 9-QPR (quadrature partial response) requires a spectral level of FM 10 dB higher than that shown in Figure 5 (page 90) in order to cause significant degradation. This type of ingress can be seen easily on the spectrum analyzer display as a spike.

As digital signals become increasingly complex (64-QAM and 256-QAM or 16-VSB), ingress will be increasingly difficult to infer from a simple spectrum analyzer since, typically, relatively low-level ingress can cause significant degradation to these complex signals.

One final issue to be addressed is the notion that if one cleans up the NTSC signals, the digital signals will be corrected as well. Some of the reasons why this may not be true:

1) The cable/connector shielding will vary with frequency (digital signals at 550-750 MHz vs. NTSC at 50-450 MHz and below).

2) The ingress — UHF TV stations in the digital band will be different from the FM, UH/VHF TV, etc., that exist in the 50-450 MHz band which will be different from the citizens band, amateur radio (ham), etc., in the 5-45 MHz band.

3) The digital signals will have less relative S/N ratio because of increased cable loss at the higher frequencies.

4) Digital signal equalizers are affected (can lose lock) by the fast "ghost" phenomena that exist from surfing on another TV set.

5) Frequency offsets may exist that are OK for the NTSC but may be too large for the digital demodulators to acquire.

Field test results

Over the past several years, many 64-QAM field tests have been conducted. This field testing has confirmed many of the expected impairments tested for in the laboratory, and also revealed some unexpected problems.

The most comprehensive study published thus far on the drop and subscriber environment found that there is a significant variation in signal and noise power at the tap and that the spurious power is actually higher than the noise power.[1] Further, up to 5% of the homes in the study had less than 36 dB of shielding in their wiring systems. This indicates that the high levels of spurious are proba-

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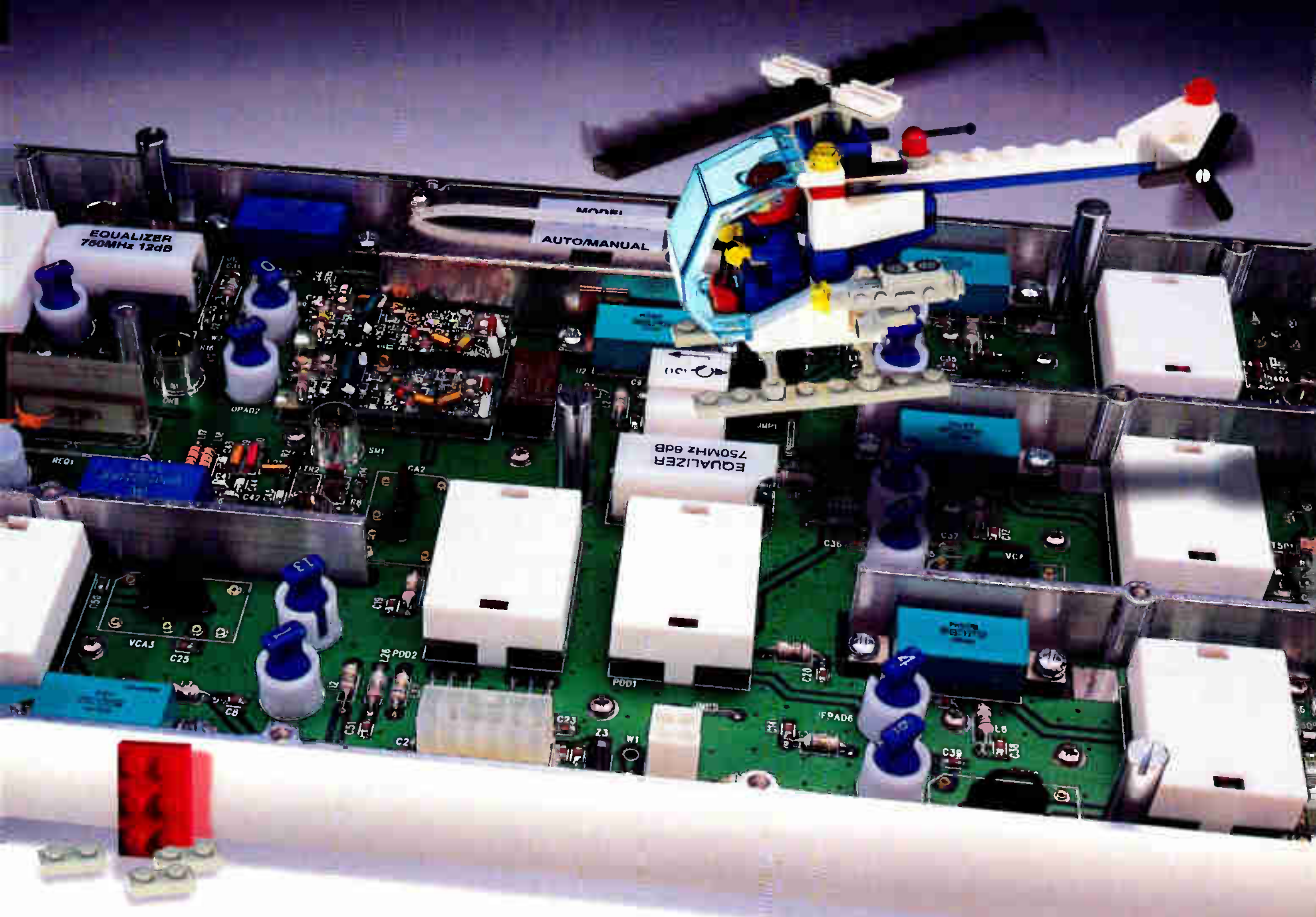

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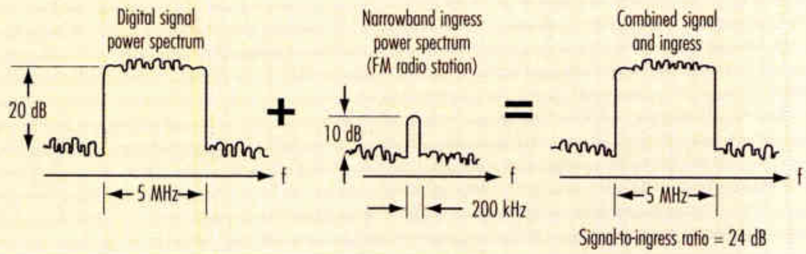


Figure 5: Illustration of ingress observability problem

Figure 6: Ingress from multiple dwelling unit environment

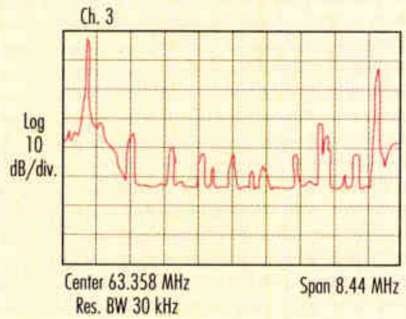


Figure 7: Constellation display with FM ingress

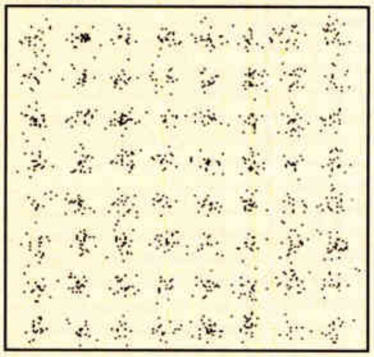
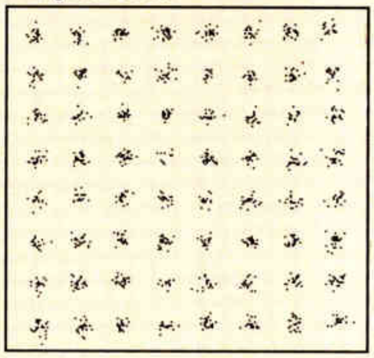


Figure 8: Constellation display with FM ingress reduced



bly resulting from ingress.

As indicated previously, digital signals are susceptible to significant yet undetectable ingress that may not be noticeable on a spectrum analyzer display. Our preliminary testing results confirm that serious ingress problems will appear at the subscriber site, although ingress also has been detected at some distribution hubs, depending on location. Multiple subscriber locations such as hotels and apartment buildings have revealed some of the worst ingress problems. Figure 6 shows ingress in a vacated digital Ch. A-4 (96-102 MHz) viewed at a set-top Ch. 3 output on a multiple dwelling unit (MDU) system. The ingress shown had the net effect of lowering the system's margin to a point at which the system produces noticeable errors (freeze-frame video) on the subscriber's TV set.

