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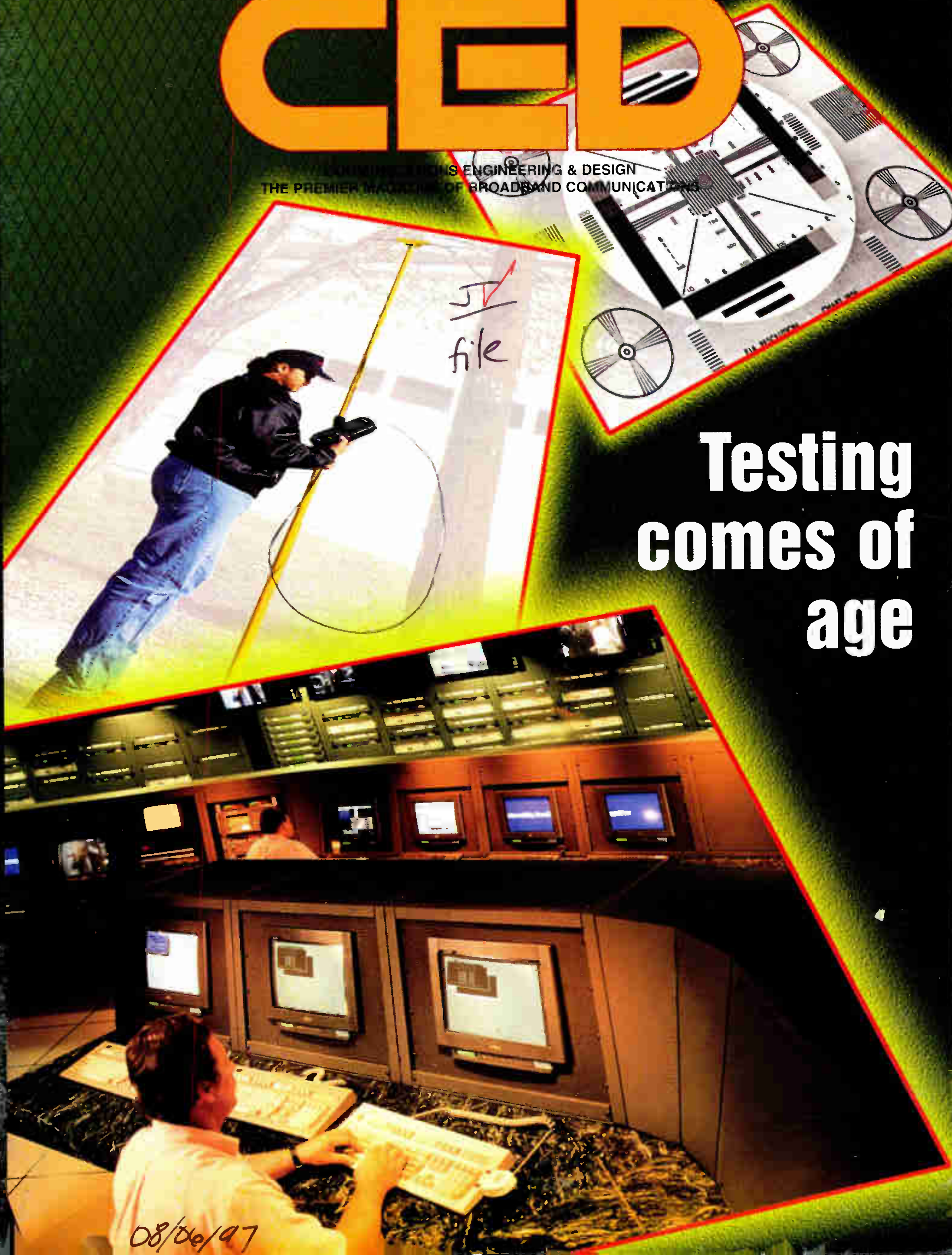

Testing comes of age

DBS competition and the great smokescreen

A recent newspaper article documenting the next moves of EchoStar and Charlie Ergen, the aggressive CEO of the upstart DBS company, pointed out his resilience and dogged determination to take on his DBS brethren, as well as the cable industry at large. The article suggested that, despite seemingly insurmountable odds, huge capital start-up costs and a quick divorce from Rupert Murdoch's News Corp., that EchoStar eagerly awaits the launch of two new satellites.

Get real, Charlie.

Yes, it's true EchoStar did manage to coax another $375 million out of its investors–money that will be used to build and launch those two satellites. "The first technology to deliver 500 channels will be Echostar's," Ergen reportedly boasted to reporters, mocking John Malone's famous 1992 promise that has gone unfulfilled by TCI.

Surely Ergen has done an impressive sales job. He has managed to put the most positive spin on an industry that is, frankly, rapidly driving itself into the ground. I offer as evidence:

✔ Competition has driven prices to the floor much faster than anyone anticipated. Remember when DirecTV hardware cost $700? Now, it's around $100. In fact, EchoStar loses $200 to $300 every time it sells a dish.

✔ DBS providers can't offer local broadcast signals, which causes potential buyers to pause. Why buy a dish when you need a broadcast antenna, too? The only way around this is a government OK–which takes time, money, and still isn't a sure thing.

✔ Even in the midst of a huge economic boom, with prices hovering around $100, dish sales have fallen off significantly. In fact, forecasts by Tom Kerver at *Cablevision magazine* suggest that by the end of the year, there will be just six million DBS subscribers, and two million of those will be PrimeStar subscribers.

But perhaps there was no single more telling event than Bill Gates' bet on cable TV technology. His decision to cut Comcast a $1 billion check speaks volumes about his view of a need for a broadband, wired world. He wants to sell more software, offer high-speed data and provide content we all turn to on a daily basis. He didn't choose a satellite provider to do that.

EchoStar needed the cash that Rupert Murdoch promised to bring. Malone's ability to quash that deal and plow the cash into PrimeStar instead could be a stroke of genius, because it's doubtful that the market can support three major players. Look for EchoStar's assets and satellite slots to be acquired by DirecTV, especially if Ergen continues to pull off his magic act and make EchoStar appear larger than life.

One billion dollars is a big bet. But don't think for a minute Gates made the gamble without a good deal of scrutiny. For all the noise DBS has made, I think it shall remain stuck in geosynchronous orbit.

Roger J. Brown

Roger Brown
Editor

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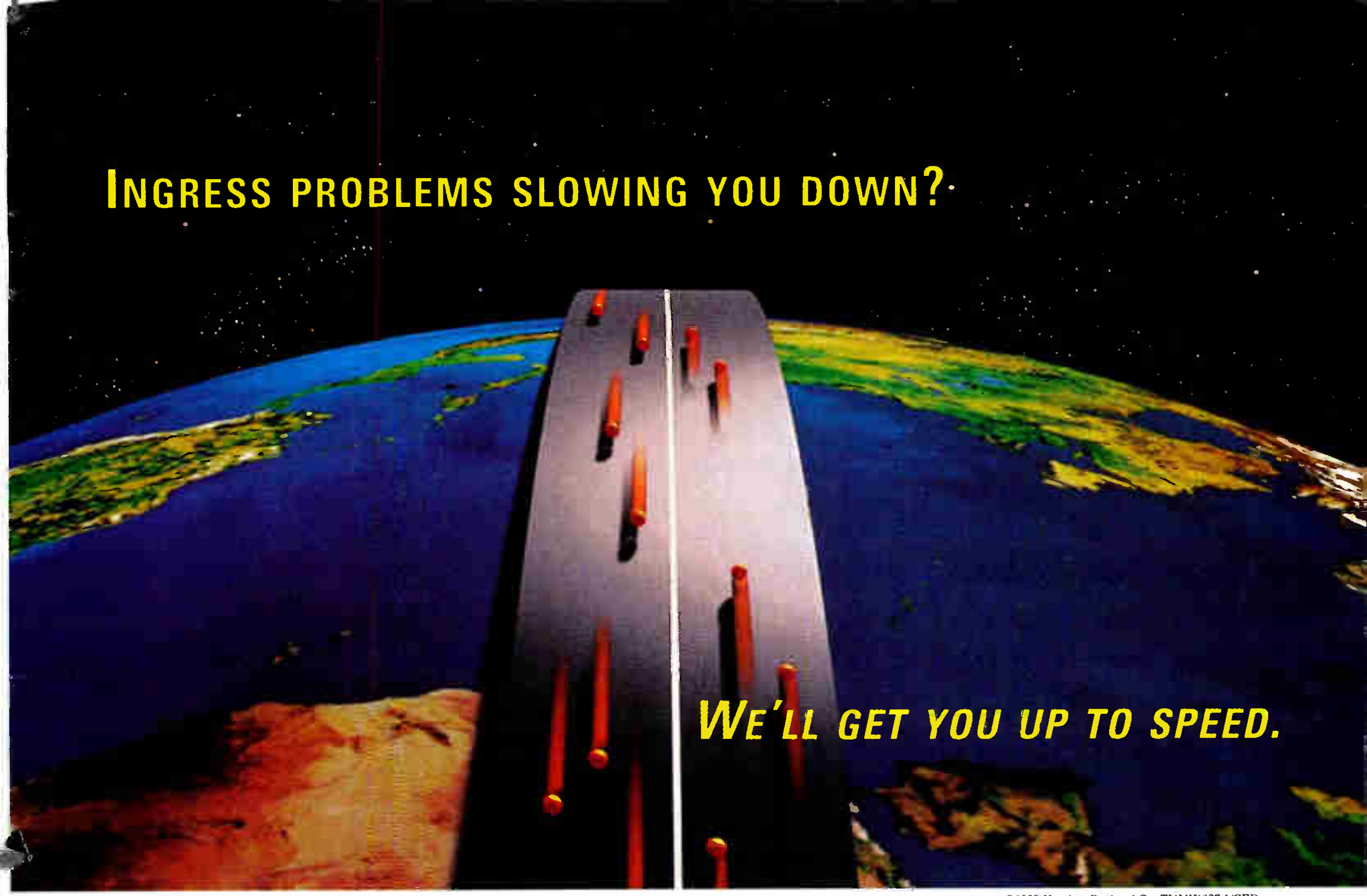

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Broadcom delivers MCNS-compliant modem prototype gear for testing

Chip-maker Broadcom Corp. in late June delivered the first MCNS-compliant cable modem prototype equipment to Cable Television Laboratories for evaluation, allowing CableLabs to accelerate the process of evaluating the interoperability and performance of the MCNS data-over-cable service interface specification (DOCSIS).

The specification is the key to offering high-speed data services over cable networks to interoperable modems that reside in consumers' homes. Cable operators plan to make those modems available at retail outlets to allow "plug-and-play" interoperability, regardless of which cable system a subscriber resides in. MSOs hope to be able to offer such hardware to consumers in 1998.

Broadcom delivered equipment compliant with the ITU Annex B physical layer. The company's QAM modulator-demodulator pair is part of the CableLabs Interoperability Incubator project, which was established to evaluate the interoperability and compliance of modems. The specification, written by the members of MCNS (Multimedia Cable Networks System), defines the characteristics of the RF interface, the message sets and the signaling sequences between the headend and the modems.

Broadcom is helping CableLabs define the physical (PHY) and media access control (MAC) testing parameters by providing programmable hardware and software to test the modems, and an on-site engineer. The company is also developing a cable modem reference system, which is a complete MAC and PHY implementation of the cable modem termination system and modem. This will allow CableLabs to test performance and compliance and provide developers with a reference design.

Several modem manufacturers, including 3Com, Bay Networks, Cisco Systems, Com21, General Instrument and Scientific-Atlanta are developing equipment based on Broadcom silicon and reference design. MCNS, MediaOne, Rogers Cablesystems and CableLabs make up the DOCSIS working group. MCNS is composed of TCI, Comcast, Cox and Time Warner Cable.

GI to build VSB-to-QAM device

In order to fill a major hardware void in the deployment of digital broadcast television, General Instrument Corp.'s NextLevel Broadband Networks Group intends to develop and manufacture a VSB-to-QAM transcoder that will allow cable operators to integrate digital broadcast signals into their existing channel lineups.

The hardware, which is expected to be available by year-end 1998, converts 8-VSB signals used by broadcasters into a quadrature amplitude modulated signal that is compatible with the digital systems cable operators are deploying. 8-VSB was chosen as part of the North American advanced television terrestrial standard. Cable operators have chosen to use QAM modulation because it's more efficient and allows them to offer more channels in each 6-MHz channel slot.

"When broadcasters begin transmitting these digital signals, the majority of viewers will be watching them over the same analog televisions that they use today," notes David Robinson, vice president and general manager of NextLevel's Digital Network System business unit. This system "will allow cable operators to offer these digital broadcasts to all of their customers, regardless of whether or not they go out and buy a new television set."

Cable operators will be able to interleave digital standard-definition TV signals into their existing channel lineups with either 64- or 256-QAM technology. For HDTV, an operator could choose to multiplex two HDTV signals over a single 256-QAM channel.

So, in spite of the fact that programming will come from a variety of sources and formats, the transcoder will enable customers to receive all programming in one package. This will allow consumers to switch between programs from different sources and navigate via a single program guide, according to NextLevel officials.

TCI launches telephony through Japanese partner

Seeking experience in the telephony business, but stymied in the United States, Tele-Communications Inc.'s Jupiter Telecommunications subsidiary launched telephony in Japan last month through its cable system, which operates as J-COM Suginami.

The digital telephony service, known as "CablePhone," follows J-COM's successful telephony trials and complements the multichannel cable TV product which has been in operation for almost two years.

J-COM Suginami will be competing directly with the long-time, dominant Nippon Telegraph and Telephone Corp. (NTT). However, where NTT has a sign-up fee of Yen 72,000 (U.S. $720), J-COM has none. In addition, J-COM Suginami is offering its customers a minimum of 15 percent savings over NTT on every call to non-cellular phones, and up to 40 percent savings on weekday, daytime, long distance calls. Monthly line rentals will be 24 percent less than NTT; customers subscribing to both cable TV and CablePhone will receive an additional 12 percent discount.

J-COM Suginami directly connects residences and businesses in its suburban Tokyo service area to its digitally switched services, and processes calls worldwide through interconnects to NTT and to international long distance, cellular and regional service providers. This is the first time a competitor to NTT has been able to supply this level of service.

Wayne Gowen, TCI International's senior vice president, telecommunications, added: "This is Japan's first full, local telephony service in combination with cable, and is reminiscent of our operations in the U.K., where we have achieved 30 percent telephony penetration. It is a breakthrough service in deregulating the Japanese marketplace."

Jupiter is a 60/40 joint venture between Sumitomo Corp. and Tele-Communications International Inc. It was formed in 1995 and is the largest cable multiple systems operator in Japan. Its sister company, Jupiter Programming Co. Ltd., is a 50/50 joint venture of the same entities, created in 1996 to develop, manage and distribute television channels to cable and satellite networks in Japan.

Revenue from data expected to explode

Those who predict the imminent demise of the cable TV industry have another thing coming, according to a new study undertaken by the Strategis Group. While it's true there will be increased competition from Direct Broadcast Satellite (DBS) and Multichannel Multipoint Distribution Service (MMDS), cable operators are poised to garner significant new revenue streams from new services , including high-speed Internet access and digital tiers.

According to the study, cable operator revenue will top $43 billion in 2002, a $17 billion increase over the 1996 figure of $26 billion. Revenue per subscriber per month will leap from $34.90 in 1996 to $53.90 in 2002.

The Strategis Group projects cable modem subscribers will reach 6.3 million, and digital cable set-top subscribers will approach 14 million in the United States in 2002. These two revenue streams will account for $14.4 billion in operator revenue over the next five years.

Basic cable subscribers reached 62.8 million in 1996. The Strategis Group predicts that cable subscribers will increase to 67.9 million by year-end–an average annual growth rate of only 1.5 percent. Cable's main competitor, DBS, will experience a much greater average annual subscriber growth rate of 24 percent from 1997 to 2002. MMDS subscribers are forecast to grow from 1.1 million in 1996 to 3.7 million in 2002.

New automated software debuts for cable MSOs

Cable companies and advertising interconnects that are aggressively pursuing cable advertising sales may be interested in a new software package touted as the first totally integrated management information system that electronically links all critical business processes.

Dubbed "Paradigm," the software comes from Columbine JDS, the Golden, Colo.-based software developer. The initial release includes a suite of functions for cable networks, DBS and multichannel environments where total integration and automation are necessary. Paradigm integrates all business processes in a single relational database, so orders can be instantly booked, scheduled, and then aired as planned.

The software can create schedules for multi-time zones with real-time inventory control and customized programming capabilities. Composed of a number of modules built around and totally integrated into a central relational database, the software makes data available on a real-time basis to anyone in the organization who needs it, from sales representatives and program schedulers to billing personnel. E-mail integration keeps everyone informed on the status of the operation. Software modules are also available for the programming department, the sales department, the finance department and master control.

To date, salespeople have generally worked blind–generating proposals without having any real idea of inventory availability. This software provides access to up-to-the-minute inventory information while doing the proposal. The entire approval process is automated and can be handled electronically through e-mail. The traffic department also operates from the same database as sales, so when any information is entered into the system, it is immediately available to all other modules and never has to be re-entered.

Broadband CDMA gets tryout over phone

Efforts to provide narrowband providers with ever-more bandwidth continue. InterDigital Communications Corp. recently conducted live demonstrations of Broadband-Code Division Multiple Access (B-CDMA) wireless local loop technology at ISDN rates, using two video phones to transmit video images over-the-air.

B-CDMA's broader bandwidth is designed to permit advanced features such as ISDN and bandwidth-on-demand for services such as wireline quality voice, high-speed fax, data and multimedia, including video. This capability will enable carriers to deliver ISDN to the desktop in a fixed wireless application, and ultimately, in portable and mobile environments. The first field trials will begin later this year.

The demonstration of B-CDMA hardware is the result of a development and manufacturing agreement between InterDigital, Samsung and Siemens. The core technology was developed by InterDigital, while the hardware and software were developed using the engineering resources of all three companies.

B-CDMA technology is particularly suitable for areas where it is difficult or too expensive to lay cable. In congested urban areas, it eliminates the cost and disruption of physically laying new cable, while dramatically reducing the time required to generate revenue.