The constellation display (a common representation of the amplitude and phase of the digital signals) gives a good visual representation of the effect of ingress on a demodulated and equalized 64-QAM signal. Figure 7 shows the constellation display of a signal at a tap location that contains ingress from local FM radio stations. Figure 8 shows the tap location after the ingress was substantially reduced via improved connectorizing and cabling. It is clear from the constellation display that the signal with major ingress is more apt to have individual data points stray into another constellation point's area, which constitutes an error.

It has been documented that impulsive impairment causes upstream problems on many cable systems. In the following example, impulse noise also was detected on the downstream frequencies. Impulse noise has the effect, if strong enough and long enough, of disrupting the QAM signal and causing subscriber picture disruption. This type of impairment was, like the ingress in Figure 7, most often noted at the subscriber site. Impulse noise sources include the expected sources of electrical appliances with rotors and tractor engines, as well as an unexpected laser amp problem that caused over 100,000 errors every second. The ability to time and date stamp impulse noise proved valuable during field tests since this information could sometimes be correlated with subscriber activities.

Field testing conducted to date has shown that there will be a definite need for periodic, system proof-of-performance for digital signals on cable. It also has shown that with the proper test equipment, the necessary diagnostic information can be collected and analyzed quickly, thus allowing timely repair.

Summary

In the future, installers and technicians will have to be proficient in diagnosing and testing digital and NTSC signals — procedures with which to ensure customer satisfaction. Certainly, additional information is available from the set-top (bit error rate readings) and from network monitoring devices installed throughout the network for preventive maintenance. The fundamental problem, however, is that the test equipment of the future must analyze and diagnose signal impairments from the digital signal itself rather than from the TV video signal. **CT**

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By David Sedacca and Wayne Thomas

Maintaining digital carrier services in the cable plant

Many cable operators are now delivering services with digitally modulated quadrature partial response (QPR) carriers in the form of Sega Channel and Digital Music Express. In the near future, wide-scale deployment of additional digital services for delivery of data, telephony and video is planned using quadrature phase shift keying (QPSK) and quadrature amplitude modulation (QAM). Because all these modulation formats suffer similar impairments, field experience gained over the last five years with QPR provides insight to issues with QAM and QPSK. This article describes how measuring bit errors can help solve problems and verify performance when combined with traditional cable TV test techniques.

The critical measurement points in the data delivery system are as follows: earth station, headend digital modulators, headend combiner, distribution plant and subscriber drop.

Two types of errors can occur at each measurement point: persistent bit errors and intermittent error events. Both types will degrade service quality and availability for subscribers.

For the Sega Channel, persistent bit errors will cause long or failed downloads of menus and games. For DMX audio there may be frequent clicks, pops and muting.

For the Sega Channel, intermittent or transient errors will affect only subscribers that are in the process of downloading a menu or a game. Depending on the duration and severity of the errors, downloading may take longer or fail completely. DMX will experience a click, pop or mute. These types of errors also will have important effects for telephony, data and digital video services.

David Sedacca is a staff engineer at Hukk Engineering Inc. Wayne Thomas is a subscriber applications engineer at Scientific-Atlanta Inc.

"By supplementing traditional techniques with bit error measurements, cable TV personnel will be much better equipped to deal with digitally modulated signals."

Earth station

Performance verification should begin at the earth station. The principal elements of the earth station are the antenna reflector, antenna feed horn, block converter and satellite receiver. Good performance requires correct system design, component selection and installation.

Often, a convenient place to measure earth station performance is at the front panel test port of the cable data modulator. Connect a bit error monitor to the modulator test port. (See Figure 1.)

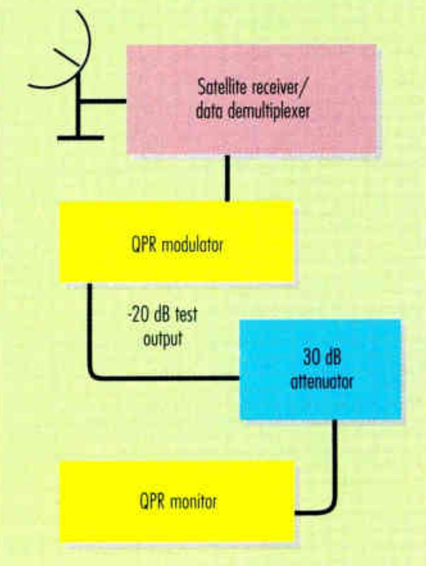
Use the "error count" function of a bit error monitor to see bit errors as they occur. The diagnostic modes of the subscriber equipment also can be used, but since they generally accumulate error information over a short time interval and may not store a history, it is to difficult to detect intermittent errors with this approach. With correct earth station installation, this measurement should show error-free performance. Bit errors observed at this point originate in the earth station or the digital modulator.

Some satellite receivers provide front panel indications of signal level and quality. Use these for monitoring day-to-day changes in received signal quality and for evaluating satellite receiver operating margin. When dish alignment is in doubt, use a spectrum analyzer and/or power meter to optimize dish aim and feed horn polarization.

A bit error monitor with data logging ability can detect transient error events at the earth station. Use the data logging feature of the bit error monitor to perform unattended monitoring. At the end of a measurement period, examine the bit error monitor for a summary of error and alarm conditions. If errors or alarms occurred during the measurement period, review each error event in the log.

It can be very informative to

Figure 1: Measuring earth station performance



review the data log after a 24-hour test. Verify that there are no long-term outages or periods of degraded operation that indicate fundamental earth station problems. Continue collecting data for another week or so. Review the larger body of data and ask these important questions to find clues that identify sources of errors:

- Does the data log reveal severe errors?
- Do these errors represent a significant impairment to subscriber service?
- Do error events occur at specific times of day?
- Do error events last one or two seconds? This could be caused by transient power fluctuations.
- Do error events last several seconds? This could be caused by airborne or mobile radio interference.
- Can error events be related to operator activities or earth station maintenance?

Use the performance log to reveal earth station problems that were previously undiagnosed. Compare the time stamps of events in the log with external events to speed the detective work of identifying problems.

By conducting earth station monitoring on an ongoing basis, the headend engineer can guard against degraded performance. Use data logging to help narrow down causes when systemwide trouble is reported. At minimum, conduct occasional 24-hour audits to stay alert for new earth station issues.

Headend

Measure headend performance after the earth station has been verified. Data performance hinges on headend design, correct installation and conscientious operating procedures. Be alert for conditions that reduce the margin of quality but still produce good function in the headend; additional minor impairments downstream could lead to severe bit errors.

Verify the performance at the output of the headend combiner or after the first amplifier that follows the combiner, using a bit error monitor or subscriber equipment in diagnostic mode. A spectrum analyzer is useful to see the relationship of each digital carrier to nearby signals.

If errors are detected at the output of the combiner but are not being detected at the test ports of the modulators, check the following:

- Digital carriers may be adjacent to each other but must not overlap. For example, QPR carriers for Sega Channel and DMX require a minimum of 3 MHz spacing.
- Provide adequate guardband between the digital signals and other types of data carriers. Frequency shift keyed carriers, sweeper pilot tones and leakage detector carriers often have modulation sidebands. When these carriers are too near each other they can create interference that reduces operating margin. Data may be error-free at the headend but show excessive errors in the field when ordinary broadband noise is added to the interference.
- Sweep generators must be re-

programmed to avoid passing through the bands occupied by digital carriers. Sweeper interference interrupts data delivery by causing a large number of bit errors during each sweep.

In addition, keep in mind that digital carriers are susceptible to in-band interference. Choose frequency assignments to protect the digital carriers. If digital carriers are placed at frequencies shared by strong broadcast signals (as often occur in the FM broadcast band), many failures will be experienced by subscribers due to ingress.

Installation quality can be impaired by incorrect power levels, incorrect frequency settings, data cable problems or incorrect operating mode selection on the digital modulators. Some digital modulators may be susceptible to errors induced by strong physical vibration or impulses.

Corrective action is straightforward. If power levels are in doubt, check them at the combiner output. Inspect data cable connections to ensure they are properly seated and restrained. Use the digital modulator front panel controls to verify that the carrier frequency is programmed correctly.

"The equipment and skills necessary to maintain digital signals will continue to increase in importance."

For the Sega Channel delivered with QPR carriers, download speed depends on proper assignment of data streams to each QPR carrier.

Distribution plant

Distribution plant issues usually affect many subscribers at once. Make measurements in the plant after establishing confidence in the performance of the earth station and headend. Troubleshoot distribution plant problems with a spectrum analyzer, sweeper system, bit error monitor, signal level meter and leakage measurement equipment.

Perform bit error measurements at various test points and taps to identify areas of degraded service and locate sources of trouble. (See Figure 2). Subscriber terminal equipment is generally ill-suited to this function because of limitations in powering, as well as displaying and capturing data. Use error logging to capture data on intermittent problems such as ingress or level changes. If multiple sites experience similar problems, two or more bit error monitors can be used to see what correlation exists.