US West poised for cable, telephony

Despite persistent rumors of a merger or consolidation, US West is "the only company that has the prime location at the intersection of telephone and cable," and is "excited to be there," stockholders were told recently.

Richard McCormick, chairman and CEO, said the company is experiencing "tremendous growth in new uses for our telephone networks, in-region," and is "developing exciting new uses for cable networks, outside our region."

Company executives said they intend for US West to become a "one-stop shop" for telecommunications, offering traditional local POTS along with long distance (in 1998) and PCS services in 53 markets.

On the cable-TV side, officials described how cable customers are using high-speed Internet access to make their businesses more efficient and classrooms more effective, and emphasized society's shift to "electronic commerce." Americans are "sending more faxes than packages, more e-mail than regular mail," and visiting "more ATMs than tellers," they said. Stores' scanners send information directly to warehouses. Consumers are ordering record numbers of pay-per-view movies, and Internet usage is doubling every year, they added.

And yet, perhaps everything isn't rosy inside the RBOC. MCImetro Access Transmission Services formally asked to postpone its scheduled July 31, 1997 entry into the local residential telephone market in Colorado. MCI cited US West's current ordering system as unacceptable, inadequate and the primary cause for the delay.

MCI demonstrated the US West ordering system to staff members of the Colorado Public Utility Commission and the Office of Consumer Counsel, who witnessed the system's failures first-hand. "Not only did the system fail to work appropriately, but also significant information was missing, and it prevented MCI personnel from obtaining the customer records promised by US West's representatives," said Bill Levis, MCI regional director.

MCI says it attempted to use US West's ordering system, known as the interconnect mediated access ("IMA") system, but until recently, was stymied by US West officials. According to MCI, actual use of the system has shown that the deficiencies are even worse than expected.

Apparently, the system requires many manual transactions and is not in compliance with recent decisions by the Federal Communications Commission. US West has filed for a waiver from the FCC's requirements for its system. US West reportedly advised MCI that it cannot provide an electronic interface until April 1998, six months later than US West's previous projection–and seven months after MCI's planned entry into the local residential market.

RCN, Boston agree on OVS arrangement

In what is the only accord of its kind in this country, RCN Corp. reached an agreement with the City of Boston that will allow it to provide video services to Boston residents under the Open Video System (OVS) provision of the Telecommunications Act of 1996. The pact will give residents a choice of cable providers, as well as innovative pack-

ages of local telephone, long distance and Internet services.

Under the deal, RCN will provide video as well as local and long-distance telephone service to Boston residents over its fiber optic network. During the two-year initial term of the OVS agreement, RCN intends to either negotiate a cable television franchise license or final OVS agreement. The agreement with the city of Boston follows the company's earlier approval by the FCC (granted in February) to conduct video operations as an OVS provider in Boston and 47 surrounding communities, subject to individual local approvals.

The Open Video System was specifically designed by the Congress and the FCC to encourage competition to local monopoly cable television providers. Among other things, the Act specifies local facilities-based providers of OVS and their programming customers may offer video programming in local communities without obtaining a traditional cable television franchise.

The RCN/Boston Edison joint venture currently offers Boston residents in some areas 73 basic channels and access to an additional 27 premium or pay-per-view channels.

RCN is the country's first and largest facilities-based telecommunications company to offer competitive local telephone, cable television and Internet access to the residential market over fiber optic networks.

LSI Logic develops digital chips for BBC

LSI Logic has reached an agreement with the BBC, the U.K. broadcaster, to jointly develop a single-chip digital terrestrial television solution.

With the United Kingdom, and many other European broadcasters, slated to deploy digital terrestrial programs over the next few years, a silicon-based solution will soon be necessary. According to Dataquest, in Europe alone, 237 million households currently view terrestrial broadcasts via their existing TV antennas. Another major market, Japan, is currently developing its plans for digital terrestrial TV broadcast.

The LSI Logic demodulation chip, and others like it, will be at the center of new digital terrestrial set-top boxes and TVs using existing TV antennas. The chip receives digital terrestrial broadcast signals, then processes them to form a digital data stream. The new chip that is under development will be fully compliant to the European Digital Video Broadcast (DVB) terrestrial standard.

Working closely with the BBC, LSI Logic will implement the required demodulation technology using its CoreWare design program and advanced, deep sub-micron ASIC process technology. The L64780 is being developed at LSI Logic's design center in Paris.

"We are working exclusively with LSI Logic on this chip because of their expertise and market presence in designing and producing high-volume integrated circuits for the digital broadcast industry. With their proven technology and CoreWare methodology, LSI Logic is able to implement a very complex design into a highly integrated system on a chip," said Dr. Ian Jenkins, controller of New Technologies, BBC.

First samples of the chip will be available in January 1998, together with an evaluation board. The board will include the L64780, software drivers and a tuner module, and will be available as a daughter card to the existing Integra evaluation platform.

Wink gets thumbs-up from NBC and HITS

Wink Communications received a strong endorsement from two major programmers recently, forging deals with both NBC and TCI's Headend In The Sky to encode portions of their programs with the interactive TV engine.

NBC will add interactivity to prime-time entertainment, weekend sports and other informational programming in the fall of 1997, using the Wink ITV Enhanced Broadcasting method, and will offer advertisers interactive commercial opportunities.

Wink ITV–which works with broadcast, cable and satellite signals–will provide NBC with increased revenue opportunities through new advertising streams and transaction capabilities. The technology allows broadcasters and advertisers to add enhancements to broadcasts, allowing viewers to interact with such features as on-demand plot summaries, trivia quizzes, profiles of athletes, actors and other program participants, sports scores and other statistics, viewer polls, and other interactive programming.

Transactional elements will be added to both program and advertising content via such applications as brochure, coupon and product sample requests, merchandise order forms, and other direct response, enhanced options.

TCI is rolling the system out in two markets: Fremont, Calif., and Arlington Heights, Ill., and plans to study the technical, content and marketing aspects of the system. Wink-enhanced programs will be offered in these markets as part of TCI's digital cable TV service offering.

Wink technology has been adopted by three set-top box manufacturers (General Instrument, Scientific-Atlanta and Pioneer) and is a standard feature on Japanese TV sets. The technology will be added to U.S. television sets in 1998.

NBC's Wink-enhanced program elements will be able to be viewed atop the TV broadcast or cable picture in an interactive graphical overlay, with which viewers can interact using existing set-top box and television remote controls. The Wink ITV platform allows NBC to package interactive value-added information that doesn't require viewers to tune away from their favorite shows or commercials to access these enhanced features.

Jottings

After purchasing the Comlux line of digital fiber optic gear a few years ago, **C-Cor Electronics** announced last month its intention to discontinue its digital fiber optic business as part of its efforts to cut overall costs. The digital business unit lost more than $2 million over the first three quarters of 1997, C-Cor officials said. The company's analog AM fiber product line remains intact . . . **Prime Cable** will purchase 30,000 high-speed comPORT cable modems from Com-21 over the next two years. Initial shipments took place in June. The two companies worked together to test the units in Prime's Las Vegas system . . . As a spin-off to **TCI's** relationship with **News Corp.**, the company's National Digital Television Center will purchase the ASkyB uplink facility in Gilbert, Ariz. and run it. The two facilities will offer similar services and act as back-up units to each other . . . **Time Warner Cable of New York City** is deploying a hardware platform consisting of gear from **SeaChange** and **IPC Interactive** to deliver video-on-demand movies to hotels in Manhattan. The network will give hotels access to video programs, guides, message systems and checkout, without the need for on-site hardware . . . **Soundview Technologies** of Greenwich, Conn., introduced its V Chip Converter, which gives TV viewers the option of blocking objectionable television programming. The set-top unit sells for about $60 . . . **Southern New England Telecommunications** has chosen to use **CableData's** Intelecable system to support its americast video service. The software supports billing and customer management functions . . . . CED

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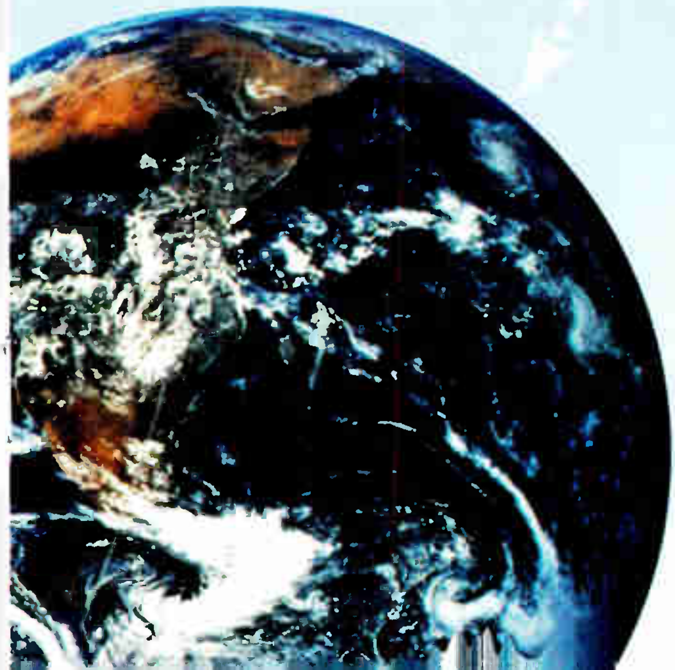

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Beddow plans own fireworks show

David Beddow

David Beddow is a man who likes to see things come to fruition. He made a promise to himself years ago that when the British gave Hong Kong back to the Chinese on July 1, 1997, he'd be there to witness it in person. And this past June, on the night of the 30th, there he was–sitting in a large sailboat in the dark waters of Victoria Bay, watching the fireworks and the hoopla. The following night, he watched as the Chinese had their turn at celebrating, as they ignited 100 million Hong Kong dollars' worth of fireworks from four barges in the bay.

Having spent a lot of time in Asia, Beddow felt a personal connection to Hong Kong's transition and wanted to see it with his own eyes, revealing a hunger for the tangible that carries over into his professional life as well.

"I like taking a concept to a reality," says Beddow. He's talking about his career, but he could be talking about his Hong Kong adventure. "The great part about start-up operations and projects is that you actually take something and make it real."

Today, as Senior Vice President, TCI Technology Ventures Inc., Beddow is seizing the opportunity to make a number of things "real." As he manages TCI's National Digital Television Center (NDTC) and Headend In The Sky (HITS), which provide production, origination, authorization, digital compression and transmission services to the cable satellite markets, Beddow emphasizes that his organization specializes in the *implementation* of technology.

"All too frequently, people look at new technology, and nothing ever gets implemented, because the next new thing is over the horizon," he explains. "At some point, you have to freeze it and do an implementation."

To that end, Beddow has a number of projects in the hopper, revolving around the application of new technology. Those include projects which relate to statistical multiplexing (improving transmission compression ratios), a PC data delivery service, next generation set-tops and some assignments for third-party clients.

And of course, signing up new affiliates for the HITS service is another priority. Those operators who have already committed to the service include Adelphia Cable Communications, FrontierVision Operating Partners LLC, Cablevision Systems Corp., Cox Communications Inc., Buford Television, and obviously, TCI. Additionally, the company has another 17 potential operators lined up, looking at the service.

From day to day, Beddow spends a lot of his time "in the planning process" looking for ways to expand the operation and attract new clients. In addition to his duties at HITS and the NDTC, he serves on the board of directors for TCI Satellite Entertainment Inc., Tempo Satellite Inc., United Video Satellite Group Inc. and PrimeStar Partners L.P.

From broadcasting to cable

Born and raised in Florida, Beddow started his career in communications as an engineer working at WUFT, an educational TV station owned by the state of Florida. In 1965, he moved to Rahall Broadcasting, and eventually joined Westinghouse Broadcasting and Cable (Group W) in 1968, where he would serve in a variety of positions, ranging from VP of Operations and Engineering to Executive VP of Group W Satellite Communications. During his tenure at Group W, the organization premiered satellite news channels, and was instrumental in the start-up of several regional cable sports channels.

His next move was to Satellite Television Corporation, a DBS venture which "failed to come together," notes Beddow, who nonetheless stayed on with one of the partners in the venture, Comsat, running Comsat Technical Services. The firm specialized in satellite construction monitoring, representing the likes of Intelsat, Arabsat and several military clients.

From there, Beddow joined PrimeStar as the organization's first employee–its chief operating officer. "In mid-'93, I had things at PrimeStar at a good point for a transition, and I left and came to TCI to really start all over again," he explains, "bringing the NDTC production and uplinking operations and the HITS structure on-board."

And now comes the ultimate start-up: digital video. "TCI is making digital available in about 95 percent of its subscriber base by the end of this year, which is going to position the company marvelously for '98," says Beddow. "That's a project my group is running. The initial rollout is three transponders, which is actually 42 channels, and we will add to that during the course of '98."

Asiaphile

Beddow's Hong Kong trip was actually the culmination of a lifelong fascination with the Orient. A devoted Asiaphile, he's been "running through" a series of fiction novels about Hong Kong in the last six months.

On the home front, he lives on a 326-acre ranch, located in Franktown, Colo. The ranch serves as a seasonal grazing area for 55 cows from a neighboring ranch, and coincidentally, features a view of the facilities of DirecTV, based nearby. "I keep an eye on them," he jokes.

Miles away from the homestead, Beddow has a daughter that he's "very proud of" who takes after her entrepreneurial Dad. Daughter Elizabeth has formed her own networking consulting company and has just landed her first major client.

And like his daughter, Beddow is not afraid to be on the leading edge of technology, as TCI has been in the implementation of digital. As for the future, "A whole bunch of people are going to jump into the (digital) pot, probably second quarter of '98," he predicts, "and that is going to spell great things for the cable industry."

–Dana Cervenka

How about a data guide clearing-house?

By Wendell Bailey, VP of Science and Technology, NCTA

How about a new business opportunity? I'm not in the habit of throwing out ideas for the next millionaire to use to start a new enterprise, but occasionally, an idea pops up that simply cannot be denied.

Ever since the cable television industry began its most earnest discussions about the coming world of digitally-compressed video offerings, one question has been asked (mostly by yours truly) several hundred times: how, exactly, do we expect our subscribers to find what they wish to see on a system with hundreds of channels? The ever-vigilant hardware community either heard me or (more likely) figured out for themselves that a program guide should be developed and built.

It is true that we have had such a thing since the days of 30-channel systems, but the need was for a new way of looking at the problem of channels, and along came several guides that, each in their own way, attempted to assist the viewer in the fulfillment of his couch-centric activities.

A constant battle

The world of video is now positively crowded with program guides of various sorts (both printed and electronic), and as far as I can tell, they all work well and provide a valuable and appreciated service. The primary source of information that all of the program guide providers use is channel lineups from specific systems.

There are approximately 11,500 cable systems in the U.S., and my guess is that they serve their subscribers with something approaching . . . well, I can't even think of how many different lineups are possible to choose from in a world that has 11,500 cable systems, 1,200 broadcasters, 150 satellite programmers and countless versions of PEG and local origination channels. It must be close to a unique lineup per system. I do know that there is an ongoing effort by some MSOs to standardize their lineups on certain tiers of service in all of their systems, but this only partially takes care of the problem. The number of permutations is still not only overwhelming, but also constantly changing.

The people who provide the guides fight a constant battle to contact as many of the systems as they can each month and update their data for the next "guide," either electronic or printed (as in a newspaper). This effort borders on the Herculean and is expensive to boot. You can also imagine that the employees at the system level get pretty tired of the dozens of different services or agencies that call each week or month to ask exactly the same set of questions about channel lineups. These facts are what led me to the idea of a business for some intrepid entrepreneur.

How about a company that collects the data (in this case, channel lineups) from all of the cable systems out there, and has as its clients the people who depend on the timely updating of this information on a system or regional basis? I'm sure that the managers at cable systems around the country would appreciate knowing that they have to call only *one* place to notify the guide companies. (Of course, they'd also appreciate that if they forgot to make such a call, only *one* person would be on their case for an update.) As for the collector of the data, the ability to make a direct data transfer to their (hundreds of) clients is an everyday thing for all of the companies that have as their core business the gathering of real-time data for third parties.

The competition knows the value of a guide

This enterprise would not only make it easier for the principals involved–just think of what it could do for the customer service image of the average cable system. One of the most common complaints I hear from people is that they have a hard time trusting the various guides that are available to them. What is the use, they ask, in having a couple of electronic guides, and several printed newspaper guides, plus a magazine or two, only to discover that they all show slightly different channel lineups? The actual pain comes not from being able to find a particular channel, so much as the opportunity of missing a once-in-a-lifetime program.

Guides take on a special significance in the world of hundreds of channels. Our competitors understand this very well. Take a look at the onscreen guide that the satellite providers use. The guide provider for this service has only one operator to contact, nationwide, so it is always up-to-date and accurate.

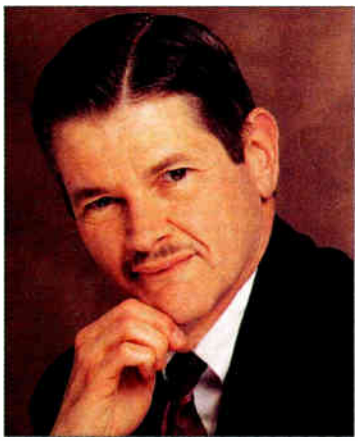
If there is anyone out there who has already had the idea to start a company like this, I apologize if I blew your cover. Sometimes, it just seems that the American cable television industry has to think of ideas and service efforts that benefit the subscriber by making it easier to accomplish the tasks that need to be done, so that we can provide a high-quality, useful product. The number of competitors that we are now facing who are constantly looking for ways to offer a service enhancement that our subscribers will find to be the defining difference is growing. These companies are always looking at us with a critical eye and asking themselves what it would take to make our customers happier than they are now. Once they see something, they look to see if they could provide that service in a cost-effective way.

The next thing you know, our customers want that, or something like that, or they will be unhappy. The other guys are able to more effectively consolidate the data for their guides, mostly because they have a limited number of systems to program, but I think that this might change, and if that's true, the need for a guide data clearinghouse will be even more valuable than even my humble opinion suggests. CED

Have a comment?

Contact Wendell via e-mail at: wbailey@prodigy.com

The more things in cable change...



By Jim Farmer, Chief Technical Officer, Antec

About the time you read this, I'll be over in Athens, Ga., getting, as they say, a son. Which is better than losing a daughter. So what does this have to do with cable television?

My wife and I were expecting Susan, our bride-to-be, when I entered the cable television industry *x* years ago (revealing the value of *x* is dangerous, even when it is more than 20 and less than 30). Oddly enough, my sentimental feelings for my daughter are leading me to think about changes in the cable industry during these intervening years. At least, this is the kind of thing I think of when I need a break from doing my part in the wedding: I'm told that my part is to keep quiet and pay. (Come to think of it, why do they call it "GIVING the bride away?" I'm paying for someone to take her.)

High bandwidth: 300 MHz

When I entered the cable industry, we were wondering if it was really possible to use the frequencies above 216 MHz (the high end of channel 13) for transmission of television. The mid band was being used. It was a good place to put premium channels (such as those that existed in pre-satellite days). Back then, there were no viable scrambling systems, though there were hundreds of patents on systems that didn't work. However, by transmitting in the mid band, you could control who received the picture, because no one could get it without a set-top convertor, which was only available through the cable operator.

We were moving toward 270 MHz systems, which were almost immediately replaced with 300 MHz systems. No one knew who would want such high bandwidth cable systems that could support 35 channels, because it was inconceivable that one could come up with programming to fill that much spectrum.

At the time, we didn't appreciate how much the cost of producing and distributing programs would drop as more programming was demanded to fill bandwidth. This resulted in economies of scale, which increased the demand for smaller, simpler and cheaper production equipment. We simply didn't appreciate the public's demand for what it wants to see, when it wants to see it.

I also remember a time when the private cable industry, which provided non-franchised cable television services to MDUs, claimed that they could make a good business on 20 or fewer channels. This claim was based on the observation that no single subscriber watches more than 20 channels. Of course, what that idea missed is that *you* may watch only 20 channels, and *I* may watch only 20 channels, but we don't watch the *same* 20 channels, so you need more than 20 channels to serve both of our interests.

If you plot the number of channels in common usage (that is, the number of channels available in a "typical" cable system, whatever that is), against the year when that number of channels became the norm, then extrapolate to see what will happen over the next few years, you will predict systems having well over 100 channels in the earliest years of the next century. Whether these channels are achieved with expanded bandwidth, or with digital compression, or with a combination of the two, is not the point. History suggests that we will be commonly offering many more than 100 channels around, or shortly after, the turn of the century.

We've seen other changes in the technology. There was a time when a technician was considered well equipped if he had a "field strength meter." I recall a customer calling one time about a picture problem. I asked the technician to measure a signal level. "I ain't got nothin' to do that with," he said. I asked him to check the frequency of a particular signal. "I ain't got nothin' to do that with," he said. "OK, let's go from the other end. What test equipment DO you have?"

"Aw, I got me an old voltmeter out in the truck, but the batteries ain't no good, and this old boy who was working here burned it out." Well, maybe the good old days weren't what they were cracked up to be.

That field strength meter was misnamed. It didn't measure field strength, which is a measure of the electromagnetic field strength of a signal at a particular location. It was really a frequency selective volt meter, which measured the RF voltage of a signal. If you connected it to an antenna having known characteristics, then measured the level of a signal the antenna picked up, you could compute the field strength. The meter by itself, though, didn't measure field strength, and was almost never used for that purpose. The more modern name, signal level meter, is more appropriate.

The fundamentals

The measurement tools available today are much better, but we will always need more. A lot of times, though, you can work around instrumentation problems by understanding what you need to do, and how the equipment really works. It can be hard, and slow. But it is often possible, and you will learn more when you work through the manual methods. You'll then be able to apply advanced instrumentation better when you get it.

There have been a lot of changes, but cable is still a fun place to work. Someone asked me recently why I had stayed in cable for so long. I couldn't really think of a logical reason, so I finally said something to the effect of, "You can take the boy out of cable, but you can't take the cable out of the boy." Hope you like it here as much as I do. CED

Have a comment?
Contact Jim via e-mail at:
jofarmer@mindspring.com

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Is HDTV doomed from the beginning?

By Jeffrey Krauss, interfacing with the digital world and President of Telecommunications and Technology Policy

HDTV is coming soon, both to broadcasting and to cable. But right now, there is no standard way to get the HDTV signal from the cable box to the HD receiver.

Twice before, I wrote about the digital baseband interface that was expected to connect digital TVs, VCRs and cable boxes. (See "Capital Currents," August 1996 and April 1995.) A year ago, I reported on a disagreement between two groups of TV manufacturers over which command language to use with this interface. Unfortunately, the disagreement still exists. There is no agreement on a standard. And time is running out.

The EIA established a standards committee, called R4.1, to develop a standard interface for a communications bus to interconnect a cluster of digital TVs, VCRs, camcorders, cable boxes and other devices in the home. Because of the high data rates involved (up to 38 Mbps on a 256 QAM cable channel), the group chose the EIA 1394 standard for the physical layer. This is also known in the computer industry as "FireWire."

The next step was to agree on a command language so that the various boxes could talk to one another. A command language is needed so that the devices in the cluster can share resources. For example, the digital VCR doesn't need MPEG decompression circuitry if the digital TV receiver has it. And the digital cable box doesn't need a tuner if the cable-ready TV has one.

The controversy

A year ago, it appeared that there were two candidates to be chosen as a command language, CAL and AV/C. CAL is the command language that was developed for CEBus, a consumer electronics network for audio/video and home automation. Thomson Consumer Electronics and Intel appear to be the main supporters of CAL.

AV/C is a command language that supports digital camcorders, TVs and VCRs. Its supporters include Sony, Philips and Mitsubishi.

Both groups claim they will have products on the market in early 1998 using their command language.

Of particular importance to the cable TV industry, CAL contains a group of commands specifically for cable boxes. AV/C is far more limited in scope. The relevant CAL commands could probably be ported or replicated in AV/C, but nobody has started that effort.

To further confuse the issue, a home automation company, Echelon, has suggested Java, a programming language used for Internet browsers and likely to be used for on-screen displays, as the command language instead of CAL or AV/C. (Java was originally written at Sun Microsystems for cable set-top boxes, according to a *Fortune* magazine article by Stewart Alsop.) Echelon had previously voiced objections to the use of CAL in TVs and cable boxes because it competes with a home automation network approach that Echelon uses.

The urgency

Home Box Office has announced that it will begin broadcasting HDTV movies in the summer of 1998. How will they be displayed? Here's a scenario.

HBO today delivers MPEG-compressed standard definition digital programming to cable headends. Most cable systems today decompress and convert them to analog and scramble them for delivery to the home. But so far, a few hundred thousand digital cable boxes have been delivered, and so some subscribers are receiving digital video down the cable. Because the programming is standard definition, not HD, it is decrypted and converted to analog in the cable box and displayed on an analog TV set. The digital baseband interface isn't needed.

The first digital HDTV receivers and VCRs will become available in 1998, at about the same time the first digital TV broadcasts start. The lack of agreement on a baseband interface won't be a calamity for viewers of broadcast signals, so long as consumers are careful to purchase an RCA (Thomson) digital VCR to connect an RCA digital TV, or a Sony VCR with a Sony TV.

But what about watching HBO's digital HDTV programming on the RCA or Sony TV? The signal has to go through a digital cable box to be decrypted. HBO's contracts with Hollywood won't allow them to deliver movies "in the clear" (unencrypted). So a cable-ready digital TV that has a QAM demodulator as well as a VSB demod might be able to demodulate the HBO digital signal, but it won't be able to decrypt it. A cable box is needed for that.

The digital cable boxes that are being shipped today do have a digital output port for delivering a decrypted signal to a digital TV. But the signal coming out of that port is simply a one-way digital bitstream on one pair of conductors, not the two-way FireWire network signal format, nor the FireWire physical connector. Presumably, cable box manufacturers waited as long as they could, but they had to start delivering boxes and couldn't wait any longer for the consumer electronics industry to reach agreement.

If and when the consumer electronics industry reaches agreement on an interface, I expect that it will also be incorporated into cable boxes. Meanwhile, how will we be able to watch HBO high definition movies? I don't know.

Maybe someone will build a special convertor box that converts the format of the digital bitstream coming out of the cable box to the FireWire format. I guess there will be two flavors of this box, one that speaks CAL and one that speaks AV/C. Or maybe someone will build a digital modulator box that takes the digital bitstream and modulates it to look like an 8 VSB broadcast signal on channel 3. Yuck!

My guess is that about a year from now, there will be a lot of finger-pointing, as everyone tries to blame everyone else. It won't be a good start for HDTV. CED

Have a comment?
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jkrauss@cpcug.org

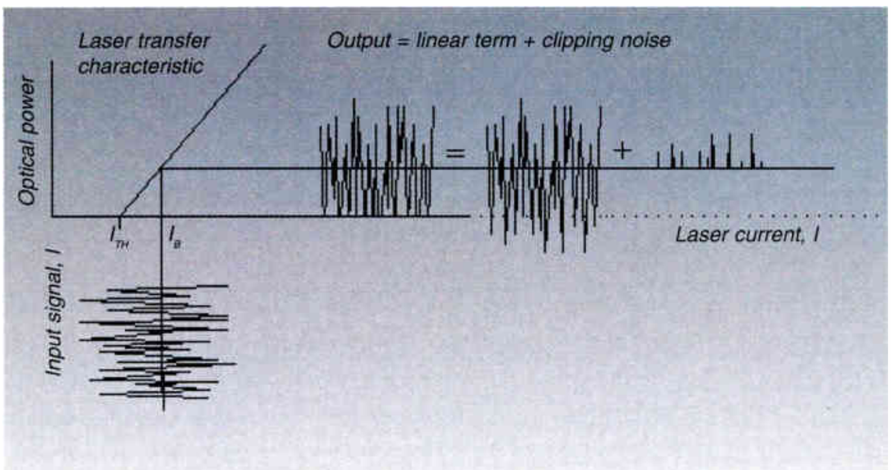
Composite power and reverse laser clipping

Forward path tests useless in return

By Lamar E. West, Senior Staff Engineer, Terrestrial Network Systems Division, Scientific-Atlanta Inc. e-mail: lamar.west@sciatl.com

Conventional design techniques for use with RF amplifiers have used multi-tone intermodulation distortion testing to determine the upper limits for signal handling capacity. A direct application of this technique to the upstream path in hybrid fiber/coax communication systems may result in erroneous limits for component performance. A description is given of the problems with this technique, and a more appropriate method is suggested. Several factors are discussed that discourage the "constant power-per-hertz" rule for assignment of subcarrier relative amplitudes on the reverse path.

Figure 1: Laser transfer characteristic. The laser output may be thought of as the sum of an ideal linear term plus a clipping noise term.



RF amplifier techniques

Previous methods of characterizing RF amplifier distortion performance in broadband subcarrier multiplexed (SCM) networks have centered around intermodulation distortion (IMD) as the limiting factor for performance. This is clearly the case for downstream applications where up to 110 conventional analog video carriers may populate the spectrum. In this case, composite triple beat (CTB) and composite second order (CSO) dominate the distortion power spectrum [1].

RF amplifiers used in broadband cable TV applications exhibit mild nonlinearities. Unfortunately, a frequency dependence exists in these nonlinearities that makes a full analytical treatment extremely challenging. A method of modeling these nonlinearities has been proposed by Chang [2] using a Volterra series model. However, in practice, we generally approximate the amplifier characteristic by means of a truncated Taylor series expansion and include the frequency dependence in the model by means of empirical measurement of CTB and CSO.

The truncated Taylor series model is of the form

$$V_0(t) = a_1 V_I(t) + a_2 V_I^2(t) + a_3 V_I^3(t) \quad (1)$$

Over the normal range of signal amplitudes, terms of order higher than three are sufficiently small so that they may be ignored. Additionally, AC coupling makes it possible to ignore any DC terms. The a_2 term is associated with second order IMD(CSO) and the a_3 term is associated with third order IMD (CTB).

Amplifier distortion is characterized using a spectrum of unmodulated (CW) carriers at a known power level. The distortion performance under power loading conditions may then be predicted based on the previous measurement. Power scaling for distortion performance using the "one-for-one" rule for CSO and the "two-for-one" rule for CTB has been described in detail in the previous cable TV literature [1].

This technique has also been used for characterizing RF amplifiers for use in the return (upstream) path for two-way RF cable TV networks. In the case of reverse path RF amplifiers, as in the case of forward path RF amplifiers, IMD is usually the primary factor limiting system performance. CW tones are used to characterize IMD performance in a manner similar to that used on the downstream path. Typically five or six tones, located at the picture carrier frequencies of the standard T-channels, are used for this characterization. When these amplifiers are loaded with signals other than conventional analog video, it is possible to predict performance based on the number and magnitude of individual distortion products measured during the characterization. Quite often the design guidelines are simplified to indicate that IMD performance may be predicted based solely on the composite RF power in any given 6 MHz T-channel band. In such a case, additional IMD products generated by replacing a single carrier with multiple carriers are ignored because of their small amplitude, as predicted by the truncated Taylor series expansion given in (1).

Laser characteristics

In the case of an optical link carrying broadband subcarrier multiplexed signals, system performance is

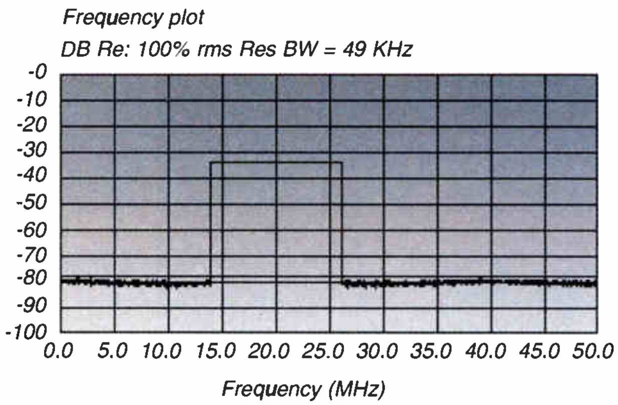


***Figure 2:** Laser clipping performance with 250 narrowband QPSK carriers present. Note that the carrier to clipping distortion ratio is 47 dB.*

also limited by distortion. However, in most reverse path optical links, the laser dynamic range is so small that this distortion is because of laser clipping.

Figure 1 shows the transfer characteristic for a typical laser. The laser optical output power is a function of the laser current. The laser is given a DC bias I_B. The signal current is summed with this DC bias current. Laser clipping occurs when the instantaneous laser drive current drops below the laser threshold current, I_{TH}. During such conditions, the laser optical output power goes to zero. The laser optical output may be thought of as the sum of an ideal, linear term and a clipping noise term.

Unlike the conventional cable TV broadband RF amplifier, the laser diode is essentially a memory-less (frequency independent) device over the frequency range of interest to the broadband hybrid fiber/coax (HFC) network designer. Therefore, it is completely appropriate to use the Taylor series expansion of the transfer characteristic to describe the laser. Unfortunately, because of the severe nonlinearity around I_{TH}, it is inappropriate to truncate the Taylor series representation of the laser after the third order term. Many higher order terms become quite significant in the transfer characteristic. A typical transfer characteristic is given by

$$V_0(t) = a_1V_i(t)+a_2V_i^2(t)+a_3V_i^3(t)+a_4V_i^4+\Lambda \qquad (2)$$

If we examine the laser drive signal for a laser in an upstream optical link, that current will be made up of the sum of the carriers to be sent over that link. In the case of the downstream path, we make measurements using a multi-tone generator (typically a Matrix generator). This multi-tone generator simulates the individual channel carriers with a CW signal (i.e. a sine wave). In such a case, the mathematical equivalent of our model would be

$$I = A\cos(2\pi f_1t+\Phi_1)+A\cos(2\pi f_2t+\Phi_2)+\cos(2\pi f_3t+\Phi_3)+\Lambda \qquad (3)$$

where A is the amplitude of all of the carriers (we assume a flat spectrum), f_1 is the frequency of the first carrier (for example, 55.25 MHz), ϕ_1 is the phase of the first carrier, f_2 is the frequency of the second carrier (for example, 61.25 MHz), ϕ_2 is the phase of the second carrier, etc.

We can make a similar model for signals in the upstream path. As a simple example, consider an upstream link that is carrying a single RF IPPV carrier and a single high-speed (T-1 = 1.554 Mbps) data carrier. As in the case of the downstream path, we will model the carriers as CW (sine waves). Our upstream model becomes

$$I = A_1\cos(2\pi f_1 t+\Phi_1)+A_2\cos(2\pi f_2 t+\Phi_2) \qquad (4)$$

where A_1 is the amplitude of the RF IPPV carrier, A_2 is the amplitude of the data carrier, f_1 is the frequency of the RF IPPV carrier, f_2 is the frequency of the data carrier, ϕ_1 is the phase of the RF IPPV carrier, and ϕ_2 is the phase of the data carrier. Plugging this equation for I into the Taylor series expansion shown in equation (2) would be a real mess. But this is what is required to model the laser with only two carriers applied.

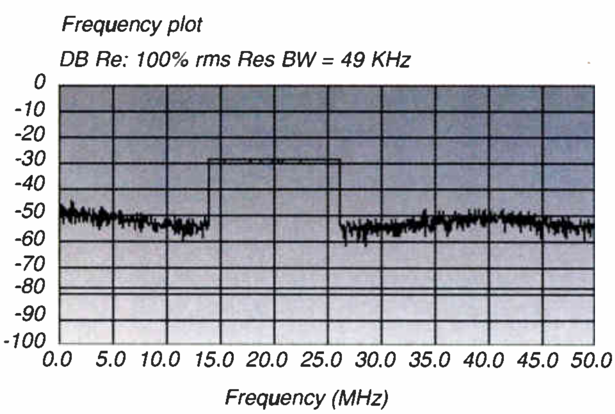


***Figure 3:** Laser clipping performance with 250 narrowband QPSK carriers present. Note that the carrier to clipping distortion ratio is 24 dB.*

Analysis

To make the analysis of laser clipping easier, a simulation tool has been developed that accurately models the laser transfer characteristic and determines the optical link output for a given input signal. As an example, a simulation of laser clipping effects was carried out. The laser was loaded with 250 narrowband (49.5 KHz) QPSK carriers centered at 20 MHz. The clipping performance is shown in Figure 2.

The resulting carrier-to-clipping distortion ratio is approximately 47 dB. The simulation was repeated with the carrier amplitudes increased by 6 dB. The result is shown in Figure 3.