Digitally modulated signals are susceptible to many common distribution plant impairments: ingress interference, incorrect signal level, channel amplitude flatness errors, group delay distortion, broadband noise and distortion product interference. Look for cable damage, failed electronics or signal processing elements that do not correctly handle the digital carriers.

Most digital signal problems in the distribution plant can be solved with the same actions that ensure good performance for traditional analog video services.

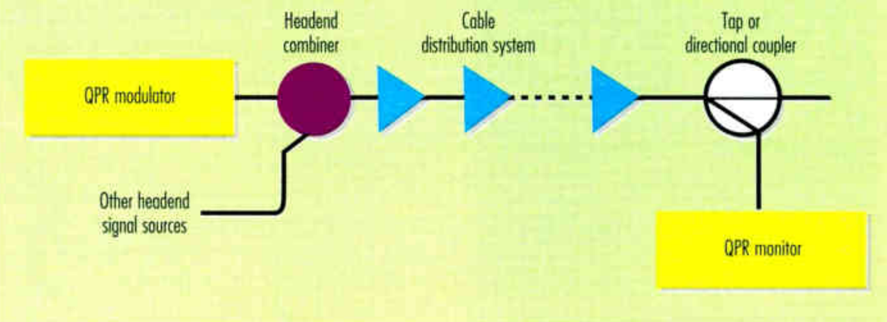
Ingress interference may indicate that connectors need repair. Use leakage detection equipment to zero in on faulty elements.

Amplitude and group delay distortion in an individual digital signal may be difficult to identify. Since the sweeper system must skip the digital channels, frequency response notches in these channels may go undetected. Look for damaged coaxial cable, connections or faulty passive elements. Use a spectrum analyzer to look at the shape of the digital signal's spectrum and verify that it matches the shape seen at the headend. Look for new notches, ripples or asymmetry.

Signal levels, broadband noise or distortion products will be incorrect if amplifier electronics fail. Look at traditional video signals at frequencies near the digital carriers to see if these failures show visible effects. A failure that makes a video service noisy but still intelligible might render the digital signals unusable. Use a sweeper system and signal level meter to help identify failed electronics.

Some distribution plants transport signals among multiple headend sites using coaxial, fiber or microwave links. If special transportation equipment is used to filter, process or retransmit digital signals, verify that these have been characterized and qualified to handle digitally modulated carriers. →

Figure 2: Performing bit error measurements at various test points



Subscriber drop

After verifying performance through the distribution plant, look for problems at the tap, subscriber drop, inside wiring and subscriber terminal equipment.

Make interactive measurements to check drop quality. Use a signal level meter (SLM) to verify that adequate video carrier levels are available at each outlet. Use a properly calibrated signal level meter or bit error monitor to measure digital signal carrier power at the subscriber equipment feeds. Check leakage, especially if any of the digital carriers share a frequency band with external radio signals. Use the diagnostic modes that are built into the subscriber terminal equipment. Verify that the diagnostics show that the terminal is functioning well at the drop.

"Digital carriers are susceptible to in-band interference. Choose frequency assignments to protect them."

Try out the application. For DMX, listen to one audio program from each of the six digital carriers; for the Sega Channel, download one game from each carrier. If intermittent problems exist, leave the a bit error monitor at the customer site for long-term error logging.

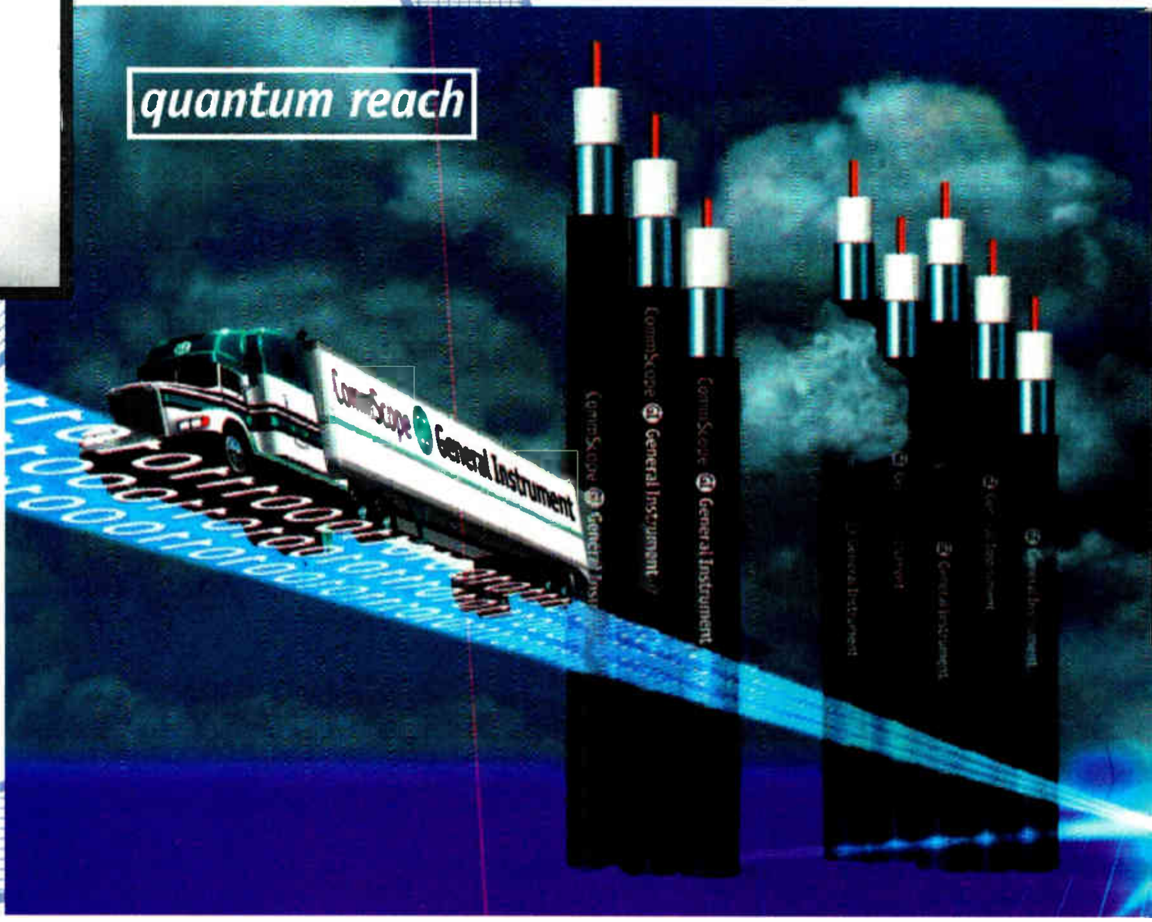
Digitally modulated signals suffer their worse abuse at the subscriber drop. Exposures include ingress, bad level, tilt, connector problems and cable damage. Also contributing are home wiring, amplifiers, splitters, directional couplers and switches. Home appliances may produce electrical noise that disturbs reception. This noise might be conducted through household power lines, as when a refrigerator compressor turns on, or radiated, as from an electronic spark ignition system.

Use the following subscriber drop corrective actions:

- Repair or replace faulty connectors and ground blocks. Replace damaged, unapproved or poorly shielded cable.
- Ensure adequate signal levels. Use an appropriate tap output level. Consider using a high-quality amplifier for a home with many outlets.
- Replace passive elements that are suspected of having bad frequency response, impedance mismatch or are properly shielded.
- Inspect connections and signal routing to verify that all terminal equipment is sensibly connected. Make sure that the directional couplers that are used for digital services precede all other elements on the drop.

Conclusion

Subscribers have high expectations for digital service availability and technical quality. Test equipment that allows measurement of bit errors reveals performance information that was previously difficult or impossible to gather. By supplementing traditional techniques with bit error measurements, cable TV personnel will be much better equipped to deal with the problems unique to digitally modulated signals. The equipment and skills necessary to maintain digital signals will continue to increase in importance as systems begin to compete in digital video, telephony and data services. **CT**



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Reader Service Number 41

By Michael Sawyer

Managing telephony traffic

How much wood could a woodchuck chuck? was the title of February's "Focus on Telephony" column by Justin Junkus, in which he covered some basic traffic engineering principles. This article will take you another step into that world. By the time you've finished it, you will be able to estimate the number of trunks or voice grade circuits that would be needed to serve a given traffic load. Before we get to that point, let us review some of the terms and principles of telephony traffic engineering.