The carrier-to-clipping distortion ratio is reduced to approximately 24 dB, a decrease of 23 dB! Clearly, the distortion does not follow the conventional one-for-one

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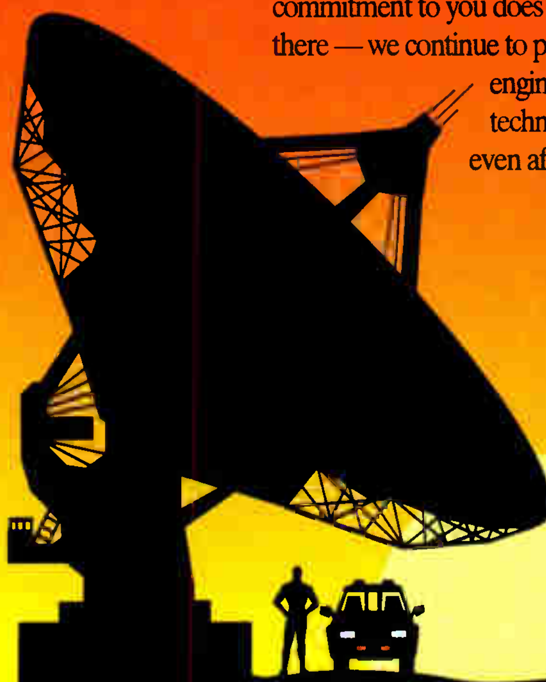

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The amplitude of the ingress is typically larger at the low end of the reverse band

often it crosses a particular value. Repeat this process for all of the values of interest and you have a PDF!

For instance, let us consider one of the five original test tones described in the example above. We calculate the normalized probability density function (PDF) for that tone. The PDF is shown in Figure 5.

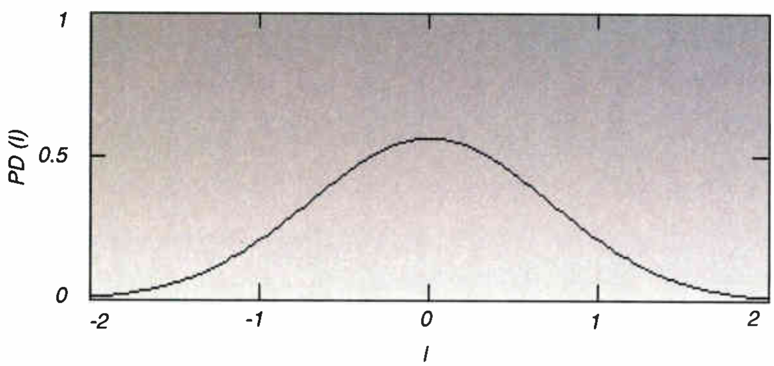
The PDF can be thought of as a histogram, indicating the time spent at any given current level. The peak excursion of the current of this single tone has been normalized to unity. Consider now the PDF of a group of 100 that results in a composite average power equal to the single carrier shown above. The PDF for this group of carriers is shown in Figure 6.

One can clearly see that the peak current excursions have dramatically increased with respect to that shown in Figure 5, despite the fact that the average power in the two cases is identical.

Other factors affecting power levels

There are several other factors that might result in a desire to violate the constant power-per-hertz rule. An initial problem results from the frequency dependence of the ingress noise accumulated from the coaxial portion of the network. Studies of ingress [4] have indicated that the amplitude of the ingress is typically larger at the low end of the reverse band. There is also a relationship with the frequencies of broadcast services, Ham and CB services. This ingress noise tends to color the overall noise characteristic of the reverse plant. Consequently, the subcarrier amplitudes should be appropriately adjusted.

Figure 6: PDF for 100 CW tones. Each tone is -20 dB with respect to the tone with PDF as shown in Figure 5.



Several types of services are expected to be carried on the HFC reverse path. Among these services are analog video back-haul, RFIPPV telemetry, telephony, high-speed data, video telephony, home communication terminal control and status monitoring. Different services may employ different modulation techniques, such as AM-vestigial sideband, FSK, QPSK, offset QPSK and QAM. Each of these modulation types has its own sensitivity to noise, above and beyond any differences that might result from bandwidth considerations. Additionally, each service may have its own unique Quality of Service (QoS) requirement. Therefore, subcarrier amplitudes must be adjusted to allocate the available dynamic range with these factors in mind.

Well-established techniques have been developed to determine the effect of Gaussian (thermal) noise on the BER of digital modulated subcarriers. However, it has been shown by Shi [5] that it is inappropriate to use these methods when the noise results from clipping. Shi's work demonstrates that clipping noise has an impact on BER that is a not simply a function of bandwidth considerations, as is the case with Gaussian noise. Additional subcarrier adjustments must be made for this effect.

Finally, headend considerations may impact subcarrier amplitudes. Certain reverse services are demodulated on an optical node-by-node basis. Typically, a separate telephony demodulator is supplied for the reverse output from each optical node. However, the reverse output of several nodes may be combined before demodulation for services such as RFIPPV. The noise funneling that results from this combining may result in a requirement to operate the subcarriers for such services at a substantially higher level than services that are demodulated on a node-by-node basis.

Conclusions

It has been shown that it can be misleading to utilize the multi-tone testing techniques developed for forward path characterization of RF amplifier performance when determining the performance of reverse path lasers in HFC networks. The five- (six-) tone method may still be used in the field for frequency response measurements. However, as a method to predict appropriate levels for plant operation, it may be extremely misleading (as shown above). There are several factors that make it inappropriate to use the "constant power-per-hertz" rule when determining the appropriate levels for reverse path subcarriers. CED

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Figure 1: Using a database for keeping good records of the equipment on each channel makes maintenance and repair easier.

Channel #	: 48	Letter	: A2	Rack location	: R10/1L
Visual freq.	: 109.2550 MHz	Aural freq.	:113.7550 MHz	Carrier level	: 30 dBmV
Main input video	: Cinemax			Main input audio	: Same
Alt. input video	: N/A			Alt. input audio	: N/A
Satellite receiver	: Y			Rack location	: R10/1 left
Satellite	: Galaxy 1			Transponder	:19
VideoCipher	: Y			Rack location	: R10/2
Address #	: A000C10XX			Serial #	: P00123456
Phone number	: 212-555-5666				
MVP	: Y			Rack location	: R10/3
Remote address	:785			Service code	: 023
Stereo generator	: Y			Rack location	: R10/4
Nustar insertion	: N			Switch number	: N/A
Commercial insertion	: N			Rack location	: N/A
Notes:					

picture gets brighter or darker, you are experiencing these distortions.

Have you ever watched a baseball game and noticed that the grass that's in the shadows of the stands appears greener in shadow than in light? This a differential gain problem. If the color of the grass shifts from green to blue-green from light to shadow, you are observing a differential phase problem. The eye tends to be very forgiving, so these distortions often go unnoticed. The 20 percent range for differential gain, and 10 percent for differential phase will probably not be noticed by most subscribers. Most modern equipment will easily pass the differential phase and gain tests when operating normally.

The other FCC color test is chrominance-to-luminance delay. It is considered a linear distortion. This is a measure of the time it takes for the color portion of a video signal (chrominance) to pass through a

Figure 2: A waveform monitor display shows peak-to-peak differential gain (chrominance filter on).

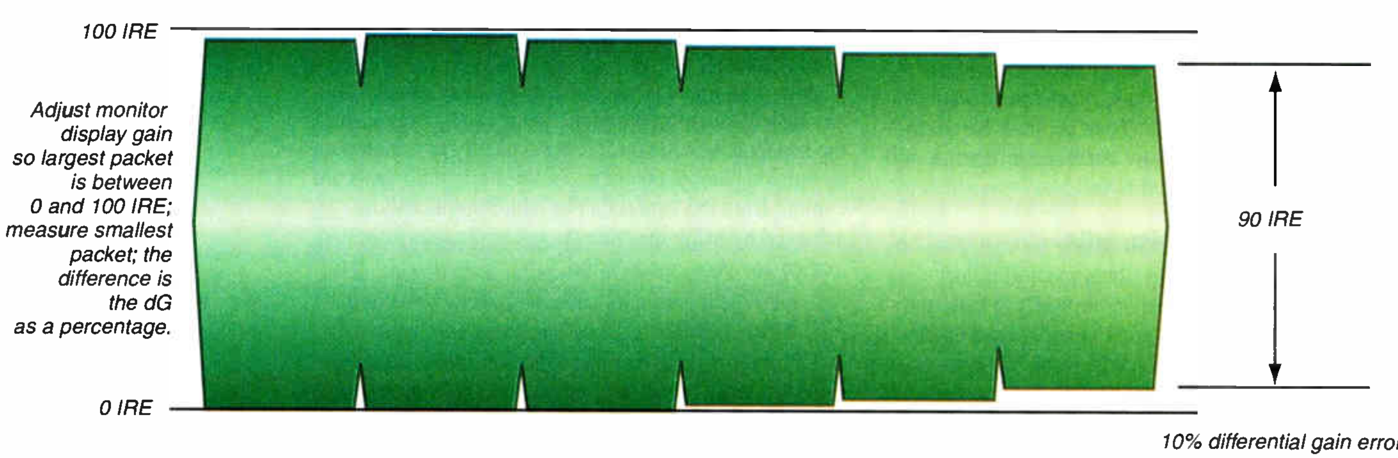

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Figure 3: *The FCC composite signal is recommended for making color tests because it has no components greater than 100 IRE.*

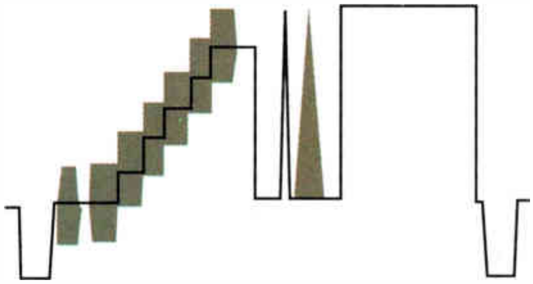
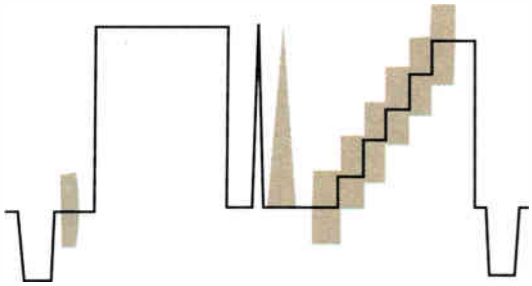


Figure 4: *The NTC7 composite signal has some limitations for making color tests because its staircase exceeds 100 IRE and can cause a properly adjusted modulator to momentarily overmodulate.*



system, and the time it takes for the black-and-white portion of the signal (luminance) to pass through a system. The amount of distortion is expressed in time in nanoseconds. If the number is positive, the chrominance is slower than the luminance. If the number is negative, the chrominance is faster.

Because the FCC used existing data about how cable TV equipment is constructed, the number was made very large–170 nS. As a result, a very large amount of distortion can be tolerated. Some manufacturers did not use pre-emphasis in their equipment, and therefore, their equipment would not pass if the number chosen was smaller. With this big number, the picture can be adversely affected even if the FCC requirement is met.

The picture will be affected by what appears to be a slight loss of focus or sharpness when the distortion is greater than 80 nS. By 170 nS there will be a noticeable shift in color. This is similar to a problem that sometimes plagues the comics section of the Sunday paper, when the colors are shifted outside the lines of the drawing. The author has observed graphics on "The Weather Channel," where the yellow of the sun was shifted to the right by more than half the diameter of the graphic!

Graphics and lettering are good places to see if you have a chroma-luma delay problem.

The appropriate test signal to make all the color measurements is the FCC Composite signal shown in Figure 3. You can use the NTC7 Composite signal shown in Figure 4, with certain limitations. A modulated staircase or modulated ramp signal can be used for differential gain and phase measurements. The FCC Composite is the best signal to use, because it is designed for transmitter measurements, while the NTC7 Composite signal is not.

Perhaps the most important video parameter is signal-to-noise ratio

If you use the NTC7 signal, you may get test differential gain and phase results that are not correct. With the NTC7 signal, the chrominance subcarrier is at a level greater than 1 volt (120 IRE units) on the uppermost modulated staircase step. The portion of the signal over 1 volt may be clipped in the modulator. This clipping will distort the signal, which in turn will indicate differential gain and phase error in a properly working demodulator. The chroma-luma delay measurement will be correct with either the NTC7 or FCC Composite signal. Another problem with the NTC7 Composite signal is rise times of the white bar are higher in frequency than the modulator is designed to pass, and will have overshoot and ringing.

In many cases the appropriate test signal can be found in the vertical interval of the video signal (VITS) under test. Where no VITS signal is available from the program supplier, you will need to provide a locally generated test signal, either full field (the picture is replaced by the test signal) or by using a VITS insertor (the test signal is added to the vertical interval).

There is an advantage in using the signal coming from the program source. You will know the performance through the entire signal path, which is just as your subscriber sees it. If a locally generated test signal is used, you have no idea of the performance of the equipment ahead of the point where it is injected into the system. If you have video equipment ahead of the modulator, go all the way back to the satellite, VideoCipher, or IRD output and connect the test signal there.

Other video parameters

In addition to the three color measurements required by the FCC, there are other video parameters you should check to assure you are providing the best possible picture to the subscriber. Perhaps the most important is video signal-to-noise ratio (SNR). While every cable technician is aware of the impact of carrier-to-noise, often there is little attention paid to the signal-to-noise performance of the signal coming into the headend. The program providers try to achieve a signal-to-noise level near 60 dB to the satellite uplink. Typically, you can expect to receive better than 50 dB SNR performance with an analog satellite receiver. Digital transmission is somewhat better and can approach the 60 dB number.

You should investigate pictures coming from the satellite that are less than 50 dB. Is there adequate signal reaching the satellite receiver? Are there problems at the dish? If the noise is coherent, that is, if it makes a discernible pattern in the picture, what is the source of the interference? A video measurement test set will allow you to make accurate signal-to-noise measurements.

Figure 5. The test tools used for measuring differential gain, phase and chroma-luma delay include a video measurement test set and a demodulator.

Video frequency response and K Factor can both cause picture effects that can be as serious as those measured in the color tests. Channel flatness should be within 3 dB. Video frequency response should be better. You should check the K Factor measurement, using the 2T Pulse that is part of the FCC and NTC7 Composite signal, for overshoot and ringing around the baseline of the pulse. Poor 2T response can result in fuzzy vertical edges color artifacts (often seen in multiple copies of VHS tapes).

Poor 2T response can result in fuzzy vertical edges color artifacts

These are only a few suggestions for optimizing headend performance. A review of good practice information available from the NCTA and CableLabs may help you identify and target a number of ways to improve your headend.

Every cable operator knows the importance of proper RF levels and system flatness, but audio and video levels at the headend are often overlooked or misunderstood. Checking these levels is part of a good maintenance routine.

In Part II of this series, we'll look at the importance of maintaining correct levels and more tips on fine-tuning the headend. CED

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Round and round the testing goes...

Operators detail testing concerns, hopes for more compact, versatile equipment

By Michael Lafferty

As new services make their way into the cable pipeline, the demand is building to develop comprehensive, effective and efficient (in both time and money) testing and measurement equipment, procedures and protocols.

While management keeps looking over their collective shoulders at the competition forming fast on the horizon, they're putting increasing pressure on their engineering professionals to get cracking on rolling out data communications (with or without cable modems), advanced analog or digital set-top deployments, new premium services, or God forbid, IP telephony!

As a result, engineers in the trenches, in all different sized systems, are struggling to stop leaks, block ingress, maintain demanding signal levels and deal with a whole host of related problems to keep their systems competitive.

CED queried a randomly-selected cross-section of engineering talent in the industry, from very small to very big systems, to see what common concerns, solutions and crystal ball predictions they might have when it comes to improving their systems' performance in this newly competitive environment. One operator, in fact, has taken the advanced testing task to heart and embarked on an aggressive effort to develop his own testing software/hardware product.

Respondents to this informal survey included:

Bill Bauer, owner, WinDBreak Cable, Harrison, Neb.

Saconna Blair, director of network management, Jones Intercable Inc., Englewood, Colo.

Jim Dupler, Midwest regional engineer, Rifkin & Associates, Mt. Vernon, Ill.

Hung Nguyen, senior staff engineer, Time Warner Cable, Denver, Colo.

Oleh Sniezko, director of transmission engineering, TCI Communications Inc., Denver, Colo.

Larry Warren, senior staff engineer, InterMedia Partners, Nashville, Tenn.

What follows is an edited transcript of interviews conducted individually.

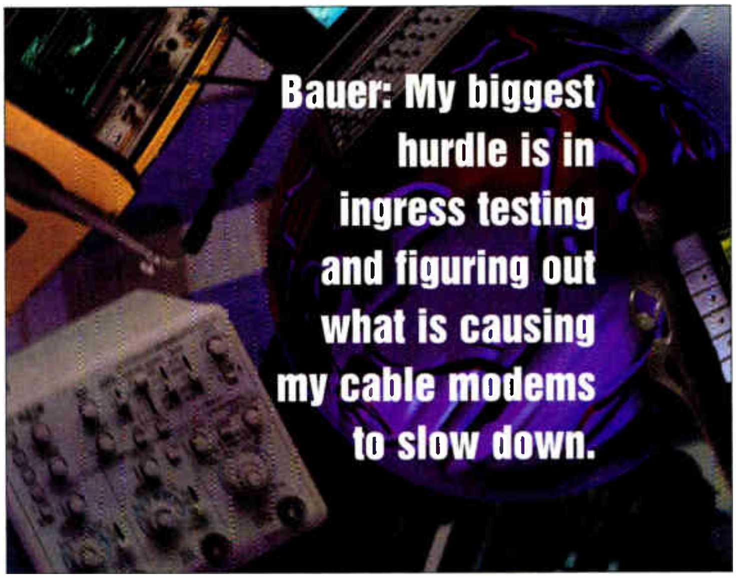
Testing concerns

CED: As far as testing goes, especially with all the new services being introduced into the cable pipeline, what are your biggest testing hurdles–short-term and long-term?

Blair: As far as short-term, we're really most concerned about the basics. When I say basics, we just like to make sure that every technician has equipment that can measure signals accurately and quickly and make assumptions. We still see the RF analog signals we're sending down as our primary concern. Long-term, there are probably two things. One is the return (path), and we just really don't know exactly where we're at with that. It's fuzzier, and it's more of a concern in the long-term. Second would be digital signals.

Dupler: Right now, we're doing a pretty good job on our forward plant. We've already got DMX and Sega and so forth out there. We've found a few little problems, but we were able to correct them relatively easily. Data brings its own problems.

But, I think if you just keep to the basics, keep on your leakage, keep an eye on your FCC proofs and everything, it's going to fall in line. I know we're going to start in our reverse path once we activate it. When we find the new business, we're going to go ahead and put the filters on the homes (that are) not taking any kind of reverse product.



Nguyen: Short-term and long-term, I think they're both the same. The biggest one is the return path testing. We're trying to develop a test procedure and trying to understand the effect of the lasers. Those are the big things right now. Both in the plan and the electronics. We really don't have any problem with the forward (path). We're doing OK with that.

Sniezko: Short-term is having inexpensive equipment to replace the link analyzer from HP. And the way we are doing this is trying to use sweep systems, but they don't give you full answers.

Long-term is to have a non-disruptive way of testing all the parameters we are interested in in the reverse path, including how much dynamic range or how far from distortion levels we are.

Warren: One (concern) is just getting our people, our technicians, up to speed on all the testing procedures they're going to have to learn. They're all used to using signal level meters, and some of them use spectrum analyzers and those types of things. It's going to take a different mentality I think to test for these new services. It's just a matter of training.

I don't see any transition problems. It's going to vary from system to system obviously. Some of the larger systems have people who are stronger technically than others. And it will be easier to bring those people up to speed. And we'll have to spend a little more time in those systems where we don't have a real strong technical staff.

Bauer: Short-term, my biggest hurdle is in ingress testing and figuring out what is

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causing my cable modems to slow down. The problem was that I couldn't come up with any way of finding out what was causing it. And, the only pieces of testing equipment that were available to me were $25,000 spectrum analyzers.

I assumed I had nice, clean plant. And the reality was that from a spectrum analyzer standpoint, I had a nice, clean plant. But that's not what was causing the problem. What was causing the problem was ingress that was very short duration, broadband, with a lot of energy in it. They were hits of several microseconds in length, but they would wipe out everything. Data would go through, but if you had these hits on a regular basis, you'd just be taking out a whole chunk of the data that was coming through.

The hits were frequent enough that it was probably slowing down my network by 20 to 30 percent. So, my short-term need was a piece of inexpensive equipment that told me what the problem was.

And that's what we've been working on to develop. (Currently) it's not everything I want because it's not in a nice handheld package, but it is inexpensive enough that I can afford it. It uses an off-the-shelf 60 MHz digital storage oscilloscope, my laptop computer, and the software we're developing. But it shows me what my problems are.

Once I've figured out what the problem is, I want to know where it's coming from. We have things that we're working on that will tell us that, but they're pretty preliminary.

Beyond that, I would like to understand that if I send out a packet of information, how many retransmissions did it incur before it got back to me.

That's the ultimate thing that I'm after here. I want to send out a packet of information, and I want it to bounce back to me, and I want to know whether it took some hits on the way. And I want it in a $2,500 handheld package that I can take anyplace.

I'd say we're 80 percent there. With this piece of equipment we've got and the other part that we're working on that identifies it, the last part would be to incorporate the cable modem analysis statistics into this.

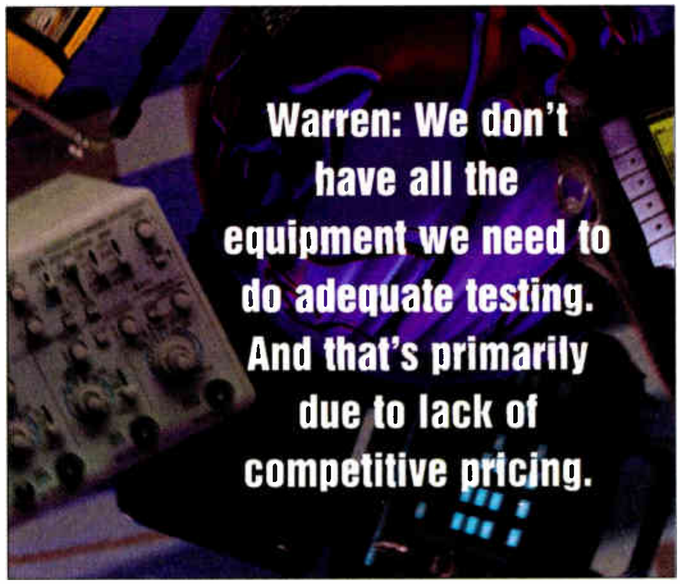
Is the equipment there?

CED: How are you fixed for test equipment? Do you have what you need? If not, why not?

Dupler: Yeah, I think the equipment is available. I think the one thing we're going to have to invest in is reverse sweep equipment. But that's coming on the market hot and heavy now.

It's pretty pricey. We're actually supposed to demo one vendor's unit here soon to see how well it works and everything. There are only two that I've actually looked at. One is in the $40,000 range, and one is in the $18,000 to $20,000 range. So there's a big jump there. One unit I believe is specifically for the reverse, and the other has both the forward and reverse built into it. And I think that's why it is a little bit more pricey.

Sniezko: It's available. But it's not affordable to put in every place that you would like to have it. It's available from a number of vendors, and it's becoming more affordable. And I think the more people work on this one, and the more standardized processes become, somebody will come up with a good piece of equipment.

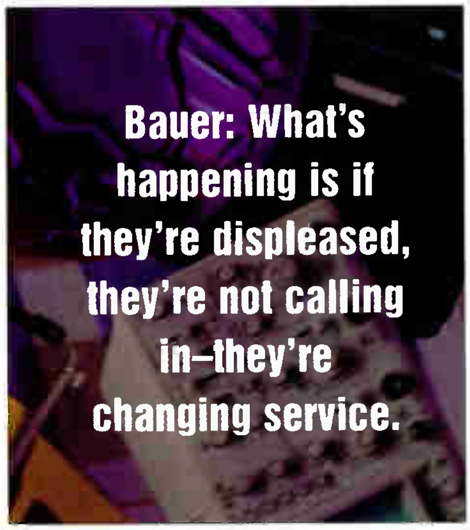


Warren: In some cases, it's available. In other cases, it's not. We don't have all the equipment we need to do adequate testing. And that's primarily due to a lack of competitive pricing on some equipment. However, most of the equipment we have in house will do the tests we need to do.

Bauer: With this new piece of software, I have what I need today, except for the problem of where it (ingress) is coming from in the plant. And because it's not in a nice handheld package, it gets very difficult. We've been

doing some testing with what we call a 'cable clothespin.' So, at the pole, we can actually do testing on each of the individual lines. We go to each drop and send a signal down to the house. If there is a broken cable, we get very high ingress coming back. If it's a good, clean signal, we get very low (ingress) coming back.

The other thing that we're doing is that we can send pulses down the hardline and see if we're getting reflections back. In one of those cases we did and we found out that we had a



seizure screw in the blind terminator that had never been tightened.

Once we saw what it was, and we did the calculations as to how many feet it was from where we were, it was easy. But, there is no way we would have ever found it without this software.

Now, a TDR (time domain reflectometer) might have been able to do it, but you have to physically disconnect the system to do that. And this was a non-intrusive thing we ran right over the top of everything else and saw the reflection come back.

The interesting thing is that our oldest, most reliable standby test equipment, i.e., cable customers, are not doing their jobs anymore. We've always relied on them when something wasn't working. The cable customer called us. Well, that won't do in today's market. What's happening is, if they're displeased, they're not calling in–they're changing service. And so, we've got to be much more proactive on our testing.

Lessons learned from testing

CED: Do you have any guidelines or rules-of-thumb that repeated testing over the past few years has taught you when it comes to establishing better performance in your system?

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Nguyen: We have not arrived at one solution. We're trying to right now. Our Road Runner cable modem group has a different test procedure to do the data, and then on the cable side, they have another procedure. We're trying to tie them together. I think by the end of this year we should have it.

Dupler: It's (testing) actually made us better. I know I wasn't very popular when I put DMX in the FM band. Especially if you've got a strong FM station around, it will knock out a block. My philosophy behind that was it will make us go fix the problem. And 99 percent of the time, it's a drop problem or an in-the-house problem.

There are an awful lot of people out there, especially in smaller systems, that if they have capacity, will stay away from channel 19 and 20 because of pagers. They just don't want to deal with it. But it makes you clean the problem up. And you can fix multiple problems when you do that. It just makes your system much, much tighter, and we've noticed our CLI, each year, has gone down. The FCC tests are a pain. But it has made us get much better.

Bauer: The rule-of-thumb we've discovered is that everything is terminated. You leave no open ports. No unterminated taps. No unterminated anything, any place! And that covers everything in the headend.

You have to take those extra steps. That means you use headend cable. You use all the right fittings. You terminate everything, every unused port on every splitter, on every piece of equipment. Even to the test ports on the trunk amps and the feeder amps. You throw away the caps that they have, and put terminators on it. Get it closed up tight. You do anything to drive down any radiated RF. That's probably what's done the most for a clean system for me.

Use good fittings. Don't go cheap. Don't rely on the weather-proofing of a vendor-supplied fitting. They're great and do a fantastic job, but put the heat shrink on. Seal that up. It's not that the fitting is going to deteriorate in a short period of time. It's the long-term (conditions) that cause the problems. Go the extra measure, put the heat shrink on and seal everything up.

Blair: Really, first and foremost, it still comes down to looking at just the levels alone. One of the first things to do is look at end of line. What does a customer see? Carrier-to-noise would be the second thing.

We're looking at what is non-interfering to the customer. Sweep response is no longer the same critical thing that it was six years ago. It has a different purpose now, and it doesn't have to have the same resolution over the entire bandwidth. You still have some issues up at the roll-off part.

And then, I can tell you the one thing that comes in over and over, and that is proof of the picture.

An FCC proof of performance looks at seven channels spread across the band. In one swipe through a television, you can see if there are any distortions there. And the one nice thing about carrier-to-noise is that noise is visible. But noise is more subjective than beats are. So, a measurement of noise tells you what the system is performing at, if you're at the high end or low end. Those RF levels tell us everything about the system and proof of the picture.

Is remote testing viable?

CED: What are your thoughts on remote or automated testing? When do you see a big degree of it happening in your system?

Warren: We would love to incorporate that into our systems. But, the biggest problem with it today is that it's still pricey. There are different companies who manufacture equipment you can place at the end of the line that is strand-mountable. It will measure carrier-to-noise performance and distortion, QAM modulation and those types of things. It's possible that we're going to purchase some of that type of equipment down the road. We don't have any of it today. But, I can see a very useful function there. If it were easily movable from test point to test point, and if the costs were reasonable, it would be very useful too.

I think we'll evaluate it, and when we do, I think most seriously it will be along the lines of automated reverse monitoring equipment. There are three or four companies today who manufacture equipment that will allow you to take the output of an optical return receiver, route it into a switch and it will monitor ingress levels, carrier-to-noise ratios and so forth off of that receiver. And, it will give you an alarm and let you know when ingress levels reach unacceptable levels.

I think that's going to be a very valuable piece of equipment on systems that are launching high-speed cable modems like we are.

Sniezko: It's too expensive. Any monitoring system is still very limited in what it does. I don't think they make sense at all.

Our services are our main monitoring system. As soon as you have problems reported by your system, which is comprised of modems at customer premises and the headend, this should monitor service quality.

And, if there is any indication that service quality is getting degraded, for whatever reason, then you go into a manual mode of monitoring, which is much less expensive.

Nguyen: We are looking at it. We're looking at some type of status monitor at the end of the line, middle of the line, the amps, the power supply, etc. We're looking at deploying something like that on a very limited basis. We need it as we roll out new services.

Our thought is that we can use the existing equipment, such as our digital boxes. We can poll those boxes and correlate that information (to determine our condition). That's a short-term solution.

Long-term, yes, I think remote testing makes sense. Right now we can't afford it. And also, we don't need it at this moment, because we don't have that much (advanced) service deployed yet. When you have hundreds of thousands of customers out there using data, digital boxes and so on, I think eventually we might need more of that stuff.

Bauer: I guess it depends on the level of remote testing. We currently have full remote capabilities of the Internet server. And we've done remote monitoring and control of that from day one. That's just because the systems we have been running are in a lights-out condition.

I don't necessarily see in my systems widely fluctuating levels on the cable plant. I think the manufacturers of the trunk and feeder amps have done a fantastic job. They are very good, strong and reliable pieces of equipment. I have amps I haven't opened in years, because they don't need it. When I do go to those, we made the extra effort to make sure they had good, solid seals on them and everything was done correctly. When I open one now, you hear the air escaping. So, you know that there was a good, solid seal on there.

As far as monitoring levels, I think that in the smaller systems you're not going to get a significant bang for the buck to do end-of-line system monitoring. I think that being able to have remote access to the signal levels coming out of the headend would be fine. Most of my problems tend to be in the headend, not in the plant.

I wish I may, I wish I might...

CED: If you could wave your magic broadband wand and create the most comprehensive, useful piece of testing equipment available, what would it be? What would it do?

Sniezko: It doesn't exist. It would do my frequency response and group delay in a non-disruptive way. And it would measure the dynamic range in the reverse path. And for the other pieces that exist, the one that monitors just ingress or all the interference that's out there without signal. Spectrum analyzers are doing a very good job on this one and can actually monitor signals underneath the service, as well as the discrete signal.

The other issue would be impulse noise. We don't have anything to monitor impulse noise. You can build pieces to capture impulse noise, but they are not single-unit pieces of equipment. You have to put different gating devices together.

Warren: If I could design a piece of equipment that would do it all, it would weigh five pounds. It would have batteries that last 24 hours. And it would combine the functions of an OTDR, an optical power meter, a spectrum analyzer and a digital power meter, all in the same package.

Nguyen: I think if we could integrate both the forward and reverse path testing, as well as analog and digital testing, that would be my wish right now. And right now, we have separate pieces of equipment for each of those.

And also, I think more importantly, at the headend, we're going to need some kind of equipment that integrates all those tests as well. Data, analog, digital, video, forward, return and different types of modulation schemes, FSK, QPSK and QAM. We run all those things now, and we really struggle with testing all those things.

And operationally, the technician needs a cheaper set of equipment to service all those things, too.

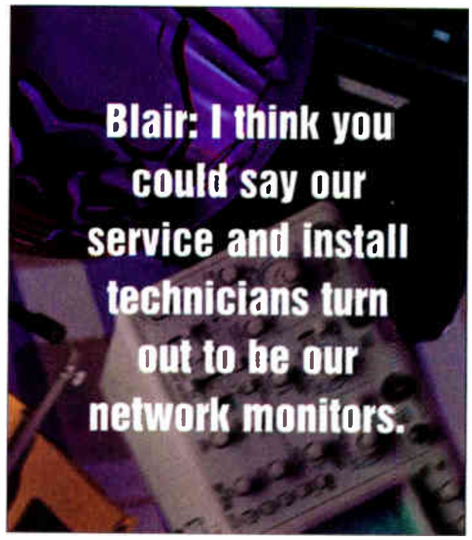
Dupler: Well, I know one vendor has made some pretty good strides in their equipment. They're making a meter that does leakage detection and level recording. It tells you whether you've passed or failed the FCC requirements. That's a pretty useful piece of equipment. It has a couple of pieces of equipment all wrapped up into one.

Now there are pros and cons to that. Say your signal level meter goes on the blink. Well, you've just lost two pieces of equipment. So it's a Catch-22. But I like having one piece of equipment when the installer/tech goes in the house. I like that. They carry enough equipment as it is.

Blair: We still wait for our customers to call us if there is a service problem. We're trying to take a stab at establishing a standard for network monitoring. It's a piece of what's needed overall in testing. I think you could say our service and install technicians turn out to be our network monitors.

Say we're running around two percent service calls a month. That means we're seeing 24 percent of our customers over a year's time, and that's an opportunity to make sure that network is capable of (providing) existing services, as well as future services.

So, when we go to that house, if they (the technicians) are taking a very small meter that gives them just two carriers, with a go or no-go, it doesn't tell you anything. What we really want to see is that we upgrade everyone to a meter that is capable of looking at everything, and then analyzing it and giving you feedback.



So, I think our goal would be, if you're talking about a magic wish, since you're already running people to homes, to use the information (the technicians get on those calls) more accurately to maintain (the network). That, alongside of your network monitoring eventually gets you to a very reliable network.

Bauer: I want a handheld device that has the ability to look at very short duration, high-energy broadband pulses coming through that are trashing the data. And, in addition, it would tell me down to even the node or house, where that ingress was coming from.

It would also have the full capabilities of being able to transport or send data out and get it back and know whether there's still a problem. That's one of the pieces that is missing even in anything we're doing with the cable modems. How do you know when you're having problems? And where are the problems occurring?