The basic mathematics behind traffic engineering is statistics or probabilities. If you were throwing dice, and your number was 10, you might want to know what your chances were of hitting your number before you hit 7 or 11. (That is, if you were gambling.) Consider, each die has six sides; both dice, together, have 12 sides. Total possible combinations that you can hit are 36 (6 x 6). If we grant that one die is red and the other die is blue, let us consider how many ways we can hit 10 vs. 7 on 11 on our throws. (See Table 1 on page 94.)

A quick look reveals that you have three chances of getting 10 while you have a total of eight chances of getting a 7 or 11. Of course, there are 25 chances of getting neither on each throw of the dice (36-3-8). However, it is pretty clear that your chances of hitting either the 7 or the 11 is 2-2/3 of getting a 10 (2-2/3 = 8/3). The telephony network is designed with a similar, but much more complicated, statistical approach known as queuing theory.

The traffic engineer's objective is to balance the cost of service with the availability of that service. Today, we are used to picking up our telephone handset and obtaining dial tone. We want that dial tone now! We all know how frustrating it can be when this does not happen. Consider severe weather or times of important community or national events. These are times when the dial tone can be slow. →

"The traffic engineer's objective is to balance the cost of service with the availability of that service."

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Definitions

Subscriber loop carrier (SLC) systems:

Developed in the late 1960s to reduce costs in the local loop by reducing the number of copper pairs it took to serve a given number of customers. For example, each residential customer is served with one pair of twisted-pair wires for each telephone number terminating at the home. If you have 24 customers each with one telephone number, then you have 24 copper pairs going out from the central office to the customers' premises. For long loops this gets expensive. Also, the long loops are difficult to serve with the standard -48 VDC from the central office.

The SLC is an electronic device typically placed in an outside cabinet some distance from the central office and relatively close to the subscribers. From the SLC to the subscribers you still have copper twisted-pair to each customer. The 24 customers are served from the SLC with 24 copper pairs. By utilizing a 24-channel transmission scheme, such as a T-1 facility, from the central office to the SLC itself, the telephone company can go from the central office to the SLC with only two twisted copper pairs. This is a savings of 22 copper pairs.

In addition, the transmission characteristics are improved and the local loop can be extended out farther to the customers. Further development in this pair gain technology has allowed telephone companies to serve 48 or 96 customers with just 24 voice grade circuits carried on a T-1 carrier system. The savings in physical plant can be substantial. The gains in service quality also are significant.

PEG:

Actual number of calls that were counted as completed. The PEG is merely a count of calls.

CCS carried (CRRD):

Amount of traffic actually carried on the network during the indicated time period.

CCS:

100 call seconds. Thus, if you were on the phone for one hour, your total time on the phone would be 60 minutes or 3,600 seconds (60 x 60) or 36 CCS (3,600/100). Thus, when it is indicated that 1,500 CCS were carried, this equates to 41.67 hours of time that has been spent on the network during a one-hour time period. This is the total volume of usage for multiple users.

Erlang:

Another term used to define traffic volumes. The relationship is 1 Erlang = 36 CCS = 1 hour.

Overflow (OVFL):

Count of calls that were not carried (e.g., calls that were blocked and could not be completed).

Daily carried CCS:

Total traffic carried on the day measured.

Average BH percent of total: Nothing more than the CCS carried column divided by the daily carried column.

GoS:

Grade of service. The GoS is the percentage of calls that are blocked (e.g., 10% blocked is referred to as P10 GoS. Therefore, 1- GoS is the percentage of traffic carried).

Blockage theories:

There are two used in telephony communications:

- *Erlang B:* Blocked calls cleared (BCC).
- *Poisson:* Blocked calls held (BCH).

To calculate these numbers, see page 102.

You pick up the phone and you don't have dial tone. It is one thing when it happens once in a great while, but just think of how you would react if this happened every day.

What does the traffic engineer have to keep in mind and how would a system be designed to keep that situation from being an everyday experience? We are going to consider a relatively simple system consisting of the trunking required for one subscriber loop carrier (SLC) system serving, say, 300 very different telephony customers. During this discussion, we are going to refer to the accompanying figure.

In the figure we have an SLC providing basic telephony service to 300 voice and/or data terminals. Each has a line back to the SLC that then consolidates this traffic and sends it to the switch at the service provider's central office or hub location. The first thing the traffic engineer needs to determine is the busy hour offered traffic. The busy hour is defined as the busiest hour of the busiest day of the month.

To ensure a more representative design, typically one looks at a series of busy hours over a set period of time — say the busiest week. From that a bouncing busy hour (BBH) can be determined and the network can be designed to handle that level of offered traffic. To determine the BBH, assume you have data collected for a single day as shown in Table 2.

Table 2 represents a day's traffic for a given location or site. It should include both the inbound and the outbound traffic. If we took the busiest week's traffic data and observed and recorded the busy hour for each day of that busiest week, we may obtain information that looks like Table 3. Note that Table 2 is represented in Table 3 as Tuesday, 10:00 a.m. Thus, we would need information such as was provided in Table 2 for each day of the week.

With this information, you can begin to ascertain how much traffic was offered to the network during the BBH.

Table 1: Hitting 10 vs. 7 on dice throws

Red	6	4	5	1	2	3	4	5	6	5	6
Blue	4	6	5	6	5	4	3	2	1	6	5
Total	10	10	10	7	7	7	7	7	7	11	11
			3 times						6 times		2 times

SLC providing service to 300 voice and/or data terminals

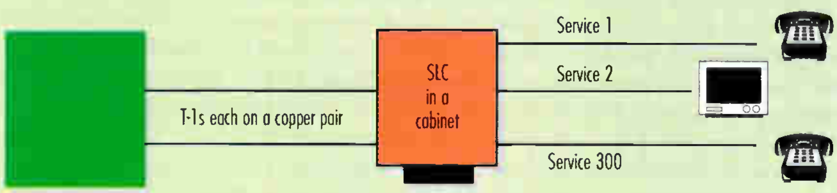


Table 2: A day's traffic

Time	Peg count	CCS carried	Overflow	
0800	1,005	1,208	151	
0900	1,107	1,305	203	
1000	***1,251***	***1,500***	***297***	***Busy hour***
1100	1,059	1,227	104	
1200	811	1,084	10	
1300	1,067	1,106	52	
1400	1,177	1,459	223	
1500	1,061	1,053	37	
1600	925	1,019	22	
Total	9,463	10,972	1,099	

What is offered (OFRD) traffic? Take the person who lives in a place that has a high water table. To keep his or her house dry, this person has installed a sump pump. Periodically, it goes on and removes the offered load of water from the house. During a heavy rain, the offered load would increase. In our example, the home owner can design the system to handle the additional load. This can be done by adding a second sump pump, which is ready to go into operation when the water is too great for the first sump pump to handle alone.

Traffic engineering plans for times when the offered load increases significantly. These rainy times are the busy hour. Fortunately, this is much easier to predict and control than the weather.

To ascertain the OFRD traffic, the traffic engineer would determine the grade of service (GoS) from the average PEG count and the average OVFL. The GoS is calculated by dividing the OVFL by the sum of the OVFL and PEG count. Once the GoS is determined, the OFRD traffic can be determined using the following formula:

OFRD x (1 - GoS) = CRRD

Then the average OFRD traffic for the BBH would be calculated. How is this done? We know how many total call attempts were made: PEG + OVFL. In the example above, the total call attempts is calculated to be:

1,241 + 269 = 1,510 total attempted calls

Table 3: Busy hour for each day

Day	Time	Peg	CCS carried	Overflow	Daily carried CCS	Average BH % of total
Monday	0900	1,351	1,627	335	12,089	13.4%
Tuesday	1000	1,251	1,500	297	10,972	13.7%
Wednesday	1300	1,201	1,511	302	11,201	13.5%
Thursday	1500	1,175	1,479	266	10,179	14.5%
Friday	1000	1,090	1,235	144	9,877	12.5%
	Avg.	1,213.6	1,470.4	268.8	10,863.6	13.5%

If 269 calls were blocked, that means that the GoS is 17.8% (269/1,510) or (OVFL/(PEG+OVFL). Almost one out of five calls is being blocked during the busy hour — not a good level of service. We can now determine the total offered traffic:

OFRD x (1- GoS) = CRRD or
OFRD = CRRD/(1-GoS) or
OFRD = 1,470.4/(1 - 0.178) or
OFRD = 1,470.4/(0.822)

Thus, our OFRD traffic is 1,789.1 CCS for the BBH.

Next, we determine how many trunks are needed to handle the traffic. What type of formulas do we have to crank through now? The good news is that others have cranked through the formulas and the nasty calculation work is done. It is like being at the dice table and having the probabilities of winning on a poster (or a monitor screen) in the casino. Can you imagine a casino doing that?