I've got it (a solution) on the drawing board right now. So, I would say we're making good progress. We have the concept for doing it, but as to putting it into the field at an affordable cost, we're not there yet. We're several months away from actually doing a field test that would identify where it's coming from. The concept is there, (laughs) we just need more hours in the day. CED

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PCS and cable: A natural complement

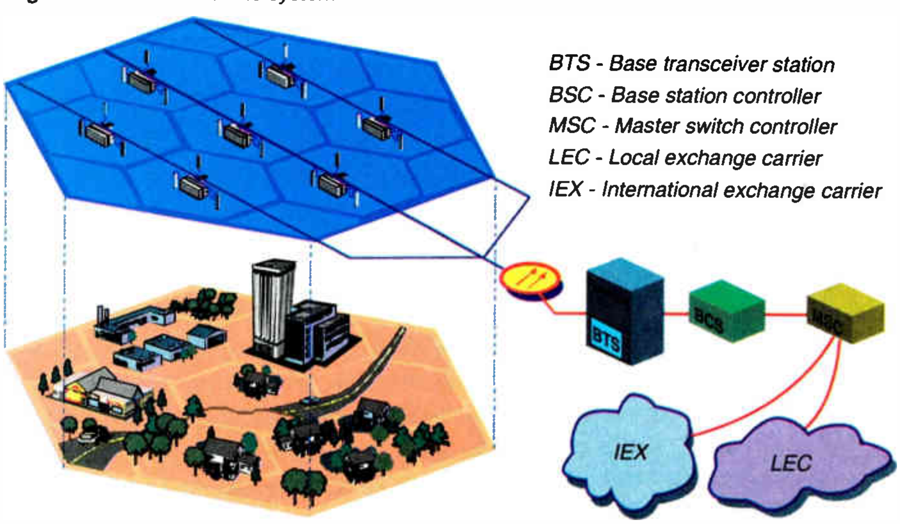
An economical approach to wireless network deployment

By Yvette C. Hubbel, Manager of Business Development, Telecommunications Systems Division; and John Sabat, Jr., Manager of Systems Engineering, Telecommunications Systems Division; Sanders, a Lockheed Martin Company

Since the beginning of cellular phone service, consumer demand for wireless services has far exceeded the most optimistic market forecasts. With the recent introduction of six new PCS carriers into each market, competition for the wireless subscriber is expected to become fierce. High quality and cost-effective networks will play a critical role in differentiating individual carriers from their competitors. In this article, Sanders, a Lockheed Martin company, describes a network architecture and system solution, called PCS-Over-Cable [1], which will make the "anywhere, anytime" PCS vision a reality today, independently, or as a complement to conventional tower-based systems.

The system allows carriers to quickly and economically construct wireless networks. Developed for the high voice quality, high capacity Code Division Multiple Access (CDMA) protocol, the system gives a PCS carrier the capability to construct wireless, mobility and local loop networks while tailoring network capacity for high call demand areas.

Figure 1: PCS-Over-Cable system



Introduction

The introduction of 1.9 GHz Personal Communications Services (PCS) has spurred an explosive growth in mobile telecommunications. Predictions are that new wireless voice and data services for business and residential users will complement, and someday possibly replace, today's wired and wireless service. Consistent quality, increased coverage, and the steadily decreasing cost of service are expected to create widespread public demand for PCS.

The Sanders' PCS-Over-Cable system leverages the upgraded broadband cable television hybrid fiber/coaxial (HFC) infrastructure and enables PCS providers to build flexible PCS networks, as well as introduce service quickly and economically. The system adds wireless telephony to existing cable TV services and is a complement to the cable TV industry's vision of two-way voice, video and data service. It offers several network advantages:

- ✔ Provides total wide-area network service without gaps in RF coverage as an alternative to tower-based deployment for wireless mobility and local loop networks
- ✔ Reduces delays and costs associated with seeking zoning and permit approvals from local municipalities
- ✔ Complements traditional tower-based networks by providing coverage in "holes" left by tower systems and where towers cannot be deployed
- ✔ Flexible hardware placement provides the ability for in-building penetration in office buildings and stadiums, malls, and other large structures.

The CDMA-based PCS-Over-Cable system is currently in production. In July of 1996, Lucent Technologies placed a large-scale production order for Sanders' PCS-Over-Cable equipment to support the deployment of PCS in Southern California for Cox California PCS Inc., a subsidiary of Cox Communications Inc.

Under the Sprint PCS name, Cox launched service in the San Diego portion of the major trading area (MTA) last December. Cox had previously won a pioneer's preference license for the Southern California market. Service is now available to 2.8 million people out of the 20 million covered by the license. As reported in *Wireless Week*, about 50 percent of the initial service base is covered by CMIs from a geographic standpoint, or 56 percent from a population perspective. [2] This network installation represents the first deployment of the Sanders' PCS-Over-Cable system.

Through its ability to simulcast, the system can be scaled both in geographical area (from hole filling to wide area coverage) and call capacity (from low demand initial buildout for mobility to high demand for mobility and wireless local loop). This technology is equally applicable for future wider bandwidth CDMA signal types and other operating bands such as the 800 MHz cellular band. In addition, protocols other than CDMA are currently being investigated. Depending on customer and market needs, other product variations are being targeted for production later this year.

System overview

The PCS-Over-Cable system, illustrated in Figure 1, is a system which provides the capability for wireless telephony services at PCS air frequencies over two-way upgraded cable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TV HFC networks. The system was developed specifically for the IS-95A CDMA standard using patented CDMA technology licensed from Qualcomm Inc.

As shown in Figure 2, the system consists of three primary elements:

1. Cable Microcell Integrator (CMI)
2. Headend Interface Converter (HIC)
3. Headend Control Unit (HECU).

Cable Microcell Integrator

The upgraded cable TV HFC infrastructure serves as the transport medium to distribute the PCS signals between the telephony equipment, located at the cable headend facility, and the CMIs, which are attached to the cable plant at remote locations throughout the service area. Multiple CMIs ("clusters") simultaneously transmitting and receiving the same CDMA carrier are referred to as a CMI "simulcast," typically requiring between two to eight CMI units. A wide service area can be covered by simulcasting the same CDMA carrier over multiple CMIs.

The CMI is the interface transceiver between the wireless mobile user handset or the wireless local loop (WLL) subscriber unit and the HFC network. Depending on the topography, capacity requirements and building type present in the predefined coverage area, the CMIs can be mounted on the cable TV plant approximately every 0.25 to 0.75 miles. Under certain terrain conditions, a CMI's range can be as far as one mile.

A CMI communicates at assigned wireless frequencies via a single transmit antenna and two spatially diverse receive antennas. In the forward link, the CMI converts the cable-based signal carrier it receives from the headend to wireless frequencies and radiates the signal through the transmit antenna to the user handset. In the reverse link, RF signals from the handsets are received by the CMI, converted to a reverse link cable plant frequency, and sent to the headend over the cable TV HFC network.

The CMI communicates with the HIC, and ultimately, with the HECU for the operation, administration, and maintenance (OA&M) functions. It is remotely tuned on command from the HECU to a specific carrier within the applicable frequency block. If the CMI detects a fault, it will immediately disable all outputs, thus never affecting cable TV HFC network performance.

Headend Interface Converter

Each HIC serves as the interface between three sectors of a Base Transceiver Station (BTS) and the HFC cable plant. In the forward link, the CDMA carrier is received by the HIC, which frequency multiplexes the signal onto the cable TV plant at a pre-selected cable TV channel for transport to the CMIs. In the reverse link, the HIC converts the diversity pair to RF signals for output to the BTS.

One HIC can control multiple CMIs in a simulcast for each sector, maintaining full control over CMI operation and frequency assignment. As directed by the HIC, the CMI can tune to any channel assignment within a predefined frequency band, independent of the remotely-selected cable TV channel. The HIC assigns individual CMIs to interface (in simulcast) to a BTS sector, thus establishing the sector footprint. Each HIC provides the cable TV interface at the headend facility for up to three CDMA BTS sectors. Two or more HICs may be combined to support six-sector or larger BTSs. Usually, the BTSs and associated HICs are co-located in the headend with the video and fiber distribution equipment. Alternatively, the BTS/HIC may be remotely located away from the headend using any suitable transport medium (e.g., fiber), allowing their co-location with existing towers or other convenient sites.

The HIC manages CMI operation through a variety of control messages, including frequency assignments, sector assignment, gain control, enable/disable, output power, operating temperature, status query and other critical operational parameters. Special, non-routine queries and commands can also be sent to the CMIs manually via the HIC. Each HIC has an onboard processor to manage all sector operations and end-to-end system gain. In addition, the HIC communicates with the HECU for the CMI/HIC OA&M functions.

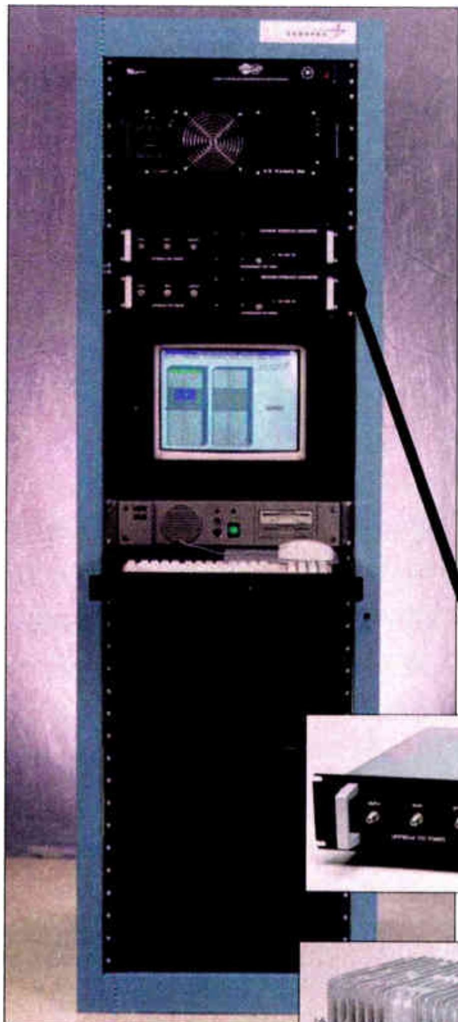

Figure 2: PCS-Over-Cable System elements. (Clockwise from left) Headend Controller Unit (HECU); Headend Interface Converter (HIC); and Cable Microcell Integrator (CMI).

Headend Control Unit

The HECU functions as the control processor, controlling all HIC and CMI OA&M. The OA&M functions include monitoring and control of the CMI/HIC parameters, detection of errors, generating alarms, and collecting, processing and displaying network information. The HECU polls each HIC to collect CMI/HIC alarms, status and statistics. There is no direct link between the HECU and the CMIs; all HECU messages to and from the CMIs are directed through the controlling HIC. The HECU, along with up to 14 HICs, are mounted in a common 19-inch primary rack. An additional expansion rack can be added to increase the number of HICs to 28. Thus, one HECU provides control and status for up to 28 HICs and more than 500 CMIs.

The HECU installed in the primary rack is a Pentium [3] class computer. The HECUs, one for each headend facility, can be remotely accessed in a multiple headend configuration from a Network Operation Control Center (NOCC) over dedicated serial links. The HECU OA&M function can be controlled

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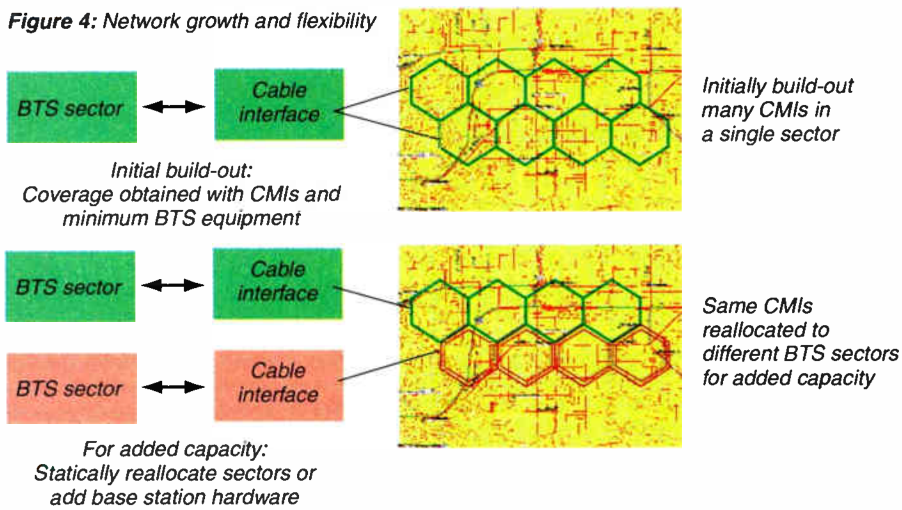
Figure 4: Network growth and flexibility



operator to minimize initial equipment costs by providing RF coverage at low call density. Initially, CMI coverage is achieved through a simulcast of typically eight units, or 24 CMIs, for a three-sector BTS. In some cases, larger simulcasts may be possible. Over a period of time, CMIs can be remotely reassigned to reduce the number of CMIs in each simulcast to support the additional BTSs incrementally installed in the network. This will increase the call capacity without the need to change CMI hardware or replan for RF coverage.

Centralized call processing

Clusters of CMI transceiver units are distributed throughout an area to provide RF coverage, while call capacity may be varied throughout the area by changing the CMI simulcast number as required. Call processing functions are centralized to allow the separation of coverage and capacity in a given service area. This means that a variety of coverage geometries can represent individual sectors (e.g., CMI strand along a highway) providing added flexibility to the PCS operator. Sector size may be adjusted easily to accommodate the varying demands within different locations of the service area. Traditional tower-based systems are constrained to arranging their sectors within the area limited by the tower's RF footprint.

The PCS-Over-Cable system allows centralization of BTS electronics to minimize the number of BTS units. All of the base stations which perform call processing on the transceiver units are located at one headend facility. With coverage and capacity decoupled, a lower cost per sector six-sector BTS can be used, instead of multiple three-sector BTSs. The same coverage area in a traditional tower-based network would require two separately located, three-sector BTSs, one to support call capacity for each tower's RF footprint. In an initial deployment hardware configuration, PCS-Over-Cable will require less BTS equipment.

PCS-Over-Cable enables the PCS provider to deploy BTS capacity incrementally, on a network-wide basis, as customer demand increases. The system uses the expensive capital asset (BTS) more efficiently than the traditional tower approach does. Thus, a significant time value of capital savings is realized by the PCS provider.

Greater call capacity is achieved by configuring with low simulcast numbers (less than four CMIs per carrier). This easily concentrates call capacity into smaller geographic areas, which is especially important for D/E/F-band PCS providers because the number of simultaneous carriers that can be transmitted from a site is limited by the available spectrum bandwidth. By contrast, when a traditional tower-based system reaches its capacity limit, additional towers must be constructed between the initial towers.

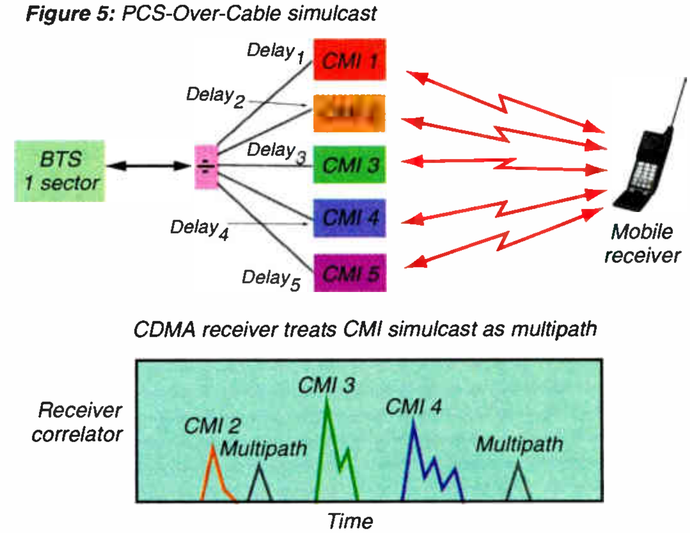
Centralized call processing also minimizes recurring BTS maintenance costs. In this system, the technician has full access to a large number of centrally-located BTSs without ever leaving the headend facility. This facilitates equipment maintenance procedures. Thus, call processing for a wide-area network is centralized at one headend facility, allowing for flexible, efficient, and economical network management.

Network growth

As subscriber demand increases, network capacity will need to grow to support the additional demand. The PCS-Over-Cable system uses the CDMA protocol to initially build out a service area by deploying a cluster of N CMIs per sector (typically, $N = 8$ CMIs) to simulcast the first 1.25 MHz carrier over the defined coverage area. Once the distributed antenna system is installed, physical reconfiguration (e.g., addition of new CMI units) is not needed to increase system capacity. The specific number of CMIs required for a given area at initial build-out is dependent on standard RF propagation parameters such as terrain, antenna elevation, gain and the multipath environment. At initial deployment, the typical ratio of BTS sectors to CMIs is 1:8 to provide the greatest coverage to a service area, while keeping the BTS quantity to a minimum.

As capacity demands increase throughout the service area beyond the call processing capabilities present at initial deployment, the given sector serviced by N CMIs may be reassigned so that two sectors can service the same area, each requiring $N/2$ CMIs. This is accomplished by adding a BTS/HIC pair and reassigning a portion of the previously-deployed CMI units to service the new sectors. This is illustrated in Figure 4. Reassignment is accomplished remotely by the OA&M software, requiring no physical configuration changes to the fielded CMIs. At this stage, the ratio of BTS sectors to CMIs typically decreases to 1:4 to support a medium call demand on the network. The two

Figure 5: PCS-Over-Cable simulcast



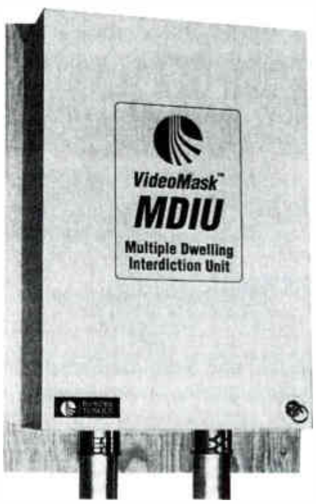
VideoMask™ Interdiction System Multiple Dwelling Interdiction Unit (MDIU)

Blonder Tongue's VideoMask™ Interdiction System is the complete program security solution for today's cable market. The Multiple Dwelling Interdiction Unit (MDIU) is a new member of the VideoMask™ family and is ideal for MDU installations. The MDIU is available in 8, 12, and 16 port configurations and is housed in a rugged, outdoor, steel enclosure. Each MDIU consists of one or more 4-port subscriber groups mounted in an RFI-tight steel inner enclosure. An outer steel enclosure provides excellent protection for outdoor installations, while an integrated lock prevents tampering with the interdiction components.

The MDIU is suitable for wall mounting and includes a backing plate with locating studs for quick installation. A removable bottom panel provides easy access to the entry/exit connections and subscriber drops. Ample room is provided for installing a directional coupler for those system designs requiring cascaded . MDIU's. This work space can also accommodate the installation of L-band components for those systems providing both analog (50-750 MHz) and digital (950-2150 MHz) programming. Blonder Tongue also manufactures these L-band components - please contact our Sales/Marketing Departments for more information.