Fortunately for the traffic engineer, tables have been developed just for this purpose. The two types of tables developed for this are the Erlang B table and the Poisson table. These tables were designed by mathematicians to determine the outcome of a particular queuing problem. Which table to use is relatively easy to determine. You pick a table based on one of two queuing schemes:

- *Erlang B:* Blocked calls cleared (BCC). The call is being carried, if not by the primary trunk group, then by an overflow trunk group.
- *Poisson:* Blocked calls held (BCH). A blocked caller would immediately attempt to make the call again. More trunks are required since there is only one trunk group handling calls.

The traffic engineer has design criteria that designate what percentage of the calls is to be blocked (e.g., 1% or P01 service, 5% or P05 service, 10% or P10 service). What would be different number of trunks required to handle an offered load of 1,789 CCS at these different grades of service? Using a traffic table, the number of trunks would be determined. A partial traffic table is provided in Table 4. (Formulas follow in the next section.)

What we need to determine is how many trunks are needed to handle the offered load of 1,789.1 CCS at the target grade of service (i.e., P01/P05). In this case, the Poisson table would be used. If the requirement was for a GoS of P01, 68 circuits would be required between the SLC and the CO to provide a GoS of P01 for the 300 terminals. These 68 circuits would give a P01 grade of service for an offered load of 1,811 CCS, which is greater than the 1,789.1 CCS expected. If the GoS was to be P10, only 60 circuits would be required.

The point is to efficiently and cost-effectively serve the customers. During the busiest hour, the average customer in our example has 9.9 minutes of time on the telephone line. To provide P01 quality service during the busy hour requires 68 circuits, or a concentration ratio of 4.4 stations to 1 circuit back to the CO (4:4:1).

This is a measure of service quality. It is also something that determines customer satisfaction and willingness to use your service. A monopoly is watched by a Public Utilities Commission. In a competitive environment the customers will determine with their pocketbooks who provides the best overall value.

Table 4: Partial traffic tables for Poisson and Erlang B

	Poisson		
Trunks	P01	P05	P10
59	1,534	1,691	1,778
60	1,565	1,723	1,811
61	1,595	1,755	1,844
62	1,626	1,787	
63	1,657	1,819	
64	1,687	1,851	
65	1,718		
66	1,749		
67	1,780		
68	1,811		
69	1,842		
70	1,873		

Erlang B			
P01	P05	P10	Trunks
1,332	1,567	1,745	49
1,364	1,603	1,784	50
1,397	1,638	1,822	51
1,429	1,674	1,861	52
1,462	1,710		53
1,494	1,746		54
1,526	1,782		55
1,559	1,818		56
1,591	1,854		57
1,624			58
1,656			59
1,688			60
1,724			61
1,757			62
1,789			63

Calculating Erlang B and Poisson

The partial traffic figures provided in Table 4 are only a starting point, however. Complicated though they are, you should still know the formulas for these calculations.

- *Erlang B.* The formula for this is:

$$P = (A^n/n!) / \left(\sum_{x=0}^{n} (A^x/X!) \right)$$

Where:
P = Probability of blockage
A = Traffic density in Erlangs
n = Number of servers
e = Naperian logarithm base (2.718+)
X = Number of busy channels

Erlang B is used for situations where there is BCC. If the calls are not carried by the primary trunk group, then the calls are carried by overflow trunk group. Thus, the call does not reappear at the primary trunk group. In our sump pump analogy from page 101, this would be the same as having the water that was not carried out of the basement by the first sump pump carried out by the second sump pump.

- *Poisson:* Blocked calls held. The formula for this is:

$$P = e^{-A} \sum_{x=n}^{\infty} (A^x/X!)$$

Poisson traffic tables are used for those situations where there is blocked calls held (BCH). The tables ascertain the number of circuits required between the SLC and the central office. In this case it is assumed that a blocked caller would immediately attempt to make the call again. Thus, more trunks are required since there is only one trunk group handling all the calls (no overflow to another trunk group). This would be like one sump pump having to handle all the water by itself. Any water not pumped out is still going to be in the sump. So, get a large sump pump if you want to remove all the water or carry all the offered calls. **CT**

By the Council on Competitiveness

Vision for a 21st century information infrastructure: Part 2

Founded in 1986, the Council on Competitiveness is a nonprofit, nonpartisan organization of chief executives from business, higher education and organized labor who have joined together to pursue the goal of improving the ability of U.S. companies and workers to compete in world markets while building a rising standard of living at home. The Council focuses on issues in the areas of fiscal policy, science and technology, international economics and trade and human resources.

The following article is excerpted from the Council's vision statement that developed out of consideration of the information infrastructure for the next century. Space does not allow to reprint the entire report. Contact the Council for a copy.

Participating in this project were cable companies, regional Bell operating companies, long distance carriers, cellular firms, computer hardware, software and service companies, banks, broadcasters, publishers, labor unions and universities. Among cable and telecommunications representatives on the project were Bellcore, BellSouth, CableLabs, Corning, Hewlett-Packard, McCaw Cellular Communications, Pacific Bell, Nynex, Tele-Communications Inc. and US West.

The vision statement addresses the need for an advanced information infrastructure in the United States. The following six questions are focused on: 1) Why is information infrastructure important? 2) Where do we stand? 3) What is our vision? 4) What are the roles of government and the private sector? 5) Where do we go from here? 6) What are the next steps?

To contact the Council on Competitiveness, write to 900 17th St., NW, Suite 1050, Washington, DC 20006, or call (202) 785-3990.

Part 1 of this article, which ran in January on page 48, covered the first three questions and this part considers the rest.

If the vision for a 21st century information infrastructure can be stated, why is there so much concern about the pace of America's progress toward it? The answer is that there is a lot of confusion about the state of the infrastructure that already exists today and uncertainty about how best to accelerate deployment and assemble the component parts into an advanced nationwide system. Such issues as how it will evolve, what rules will govern access, how it will be paid for and who will provide key services are the subject of lively debate. Policy discussions center on one fundamental issue — how to determine the proper balance between a diverse, evolutionary approach driven by competitive market forces and closer government/industry coordination.

"Industry must complement its strength in technology with strength in services and manufacturing."

Government's first task is to help articulate the national need for an advanced information infrastructure. The government also has a critical role to play as a catalyst and coordinator. At both the federal and state levels, as well as nationally and internationally, government should convene users and providers to forge a strategy, or at least a common understanding and some shared goals. In addition, government must bring U.S. telecommunications regulations in line with new requirements and market opportunities. In the past, the fragmented government regulatory environment has often tended to inhibit competition and delay deployment of new technology. Finally, government must make sure that its diverse R&D programs are well managed and designed to advance practical applications. It should serve as an early funder of research and large-scale experiments that are out of reach of individual companies because of risk, cost and time-to-maturation. And it should make sure that the private sector has appropriate access to this R&D.

The private sector, by contrast, has the responsibility for actually building and operating the infrastructure, for serving new markets and for providing value to its customers. It must explore new market opportunities, make systematic investments in technology and applications, and constantly seek to deliver high-quality goods and services. As part of this effort, it should bear in mind the role that mass-market consumer services play in creating demand, bringing down costs and generating wealth.

Leadership in technology is not enough. Industry must complement its strength in technology with strength in services and manufacturing. Industry must remain open to working with government, labor, universities, consortia and users to drive the creation of new technologies and develop new applications. →

Where do we go from here?

Much of the discussion about how to mesh public policy with market forces can be clarified by understanding the next plateau of service after the telephone. In order to reach the long-term goal of a nationwide system of advanced information services, we must establish short-term goals and programs that accelerate progress toward a variable bandwidth, digital, interoperable set of networks that are easy to use and widely accessible.

Rather than try to pick winners among technologies or choose one technology platform, the United States should pursue a multifaceted strategy that is ambitious, yet flexible and realistic.

Three different kinds of proposals to provide digital service deserve consideration. First, there are programs that target the underlying technology as a means of creating a new platform for the delivery of goods and services. One set of examples includes narrowband integrated services digital network (ISDN), asymmetric digital subscriber line (ADSL) technology, and high-bit-rate digital subscriber line (HDSL) technology. These could be deployed in existing networks and would enhance the level of current services, enabling voice, data, fax, image and multimedia capabilities. While these technologies do not address the need for very high bandwidth in some applications, they utilize existing twisted-pair copper wire and have unquestionable immediate utility for the mass market. Some doubt, however, whether they are ambitious enough to serve as enablers for more advanced services.

A second example that targets the underlying technology aims at accelerating the evolution of existing broadband networks, like those providing cable TV. This approach is recommended for several reasons: there is already an extensive installation of broadband-to-the-home, one-way delivery systems; these systems are rapidly digitizing for core business reasons and will see their capacity grow in the near future; interactive communications applications on such systems are projected to increase; the systems are heterogeneous, familiar to consumers, easy to use and affordable; and no large public expenditures or reallocation of spectrum is required. In this area too, however, there are questions about whether the present collection of local, one-way, analog video distribution systems and ad hoc architectures can be extended to more demanding uses that require greater versatility.

A third example in this category involves wireless communications. Given the ability of wireless communications to provide mobility and remote access, there is no doubt that it will play an important part in the evolution of the U.S. information infrastructure. There is some question, however, whether it will be capable of supplying sufficient bandwidth for multimedia applications.

A second category of proposals involves redirecting existing federal R&D programs toward practical U.S. business and consumer needs. For example, the federal government's High Performance Computing and Communications Initiative (HPCCI) is currently limited to sophisticated supercomputer applications that focus on the needs of the research community. Legislation is pending that would expand this initiative to include greater attention to manufacturing, libraries, education and health care and involve the relevant government agencies. By targeting practical applications in these areas, the HPCCI could make a major contribution to the deployment of an advanced information infrastructure.

Finally, the federal government could champion specific regional proof-of-concept experiments that hold promise for stimulating promising applications.

In pursuing these technology initiatives, government's goal should be to work with the private sector to identify promising technologies, to encourage industry to develop them, and to fund precompetitive R&D in those areas where barriers to development are so high that they discourage industrial investment. The government should let market forces determine winners and losers.

In the end, some combination of these different kinds of technology initiatives will probably be adopted. What is important is to make sure that programs aimed at these medium-term technical goals are part of a broader, joint public/private effort to accelerate the development of a wide range of applications. It is these applications — not the technology itself — that will determine the vitality of America's national information infrastructure.

While trying to stimulate the technology underlying the infrastructure, the government must not lose sight of the decisive influence of the regulatory environment. More than any technology program, the regulatory framework will determine the face of America's information infrastructure. The best role for government is the one that is least intrusive.

What are the next steps?

The Council on Competitiveness has outlined three steps that are necessary to advance the rapid deployment of a 21st century information infrastructure and intends to pursue initiatives in all three areas actively.

First, the tremendous advantages that an advanced information infrastructure offers in such areas as health care, education and manufacturing must be conveyed to the American public. In order to aid this effort, the Council will profile key pilot projects and demonstration programs around the country and highlight their benefits. Moreover, it will work to emphasize the wide variety of applications information infrastructure makes possible and bring them to the attention of policymakers in Washington, D.C.

Second, government and the private sector must address several thorny policy issues that cut across the communications networks, computing systems and databases that constitute the physical infrastructure. The Council will set up a process to address these issues, isolating make-or-break concerns and developing a core private sector consensus in key areas.

Third, key questions related to the status of the underlying technologies must be addressed. There are a number of groups working on core technical issues and related policy concerns. The Council plans to work closely with organizations interested in this aspect of the issue, such as the Corporation for National Research Initiatives and the network of policy groups assembled in cooperation with Harvard University.

In the end, the strength and vitality of America's information infrastructure will depend not only on healthy competition, but also on constructive cooperation between the public and private sectors. We look forward to working with Congress and the new administration to make this kind of cooperation a reality. **CT**

By John Chamberlain and David Vokey

Grounding practices for fiber

Due to the rapid deployment of fiber in the cable TV industry, safe grounding and bonding practices of these cables are often misunderstood or sometimes even forgotten.

The armoring component of a fiber is required in order to protect the high-capacity optical fiber from environmental hazards including rodents, rocks, pole attachment hardware, shotgun blasts and other natural and man-made threats. In addition, the armor of a fiber is used for proactive monitoring and tone locating in support of "dial before you dig" programs.

Because the protective armor of a fiber is metallic, it can be a conductor for induced AC or surges when in close proximity to power lines or lightning. Although exposure to hazardous voltages is low for most regions of the country, these "stray" voltages can present potential danger to personnel and electronic equipment.

John Chamberlain is general manager and David Vokey is president for Norscan, a manufacturer of fiber-optic cable monitoring systems.

For these reasons, a number of specifications regarding the proper grounding and bonding of fiber-optic cable armor have been developed. These documents include:

1) *Bellcore's Blue Book — Manual of Construction Practices*

2) *The National Electrical Safety Code (NESC)*

3) *The ITU/CCITT Series K & L Recommendations*

The Bellcore and NESC pertain in particular to the United States and the ITU/CCITT recommendations are international specifications concerning construction, installation and protection of cable and other elements in outside plant.

The intent of all three specifications with respect to the bonding and grounding of armored cable is to create a low impedance path from a cable armor to all other local cable armor(s) and earth ground in order to dissipate high voltages that may endanger equipment and personnel.

The NESC and Bellcore define bonding, grounded and effectively grounded as:

Bonding — The electrical interconnecting of conductive parts, designed to maintain a common electric potential.

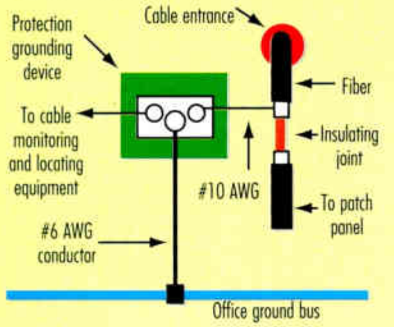
Grounded — Connected to or in contact with earth or connected to some extended conductive body that serves instead of earth.

Effectively grounded — Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or persons.

In general, the aforementioned documents state that all metallic components, including the armor, should be grounded and that the armors at the splice points should be bonded together. This minimizes the buildup of voltages on the armor and keeps all the metallic components at a splice point at the same electric potential.

All three documents also state that the armor should be effectively grounded to the building ground at the entrance point. By employing the

Figure 1: Protection grounding at building entrance



use of an "insulating joint" the outside plant cable can continue to be run into the office. This method eliminates the need for a splice enclosure at the building entrance. Local fire codes can be met by installing the cable in conduit. (See Figure 1.)

In addition, the NESC, Bellcore and CCITT state that the metallic components in the cable may be connected to ground directly or via lightning surge arrestors. Protection grounding the armor through the use of surge arrestors allows for the use of long-range tone location and sheath monitoring equipment that are invaluable tools for cable locating and preventive maintenance.

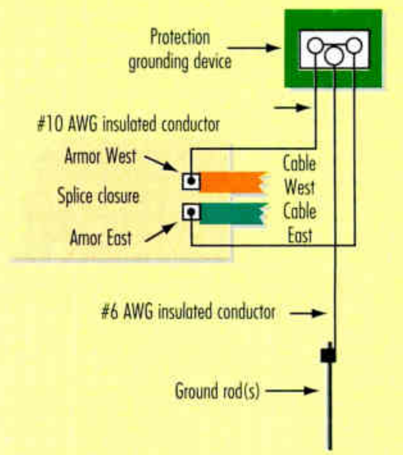
Bellcore specifically addresses the aerial installation of armored fiber. Bellcore recommends bonding the armor to the supporting strand, which has been properly bonded to ground, every 1.25 miles (6,600 feet or 2 kilometers). This can be accomplished by bonding directly or through properly designed surge protection devices.

Industry experience and published guidelines state that building grounds should be designed to a maximum ground resistance of 5 ohms and that 3 ohms or less is preferable. Grounds in the outside plant at splice locations, equipment cabinets, etc., are generally designed for a maximum ground resistance of 25 ohms. This is not always practical in the regions where the ground resistivity is high such as in rocky or sandy soil. In extreme conditions commercially available chemical grounds can be used to lower the ground resistance.

The NESC requires that grounding electrodes be bonded together with AWG #6 copper and that the grounding conductors used for connecting equipment and cable not be less than AWG #14. Bellcore recommends AWG #6 for all connections to ground. The international CCITT standard states that the resistance provided to ground through the connecting conductor should be low enough to carry the current required to dissipate the maximum expected voltage. For fiber with armor resistance ranging from 10 to 20 ohms per kilometer, a ground conductor of AWG #10 or heavier has adequate current carrying capacity for connections from the armor to ground.

At splice points, an effective way to bond fiber to ground and provide access to the armors for tone location

Figure 2: Protection grounding at splice



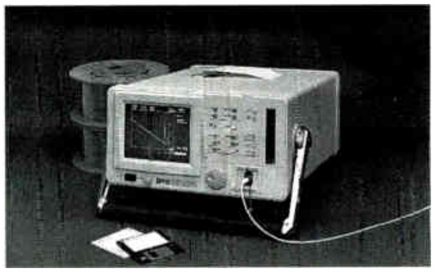
and sheath monitoring is to bond the armors to ground through a protective device in an accessible housing either above or below grade. A number of these enclosures are available on the market and allow for good cable maintenance practices. (See Figure 2.)