Available in 8, 12, and 16 port configurations

Blonder Tongue's VideoMask™ Interdiction Unit (VMIU), which serves 4 subscribers from a die cast housing, is also suitable for pedestal based MDU installations. Blonder Tongue has recently begun offering several pedestal mounting kits, including Channell (SPH1320, SPH1212, SPH1010) and Reltec (TV1024) models. These bracket kits allow up to 4 VMIU's (a total of 16 ports) to be mounted in one pedestal, with plenty of room for entry/exit connections and subscriber drop cables. Both the MDIU and VMIU provide identical electrical performance and can be intermixed on properties to increase the efficiency of the system design.



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is required

✔ Centralized call processing uses lower cost BTSs and minimizes BTS maintenance costs

✔ Network responds to changing capacity requirements through easy, software reassignment of hardware

✔ Soft hand-offs are maintained longer in the system network.

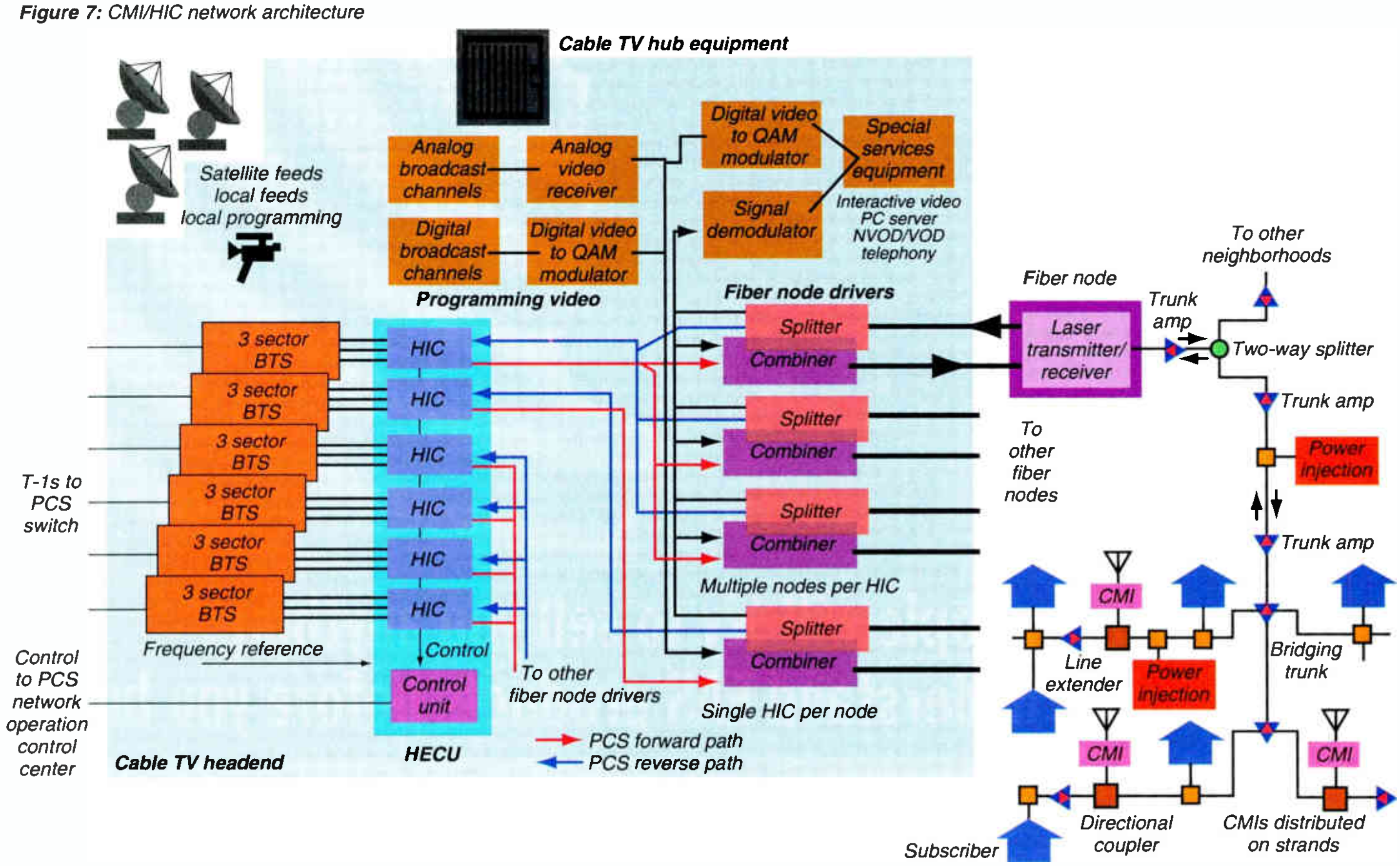
System installation and maintenance

The PCS-Over-Cable system is typically installed on aerial cable plant, strung between telephone poles 23 feet above the ground, and spaced 2,100 to 4,200 feet apart. The CMIs are weather-resistant, consistent with common HFC line equipment. Installation and maintenance methods are similar to methods used for cable TV trunk amplifiers and other active line components. CMIs are coupled to the cable plant independently such that currently available video and data services are not affected while the unit is being serviced.

The CMI employs two receive antennas and one transmit antenna for operation. In a typical cable strand operation, small, 6 dBi gain antennas, approximately eight inches in length, are used for both transmit and receive. Antennas can be either omnidirectional or directional (e.g., highway coverage) depending on the specific coverage application. The two receive antennas are installed on brackets which hang down from the strand with the transmit antenna standing upright between them. Separation between the transmit and receive antennas must be at least 40 inches to provide a minimum of 40 dB RF isolation between them. CMIs can also accommodate an underground cable plant by installing the CMI (surface or subsurface) and remoting the antenna to a nearby light pole or other elevated position.

In general, CMIs can be installed wherever cable TV (or dedicated) coaxial cable exists. CMIs can be installed in subways, tunnels, airports, bridges, office parks, inside office buildings, malls, hospitals, etc. They can be installed on rooftops or on the sides of buildings if cable plant is nearby or if it is economical to run dedicated cable where existing cable TV infrastructure does not exist. Locating the CMIs to achieve optimum RF coverage enables the RF planner maximum flexibility when planning out the defined service area.

Figure 7: CMI/HIC network architecture



Simulcast feature

The PCS-Over-Cable system uses the CDMA standard developed by Qualcomm. The real advantage in using CDMA is the increased capacity it provides, as well as its robustness in the presence of multipath interference. Thus, with CDMA, better reception is sustained, and more links may be packed into a limited bandwidth than might be possible with any other available access scheme. [4]

CDMA employs hard, soft and softer hand-off procedures to support the mobile user's need to change channels within a given coverage area. Using CDMA, carriers are distinguished from each other either by different PCS carrier center frequencies or different pseudorandom noise (PN) timing offsets. A hard hand-off occurs when the mobile user transitions between two base stations supporting two different carrier frequencies. A soft hand-off results when a mobile user moves between two base stations using the same carrier frequency but different PN offsets. Soft hand-offs are preferred to hard hand-offs because the mobile can be simultaneously serviced by multiple base stations, thereby preserving audio quality through selection diversity even under highly variable RF propagation conditions. A softer hand-off results when a mobile user moves between sectors within the same cell. [5]

Simulcast in the PCS-Over-Cable system, illustrated in Figure 5, adds another form of hand-off which is transparent to both the BTS and the mobile user. In the CDMA waveform, simulcast appears to the BTS and the mobile as multipath, which both the BTS and mobile unit are designed to use to their advantage.

Figure 6 shows an example of the effect of simulcasting upon the time-based correlator for a CDMA receiver. The relative delays for each correlation peak are the sum of propagation delays along the cable plant to different CMIs and the RF propagation delays from the individual CMIs to the mobile handset. Differences greater than 2 μsec are easily resolved by the correlator and are easily met during the layout of the CMI network.

The limit on the number of CMIs in simulcast is established by noise summation on the reverse link. The total reverse link system noise figure increases as 10 log(*N* CMIs in simulcast). The reverse link range allows the CMI to use forward link transmit power levels less than that of a tower (2.5 watts). With the strand-mounted CMIs typically at 23 feet in height and at lower transmit power levels, the coverage area of a single CMI must be less than that of a tower. Through the use of the simulcast feature, however, CMI coverage can be as large as the footprint of a tower. In fact, if CMIs were operating at a height comparable to towers, the coverage area of a CMI simulcast would be greater.

Network architecture

The cable TV plant provides the network infrastructure, illustrated in Figure 7, through which all communications and statusing to and from the CMI cluster is achieved. The network also provides a means by which the PCS signal is translated to and from the base station and transponder. In general, the function of the HIC/CMI system in the forward link is to downconvert the PCS telephony signal to be compatible with the cable TV system and send the signal through a combiner for addition with broadcast video signals, cable modems, and other advanced services (e.g., video-on-demand (VOD), near video-on-demand (NVOD), impulse pay-per-view).

After the signal is combined, it is then sent through the laser transmitter and converted to light for transmission over fiber optic cable to the fiber nodes. At the fiber node, the signal is converted back to coaxial medium for transmission out to the neighborhoods where the CDMA signal is extracted and re-radiated in its original form through a simulcast of distributed microcells.

In the reverse link, the CMI serves as a distributed reception array servicing a single PCS sector. Once received, the telephony signal is converted to the appropriate cable frequency by the CMI and added onto the cable plant along with the other cable services and transmitted in the reverse path to the fiber node. At the fiber node, the signal is converted to light for transmission over fiber to the laser receiver located at the headend. Here, the combined signals are converted back to an electrical medium and distributed to all of the reverse path headend equipment. Once extracted, the HIC sends the PCS telephony signal to the

BTS for demodulation and to the switch for further routing. If the destination is a wireline network, the call will be routed to the PSTN.

Up to three CDMA sectors of the BTS telephony equipment interface to the cable plant through a single HIC unit. A CDMA sector/HIC can interface to single or multiple cable plant fiber nodes, depending on the differences between fiber node coverage and the desired coverage of a single CDMA sector. Any number of CDMA sectors/HICs may be combined for operation on a single fiber node or group of fiber nodes. A typical installation will have dozens of CDMA sectors with their associated HIC units connected to dozens of fiber nodes simulcasting the same PCS frequency.

With multiple fiber nodes, separate CDMA carriers from different HICs/BTSs may re-use the same 6 MHz cable TV channel allocation on the cable plant. The same cable TV channel will be used across the entire cable network, while the CDMA content on each fiber node in that channel allocation will be different. This is also true for the efficiencies of reverse cable spectrum frequency allocation.

Headend wiring topology

The interface between the PCS headend equipment and the cable TV HFC network treats the reverse and forward links slightly differently. On the reverse link, each sector is treated independently, with each diversity receive pair requiring 4 MHz of reverse link cable bandwidth anywhere in the 5 MHz to 42 MHz region. The telephony call capacity per geographic area determines the number of fiber nodes per PCS sector, or the converse, the number of PCS sectors per fiber node. Typically, based upon RF propagation and coverage, there will be only a few CMIs per fiber node–in some cases, just one.

The simulcast of CMIs which constitute the entire sector will span multiple fiber nodes. Because the same reverse link cable TV frequencies can be reused for different PCS sectors, usually only 4 MHz of reverse link spectrum is required to support a PCS-Over-Cable network. Only when a fiber node splits across the coverage area of two or more PCS sectors will more than 4 MHz of bandwidth be required. In most cases, this situation can be avoided by considering the layout of the cable plant when deciding upon the boundary regions of the PCS sectors.

Because three CDMA carriers fit within a single cable TV channel, the forward link interface between PCS headend equipment and the upgraded cable TV HFC network is considered three carriers at a time. On the forward link, the entire group of three carriers is broadcast across the sum of the fiber nodes that comprise the three carriers. Each CMI selects one of the three forward link CDMA carriers for transmission. There is a single control and reference signal pair that is shared across all CMIs within the three simulcast sectors. A single HIC is used to generate the three CDMA carrier grouping, along with the control and reference pair, and it supports a single three-sector BTS. The control and reference pair from one HIC is independent from those of other HICs. Six-sector BTSs can be simply supported by the use of two HICs in parallel, while still maintaining the same three-carrier grouping described above.

Centralized call processing accommodates a network's changing capacity requirements

Through frequency reuse across the cable plant HFC network, multiple HICs can interface to the cable plant, all using the same cable TV channel, with each one carrying different CDMA carriers. These carriers can be either the same PCS frequency with different PN offsets or different PCS frequencies. The relationship between PCS frequencies, PN offsets, forward link cable TV frequencies, and reverse link cable TV frequencies are all independently and remotely selectable from the headend control unit. These control functions can also be accessed from a site remote from the headend such as a NOCC, allowing multiple headends to be controlled from a single centralized location.

Cable plant spurious requirements

CDMA, as transported by the PCS-Over-Cable system, makes few demands upon the dynamic range and ingress performance levels required of the cable plant. The forward link is straightforward because the range of power levels between a CDMA pilot and a fully loaded carrier is only 7 dB. Each fully loaded carrier operates at 15 dB below video reference. Spurious signals within the CDMA signal resulting from the cable plant need only be 40 dB below video reference, well within the operating characteristics of present HFC networks. The CMIs incorporate all the requisite filtering needed to reject the other video and digital signals coexisting on the cable plant to meet the transmission purity requirements of both the FCC and J-STD-019 ("Recommended Minimum Performance Requirements for Base Stations Supporting 1.8 to 2.0 GHz CDMA Personal Stations").

The CDMA reverse link is resistant to cable plant ingress levels because CDMA is a spread spectrum signal, and it is designed to operate at or below noise. The only requirement is that ingress power be at least 10 dB below the noise floor of the simulcast of CMIs when placed upon the cable plant. The cable plant needs only to maintain a 30 dB noise/ingress free range. As with the forward link, the reverse link has requirements imposed upon it by J-STD-019. The standard includes some high dynamic range desensitization requirements (e.g., two interfering tones 70 dB greater than the CDMA signal power at 1.25 MHz and 2.0 MHz frequency offsets) as well as linear operation with CDMA signals as strong as -65 dBm. The CMI's reverse link receivers not only translate the PCS carriers to cable plant frequencies, but filter out the interfering signals and perform the necessary gain control to meet both requirements without placing the dynamic range burden on the cable plant, nor on the fiber link transceivers within it.

Conclusion

The ongoing upgrade of the traditional cable architecture to a two-way HFC architecture has provided cable operators the luxury of adding new broadband communications services to their cable plants through significantly increased capacity. Thus, the modern cable TV distribution plant, with upgraded fiber architectures already in place, is a good platform for PCS. This diligent upgrade effort over the last decade has placed the cable industry in a strong position to provide PCS service to its customers with minimum additional investment. [6]

Sanders' PCS-Over-Cable system is a self-compensating, closed-loop, transparent extension of the BTS utilizing modern, highly reliable HFC networks. Leveraging the existing broadband infrastructure, the system allows carriers to build uniform, wide-area coverage quickly and economically.

Using PCS-Over-Cable, RF coverage and call capacity are more independently controlled than in traditional tower-based networks. With a CMI network, the simulcast feature enables greater and more uniform RF coverage through increased flexibility in installation and permits a network to be tailored to the capacity demand of the service area. Centralized call processing provides quick response to call capacity changes, resulting in optimum network performance. The centralization of BTS electronics at one headend facility minimizes the number of BTS units, as well as recurring BTS maintenance costs. Initially, the system can be inexpensively built out to meet coverage and low initial call capacity requirements. Later, the same physical CMI hardware configuration can still be used to support increased capacity network conditions.

As call capacity demand increases over time, only the headend equipment needs to be expanded. Network growth is achieved more efficiently through software reassignment of CMI hardware while sustaining soft hand-offs over the life of the network. The potential addition of dynamic reallocation to the PCS-Over-Cable architecture will add even more flexibility to tailor the system automatically to ever-changing capacity demand.

Sanders' PCS-Over-Cable system provides a PCS provider with a network platform that will accelerate service introduction to any area including those facing difficulties with the construction of towers. The PCS-Over-Cable system eliminates time-to-market delays and the costs associated with regulatory issues such as land acquisition, permitting, zoning restrictions, and construction delays found in the conventional tower site acquisition process. For the first time, carriers have an alternative to traditional macrocell networks. The PCS-Over-Cable system is now available to provide wide area wireless coverage for both mobility and wireless local loop applications. CED

Acknowledgments

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Biographies

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GRAPHICS COURTESY OF INTERVU (BACKGROUND); WORLDGATE COMMUNICATIONS (TOP); & COX COMMUNICATIONS (BOTT.)

Cool technologies are hot on the 'Net

Some operators are seeing the light

By Craig Kuhl

With more than 1 million active Web sites reportedly in use today, and the number of Web users expected to jump from 90 million to more than 200 million by the year 2000, it's no wonder that entire industries, including cable, are intent on carving their Web niche using the most advanced technologies available.

To attract and retain a Web user's attention with the sizzle, freshness and creativity they've come to expect is a monumental challenge. Web users not only want relevant information, they want it with magic. Throw in the costs of developing and maintaining the site that seem to rise with each hit, and Web ownership quickly becomes a business for only the brave-at-heart.

Yet, a growing number of cable operators, mainly the larger MSOs, are seeing the Web as a valuable way of expanding their visibility and offering added services to their customers using the explosion of state-of-the-art graphics, audio and other technologies available to Web owners.

Whether actually owning a Web site is right for all cable operators is debatable, but for some, it's the place they feel they need to be. With a veritable smorgasbord of new Web site technologies hitting the market, and with more on the way, cable operators such as MediaOne are beginning to look at Web site ownership as a viable means of reaching their customers and adding value to their business, with a technological flare.

"Initially, we needed to re-create our existing Web site to reflect our name change (from Continental to MediaOne) and tell who we are and what products we offer. It was very functional," says Bill Cluzel, product manager, corporate Internet services for MediaOne.

"Now, we are in phase two: to re-purpose our Web site to communicate not only who we are, but more importantly, to add value to our company and tell people why they should do business with us."

MediaOne is now in the midst of a $20 million national TV and radio ad campaign which hopes to drive viewers to its Web site and promote its MediaOne Express high-speed data service, while upselling its program services. And the graphics/audio technology is an integral part of the strategy. Says Cluzel, "The graphics and audio are important. Do they have the look and feel of our brand image? We want a warm, homey image, not too high-tech, which will scare people. My function is to create a site that will enable people to do business with us."