Summary

Grounding and bonding of fiber-optic cable should not be forgotten in the haste to install these high-capacity circuits. Proper bonding and grounding is essential for personnel and equipment safety as well as the longevity of the plant. Installing surge protection devices in separate "grounding housings" allow for safe grounding of fiber sheaths and long-term cable maintenance. **CT**

AD INDEX

OTDR module



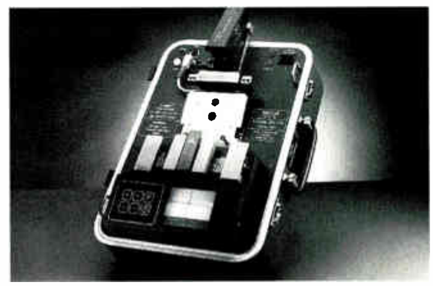
Photon Kinetics added the 682M high-performance plug-in module to its family of "application optimized" plug-ins for its Model 6500 optical time domain reflectometer (OTDR). The multimode plug-in provides over 33 dB of dynamic range at 850 nm, the highest range of any multimode OTDR available, according to the company, making it possible for fiber and cable manufacturers to test longer product lengths and reduce their manufacturing costs.

The module completes the company's Model 6500 product line for fiber and cable manufacturers, which already includes the 662SA cable test and 674S spectral modeling modules for single-mode fibers.

Reader service #312

Fusion splicer

Siecor Corp. announced enhancements to its M90 Series 3000 microprocessor-controlled fiber-optic fusion splicer that makes it more accurate and easy to use.



Primary enhancements include fully automatic, three-dimensional fiber positioning, programmable attenuation software and altitude compensation. In addition, the unit now has a service counter for cleaning and changing the electrodes, displays that show total splices made and hours used, optimized parameter menus for easier access, and a clock with date and time. The enhanced splicer also features expanded memory to store more than 1,000 splice loss values, a powerful new processor and simplified mechanics and electronics for easier maintenance.

The enhanced unit combines two technologies in one machine. The LID System unit monitors light injected into the core of the fibers and provides the lowest splice loss possible with the most accurate loss readings in the industry, according to the company. In addition, the company says the unit's profile alignment system (PAS) completes fiber splicing in less than 10 seconds, up to five times faster than other PAS machines.

Reader service #311

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.

☛ *Applications of Digital Technology* — Digital technology will change the way we do business. This program, featuring Scott Bachman, Roger Brown, Tom Elliot and Jim Ludington, provides an overview of the types of changes to expect. Topics covered include: superhighway, driving forces behind computer capacity and digital compression, comparison of CATV delivery to RBOCs, ATM protocol, cable's window of opportunity, and digital technology cable advertising. (70 min.) Order #T-1137, $45.

☛ *Cable and Telephony Integration: Balancing Revenue Opportunities and Network Evolution* — Cable and telephone companies must transform the services they provide, or they will be transformed by the market. Topics covered include: network and telecommunications drivers, telco/CATV convergence, competitive access, personal communications networks, two-way interactive and multimedia, CAP opportunities, design network architectures, CATV deficiencies, telco deficiencies, regulatory drivers and new potential services. (85 min.) Order #T-1138, $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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May

1-2: Scientific-Atlanta technical training seminar, migration to digital networks, Atlanta. Contact Bridget Lanham, (800) 722-2009, press 3.
2-3: Antec FiberWorks training course, broadband cable TV technology, Antec training center, Denver. Contact (800) FIBER ME.
3: SCTE Greater Chicago Chapter testing session, BCT/E exams to be administered. Contact Joe Thomas, (815) 356-6105.
4: SCTE South Florida Chapter testing session, Installer exams to be administered. Contact Jim Jones, (407) 478-5866, ext. 409.
6-7: SCTE regional training seminar, introduction to telephony, Quality Hotel Central, Phoenix, AZ. Contact SCTE national headquarters, (610) 363-6888.
6-9: Siecor training course, fiber-optic installation for LANs, Hickory, NC. Contact (800) 743-2671, ext. 5539.
7-8: Scientific-Atlanta technical training seminar, advanced field test and measurement, Atlanta. Contact Bridget Lanham, (800) 722-2009, press 3.
7-10: Antec FiberWorks training course, fiber-optic systems, Antec training center, Denver. Contact (800) FIBER ME.
7-10: Siecor training course, fiber-optic installation for LANs, Rochester, NY. Contact (800) 743-2671, ext. 5539.
7-10: Siecor training course, fiber-optic installation for LANs, Albuquerque, NM. Contact (800) 743-2671, ext. 5539.
8: SCTE North Country Chapter seminar, BCT/E Category II tutorial, video/audio signals and BCT/E Category IV tutorial, distribution systems, Anoka Technical College, Wadena, MN. Contact Bill Davis, (612) 646-8755.
8-9: Scientific-Atlanta technical training seminar, planning for cable telephony, St. Louis, MO. Contact Bridget Lanham, (800) 722-2009, press 3.
8-10: SCTE regional training seminar, introduction to fiber optics, Quality Hotel Central, Phoenix, AZ. Contact SCTE national headquarters, (610) 363-6888.
9: SCTE Satellite Tele-Seminar Program, *Interdiction and Other Signal Security Techniques (Part II)* from Expo '91, and *CLI—Now and Tomorrow (Part 1)* from Expo '94, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m ET. Contact SCTE national headquarters, (610) 363-6888.
13-15: Siecor training course, passive fiber-optic system design for LANs, Hickory, NC. Contact (800) 743-2671, ext. 5539.
13-17: General Instrument training course, plant maintenance, proof-of-performance and signal leakage training (week one), Seattle, WA. Contact Lisa Nagel, (215) 830-5678.
13-17: General Instrument training course, broadband communications network design, Seattle, WA. Contact Lisa Nagel, (215) 830-5678.
13-17: Siecor training course, fiber-optic installation for LANs, Hickory, NC. Contact (800) 743-2671, ext. 5539.
14: SCTE Cascade Range Chapter seminar, Wilsonville Holiday Inn, Wilsonville, OR. Contact Cindy Welsh, (503) 667-9390, ext. 226.
14: SCTE Michiana Chapter seminar, standby powering and status monitoring, Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.
14: SCTE Great Plains Chapter Third Annual Vendors Day and Workshop, Holiday Inn Central, Omaha, NE. Contact (402) 393-3950.

Planning Ahead

June 10-13: SCTE Cable-Tec Expo, Nashville, TN. Contact SCTE national headquarters, (610) 363-6888.
June 26-28: Global DBS Summit, Denver. Contact Global Exposition Holdings, (713) 342-9826.
July 10-12: WCA '96, Colorado Convention Center, Denver. Contact Wireless Cable Association, (202) 452-7823.
Oct. 13-15: Atlantic Cable Show, Baltimore, MD. Contact Cable Television Association of Maryland, Delaware, D.C., (410) 266-9111.

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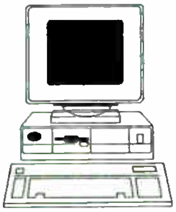

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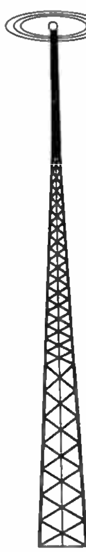

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Return path

(Continued from page 80)

Jones has already replaced old drops as part of the rebuild of Alexandria, or if they are at all suspect at the time the Internet connection is made, they are immediately replaced.

So what about the butter knife wielding customer playing amateur installer? In Alexandria, they are attempting to make subscribers part of the solution. The system has a special Jones Internet Channel staff that includes a computer-literate installer who warns customers that if they add anything or change the installation (whether it be on their TV set receiving cable TV services or their computer receiving an Internet connection from the cable company), they could very well affect speed or quality of any of their services.

Despite the issues of the return, people like Mike Heinze of Horizon Cablevision in Charlotte, MI, are very confident about cable's ability to get it right. His 30,000-sub system (of which 20,000 are attached to the HFC network) is presently testing data services to 12 schools and 12 residential customers.

"As cable operators bring up the return plant, as they learn to maintain it, it'll be just a migration we'll deal with. It'll be a learning curve of a year or two to really get on top of it, but technically, it's do-able," says Heinze.

TW's Staniec echoes the sentiment. "Having built and operated corporate telecommunications networks in this environment for 15 some-odd years, I know that it can be done."

Staniec's advice is that if you've never operated return networks before, then you should get the equipment, put it up and start working with it even if you don't have any communications equipment to put into it. "You physically have to see this, feel it, touch it, turn it on and play with it," he says, "Just put it up so you can begin to understand the animal."

For more information: If you are a CableLabs member and interested in the report mentioned in this article, "Two-Way Cable Television System Characterization," call the Labs at (303) 661-9100 for details on obtaining a copy.

Tom Staniec of Time Warner's Excalibur Group, who was quoted in this article, will be offering a presentation along with Coaxial International's Ron Hranac at this year's Cable-Tec Expo in Nashville, TN, detailing concerns of the return path. **CT**

By Rex Porter

Trivia quiz #7

Our historical guru 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 86 of the March 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 an industry-related novelty prize (e.g., cap, water bottle, T-shirt).

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

Trivia #6 answers

1) Mini-Hub
2) Al Warren
3) Mary White
4) Dynafoam
5) G-Line
6) Jack Kent Cooke
7) Roger Wilson
8) CNN
9) RMS
10) Gail Sermersheim

By the way, if you thought Question 1 was really hard in March, it might have been because we goofed and didn't include the correct answer in the possible multiple choice answers. (Mini-Hub is the correct answer as listed above.) We apologize if this caused any confusion and thank everyone who pointed out the oversight.

Trivia #7

A special note of thanks for some questions in this quiz goes to Neil Serafin of Cable TV Supply in Denver.

1) He had a cable tower for a torso, TV picture-tube for a head, and curly drop cables for arms. The cable industry stopped using him as the symbol for cable TV because he too closely resembled the caricature used by the REA. His name was:
A) Antenna Andy
B) RF Plenty
C) Able Cable
D) TV Cable

2) The cable amplifier manufacturer which introduced the chip to the cable industry was:
A) Vikoa
B) Entron
C) Jerrold
D) Anaconda

3) The model number of the single-ended line extender manufactured by TOCOM was:
A) 237F
B) 300P
C) 280D
D) 440L

4) An early New Jersey-based manufacturer of trunk/feeder/drop cables was:
A) Entron
B) Cerro
C) Vitek
D) Times

5) General Instruments' interactive 24-channel system was known as:
A) Omni-com
B) Communicom
C) Compucon
D) View-All

6) CATV equipment manufacturer's SKL was an abbreviation for:
A) Satcom Kemper
B) Sammons Krone Laboratories
C) Scott Kable Ltd.
D) Spencer Kennedy Laboratories

7) New York-based passive products were named after this mammal:
A) Dolphin
B) Cheetah
C) Puma
D) Tiger

8) The Texas-based manufacturer that featured a revolving video camera observing weather instruments was:
A) Tomco
B) Weatherscan
C) Taco
D) Fannon

9) The original cable franchisee of Ft. Worth, TX, was:
A) Sammons
B) Ft. Worth Star-Telegram
C) TCI
D) Teleprompter

10) The Federal Communications Commission gave this network special permission to operate a cable system in Hurst, Texas:
A) ABC
B) NBC
C) CBS
D) PBS

And the winners are ...

Congratulations to our two winners of "Cable Trivia" #6: Jake Landrum of Mid-Coast Cable TV and Neil Phillips of Signal Vision.

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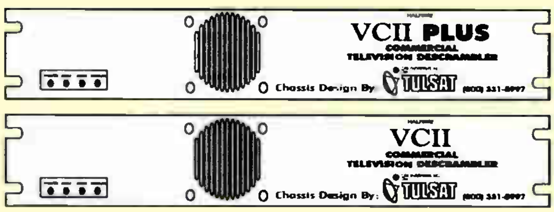

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By Bill Riker

Coming soon: Cable-Tec Expo '96

As you may have already seen in our advertisements in *Communications Technology*, this year's Cable-Tec Expo will be held June 10-13 at the Opryland Hotel in Nashville, TN, the site of Cable-Tec Expo '84 and the 1990 Expo Evening.

On June 9, we will offer Preconference Tutorials to those who arrive in Nashville early. These tutorials will cover Broadband Communications Technician/Engineer (BCT/E) technical certification, audio quality, interfacing with consumer equipment in light of the newly-passed telecommunications bill and how to justify technical training in your company's annual budget. Also scheduled for June 9 are meetings of the Society's Engineering Subcommittees, which currently are developing technical standards for the industry.

Cable-Tec Expo '96 will officially commence on June 10 with our 20th Annual Engineering Conference, offering four panel discussions on issues that confront today's broadband professionals, such as fiber optics, return spectrum, video transport and data over cable. The next two days of Expo '96 will offer breakout workshops on a variety of topics including cost analysis of system rebuilds, data transmission, digital technology, in-home wiring, making two-way communication work, network architectures, network management, powering issues, regulatory issues and telephony. In an industry that is moving so rapidly into previously uncharted territory, it pays to stay current with the changing technology, and new developments and regulatory issues that are on the horizon. Cable-Tec Expo '96 will offer its attendees this opportunity.

Registration packages were mailed out in mid-March, and the deadline for pre-registration is May 1. If you haven't registered by this date, remember you can still register on-site. After all, you don't want to miss the industry's premiere cable hardware trade show and all of the vitally important technical information that will be presented at the conference and workshops!

Over the years, as Cable-Tec Expo has dramatically increased in size and attendance, we have found that the show has outgrown many convention locations in the U.S. In fact, it is only due to the Opryland Hotel's recent expansion that they are able to accommodate a show the size of Cable-Tec Expo.

Cable-Tec Expo '96 will be the first convention held in the newly-expanded Opryland Hotel Convention Center. This expansion has resulted in one of the world's largest hotel/convention centers, offering a total of over 600,000 square feet of meeting and exhibit space. The hotel's new Delta Region is being constructed under a glass dome and will boast lush surroundings including a 4-1/2 acre indoor garden, a river and a 110 foot-wide waterfall.

During the September Board of Directors' meeting, Board members were given a tour of the new facility and had an opportunity to see all that this location will have to offer convention-goers. They were very pleased with the site, as it will comfortably house Cable-Tec Expo '96 and provide attendees with all of the amenities that travelers could need in one location. The hotel offers over 15 restaurants and lounges, 22 retail shops and a large staff that specializes in convention service.

In addition, there are many nearby activities for visitors. Nashville's local attractions offers a variety of diversions, such as playing at the 18-hole championship Springhouse Golf Club, enjoying rides and music at the world-class Opryland USA theme park,

hearing the best in country music at the internationally famous Grand Ole Opry, riding the General Jackson Showboat (the world's largest at over 300 feet long), being part of a live studio audience at the Nashville Network, or touring historic Ryman Auditorium, the original location of the Grand Ole Opry.

Coinciding with Cable-Tec Expo '96 is the Nashville country music event, Fan Fair. Top names in country music entertainment will converge in Nashville for concerts and festivities to be enjoyed by country music fans from across the nation. Nashville, so well-known for its musical heritage, will host numerous country stars during this event organized specifically for the fans. Several of these stars will be staying at the Opryland Hotel, so keep your eyes peeled and cameras ready for opportunities to mingle with top country performers.

The theme of southern hospitality also will play into this year's Expo Evening, which will be a country street fair.

The Society strongly encourages anyone not already registered to make plans to attend this premiere broadband telecommunications hardware trade show. You don't want to miss out on the technical education event of the year, so I hope to see you there! **CT**

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

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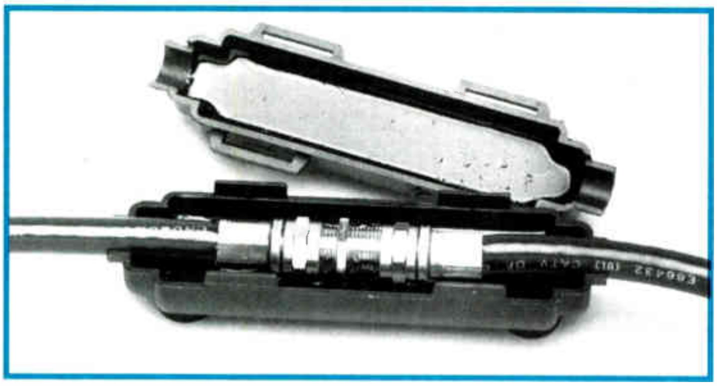

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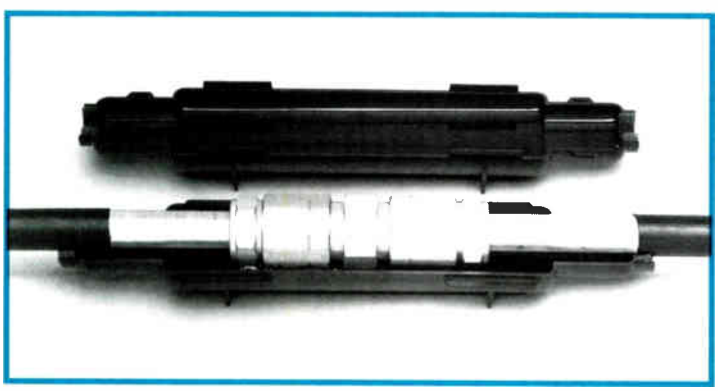

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