MediaOne's challenge, according to Cluzel, is to create a national look on its Web site, yet still deliver localized information such as pricing packages, programming, local office locations and more. "We currently offer that, but it's not as streamlined as we'd like it to be. But it's in the plan," he says.

Active server pages

Cox Communications experienced a similar beginning with its Web site, built 18 months ago to address inquiries from financial analysts and the media. However, it quickly became clear that customers were eager to find more information about Cox, its programming and other services. Says Bobby Amirshahi, communications coordinator for Cox's Web site, "When we found more customers were using the site, we wanted to become more customer-friendly and looked for an added on-line presence."

That presence, according to Amirshahi, will materialize when Cox initiates its active server pages in early 1998 using Microsoft technology, which will allow customers to access customized pages to check their bills, order movies and a host of other services using personalized PINs. Adds Amirshahi, "Once a customer's PIN is keyed in, it brings up a program channel lineup and other information. Of the 40 e-mails we get a day from the site, 95 percent are from customers with questions about the system, services and other cable-specific information." Cox is also building an education out-reach mini-Web site which will act as a storehouse of information for educators, and a company-wide "job-line" with daily updated job information.

Cox is taking the right path on the 'Net, says consultant Scott Mayo, who is helping the company design and implement its Web site. "For a company like Cox, they can build a site for their customers, and then recognize who those customers are through their PINs and tailor right to those customers with local weather, invoices, movies and more, all by the click of a mouse. We want our image to relate to our industry—high tech. However, the site must be useful, easy to download and update, with the graphic image and design constantly being changed. The sites with the most visits are (kept) fresh with material."

Keeping material fresh requires diligence, visual appeal, and money, according to Amirshahi. "Cost is a big factor. We must show the site's worth and value. But this is the way to go, and there is more coming."

More is probably an understatement. Cable operators have a huge spectrum of technologies to choose from when either building their own Web sites or joining existing sites. One company providing a cutting-edge technology is InterVU, a San Diego-based company which provides end-to-end service to Web site content developers, owners and Internet Service Providers. "If a cable operator wants to build a Web site and use say, VIVO, which encodes video data and enables the end-user to hear audio in real time and see video, we can tell the user which of our delivery centers is fastest, and it gets the video to the user two to three times faster. We have the ability to take one of these delivery centers and place it right into a cable operator's headend. It sounds like magic, but it's unique because customers get the fastest delivery center automatically, with the delivery center essentially being a server," says Arnie Karush, director of marketing for InterVU.

Adding more value to a business is what InterVU does, says Karush. "An operator would ask, how do I add more value to my business over the Internet? First, they're competitive by getting data to their users faster, and that means bypassing the 'Net congestion; and second, they can separate themselves by content."

How some cable operators are using their Web sites:

- ✔ *Job-line function*
- ✔ *Information storehouse for educators*
- ✔ *Upselling*
- ✔ *Provide company information*
- ✔ *Billing*
- ✔ *Programming information and special promotions*
- ✔ *Answering media inquiries*
- ✔ *Order movies*

WorldGate Communications is another service on the horizon and is currently being tested at Comcast, Charter and Cablevision. The service allows a customer to access the Internet through their TV remotes. Says Peter Mondics, vice president of sales and marketing for WorldGate, "We recognized that cable operators were on the 20-yard line (the red zone) for having Internet. If they have addressable capabilities and modest cable plant, they could do this (Internet Basic) in two weeks. It's what a lot of us have been wanting to do for a long time."

According to Mondics, both programmers and advertisers have shown great interest in the service. "From an advertiser's perspective, for someone to go directly from a TV ad to the Internet for more information is very appealing." WorldGate, Mondics added, will also allow customers to send and receive e-mails via the TV and activate pagers, with each system operator deciding how and what to charge for the service. The company's "Internet Basic" service could be housed in either analog or digital set-tops.

Return on investment

Technologies like Flash, Shock Wave and Authorware from Macromedia in San Francisco are also allowing Web site owners to create cutting-edge graphics, animation, interactive interfaces, advertising banners and navigation buttons, and will eventually allow them to make use of technologies that don't even exist yet. Macromedia is just one of hundreds of similar creative houses that are offering new technologies for Web sites, and these tools are just a fraction of the technologies available to Web sites.

Yet, becoming a Web site owner and committing to the costs and diligence necessary to make it a viable part of a cable operator's business is chancy, and developing a site can be a long, arduous process. "One of our challenges in building our site is to ensure a return on investment," says Sherrie Litito, corporate communications specialist for Jones Intercable, which is currently building its own Web site slated to be up and running in two to four months. "Our objectives have always been to drive customer sales and add value for our customers and shareholders. The problem is using our site to reach our 46 different systems. Costs are very high."

As Litito can attest to, cool new Internet technologies come with some hefty price tags, and when cable operators decide to build a Web site, function usually dictates form. Concludes Litito, "Cool technology must serve a purpose." CED

Building an efficient headend for data

Operational, cost and spectral efficiency

By Adrian Jones, Director, Strategic Channel Development, Terayon Corp.

This is the first part of a two-article series to address the issues in deploying data services over a broadband cable network. In such networks, it is essential to understand the architecture of the headend system, which deals with the transport of information between the residential and business users and the Internet and private networks. The headend systems allow the network operator to configure, provision, and bill for data services.

These articles address the major architectural and operational issues of the headend portion of a broadband data network. They examine ways to achieve the optimal headend architecture for broadband data services, the major ingredients in designing a headend system to support such services and ways of integrating data services into existing cable TV systems.

This first part of the series focuses on operational and cost efficiencies to offer reliable and uninterrupted service while achieving high throughput and spectral efficiency.

Cable network architectures

Data services offered over the cable network use one or more digitally modulated RF channels to carry

Figure 1: *Advanced modulation schemes, such as S-CDMA, extend upstream capacity.*

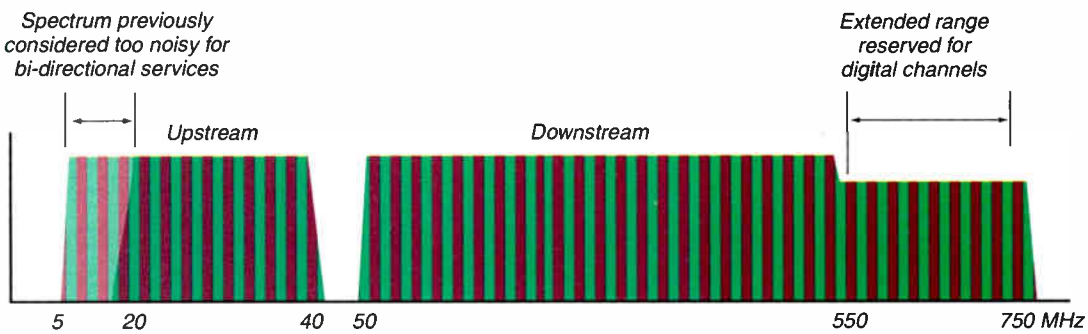
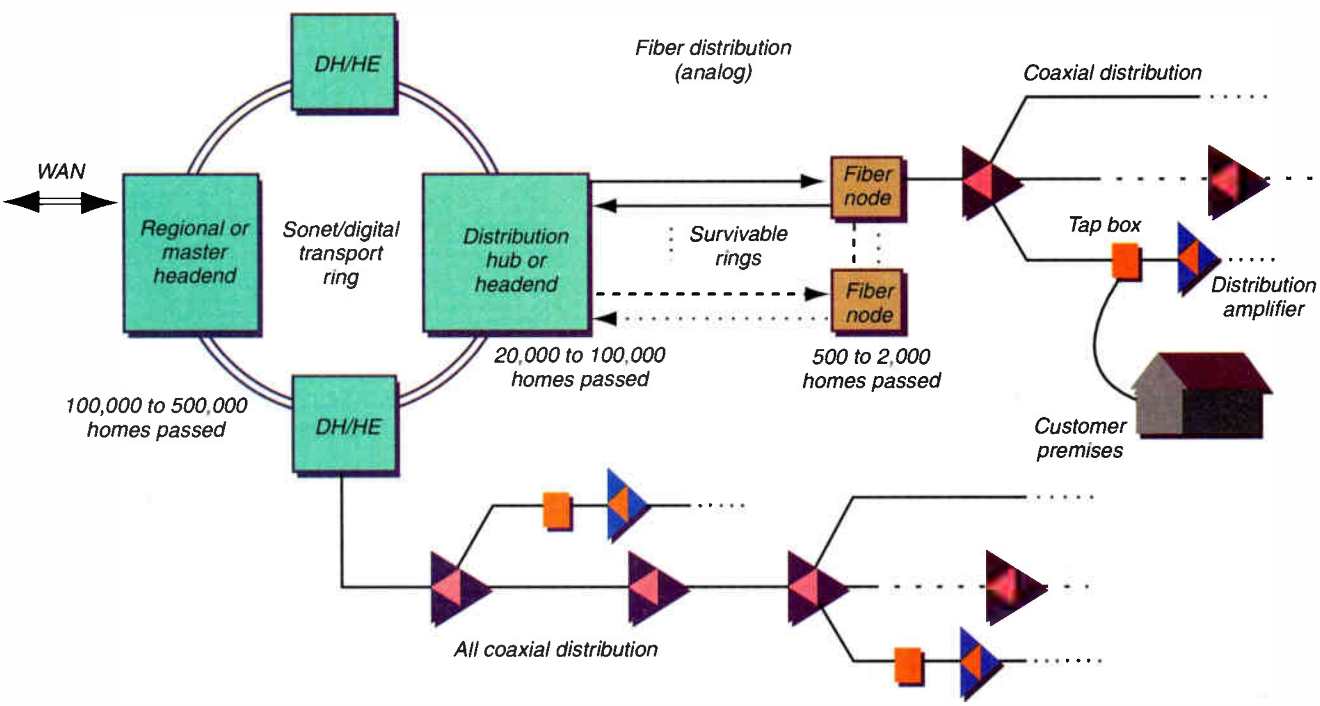


Figure 2: *HFC and coaxial tree-and-branch cable architectures*



information to and from the subscriber. These RF channels are located in available channels in the forward spectrum, typically between 50 MHz and 550 MHz. In the reverse direction, RF channels bringing data back from the subscriber are generally situated in the 5 MHz to 30 MHz range. Newer and upgraded hybrid fiber/coax (HFC) cable systems are generally designed to extend the forward spectrum to 750 MHz and the reverse to 42 MHz.

Cable networks are often based on a hierarchical architecture consisting of a regional headend connected to several local distribution hubs which, in turn, support many fiber nodes extending into the serving area (see Figure 2). Final connection to the subscriber is made through a coaxial distribution network consisting of passive tap boxes and bi-directional amplifiers.

U.S. cable plant statistics suggest that approximately 20 percent of subscribers are passed by HFC networks, while only 10 percent of networks are two-way activated. While substantial money is being spent on network upgrades, rapid and ubiquitous service deployment requires that the operator offer data services to all subscribers irrespective of the plant architecture. It is important that the data system accommodates rather than dictates the distribution architecture.

High-speed data service considerations

The network operator preparing to deliver high-speed data services over the cable plant will need to consider the effect of service introduction on his existing cable TV business, operations and support services. While most of the focus has been placed on RF modem technologies, the network operator will need to plan for the integration of network and service management systems into existing operations support systems.

A cost-effective data network system that allows the service to grow in a scalable and modular manner must support widely different plant architectures by strategic placement of headend cable modem data controllers, data concentrators, IP routers and other servers in remote distribution hubs and centrally located headend systems.

Data network elements

Headend data controllers manage the transport of data traffic across the cable network. In the downstream direction, data is modulated onto a suitable RF channel and received by all cable modems tuned to that channel (referred to as point-to-multipoint). Data from cable modems is modulated onto an upstream RF channel under the control of a multiple-access scheme (referred to as multipoint-to-point). The allocation of upstream bandwidth for each cable modem is determined by the user's class of service, generally arranged as the more you pay, the more you get. The data controller receives and passes its traffic to a network router which directs data between the WAN and the appropriate cable modem.

Traffic concentration

Figure 3 shows the various points of data traffic concentration, all of which aim to provide efficient use of resources.

✔RF concentration occurs by combining (aggregating) nodes together–effectively creating one large node;
✔Data concentrators can be used to collect and bundle traffic from many headend data controllers to conserve transport resources;
✔The transport ring can multiplex data traffic from multiple distribution hubs.

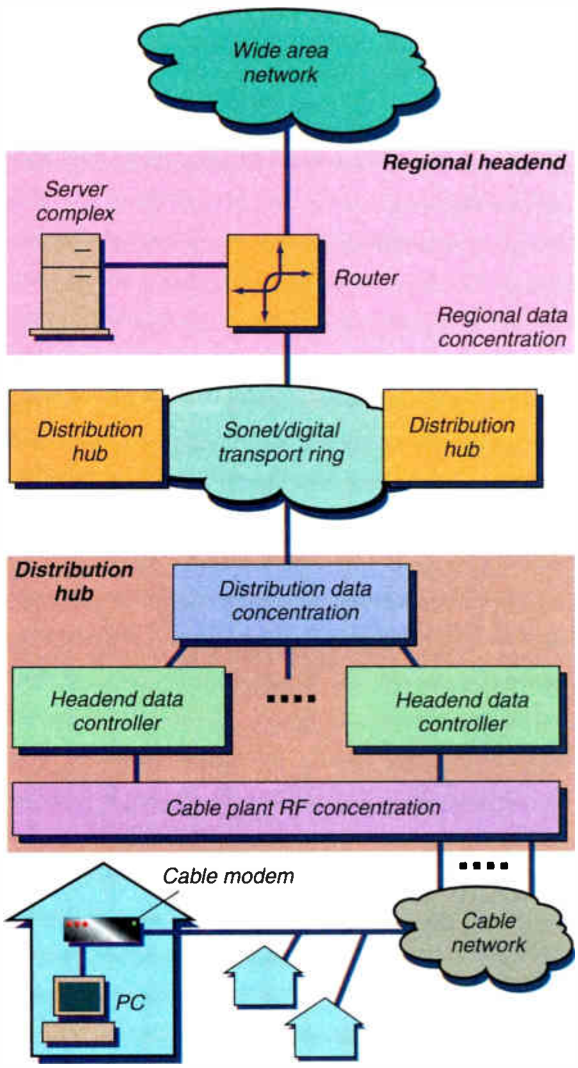
These points of traffic concentration ensure that router connections to the WAN are always fully utilized and sized for maximum cost-efficiency.

Service and network management consolidation

The consolidated headend architecture also permits the centralization of network management functions that helps to simplify and streamline operations, administration and maintenance functions. The ability

Efficient use of the reverse can defer or avoid unnecessary upgrades

Figure 3: *Cable architecture with the three points of concentration*



Will digital roll-out speed ITV, HDTV deployment?

Delays lead to more options

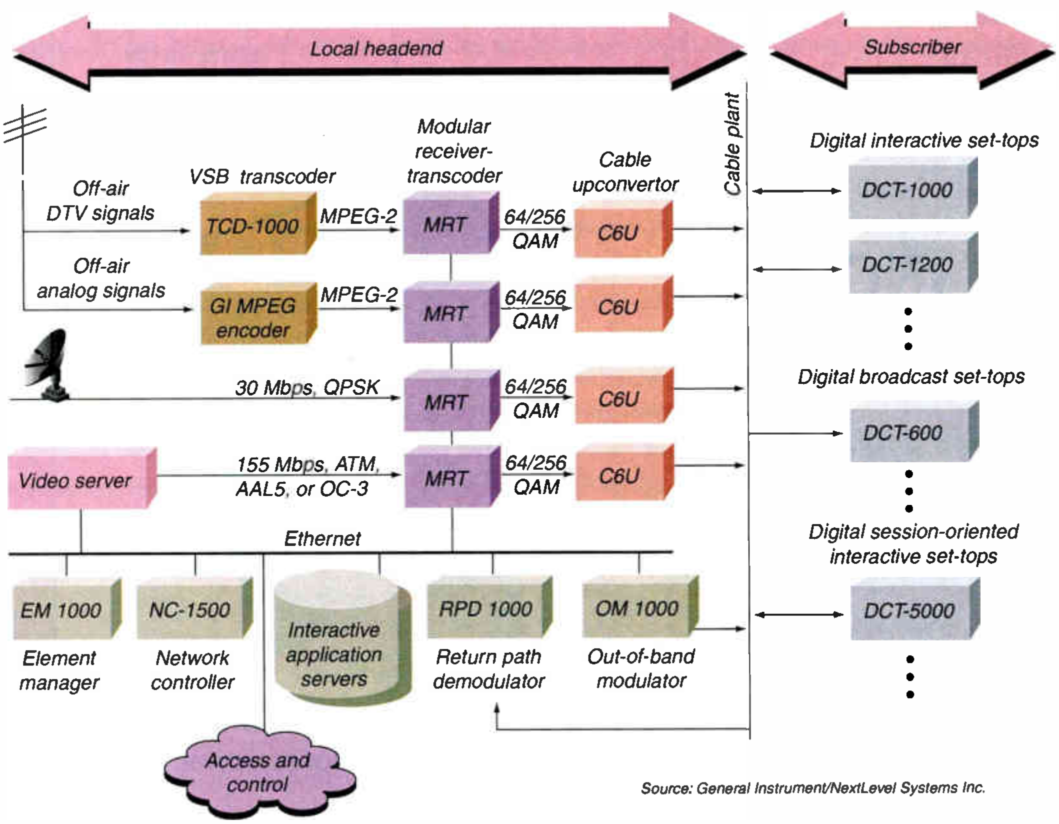
By Fred Dawson

The cable industry's move into digital TV has suddenly become much more complicated than the first phase of that process was expected to be, thanks in large measure to how long it has taken to get started.

Through the four-plus years since Tele-Communications Inc. CEO John Malone spelled out plans for the 500-channel digital TV system, operators waited for the boxes to arrive at price points they could work with, anticipating that first-generation digital represented a means of offering the customer more choices without eating up a lot of bandwidth.

Enhancements like high definition TV, on-demand video and fully interactive services were viewed as components of a fairly distant and largely indecipherable future that would be addressed once the initial digital platform was in place.

Figure 1: Sample system—Broadcast DTV signals integrated onto QAM modulated interactive digital cable plant.



Source: General Instrument/NextLevel Systems Inc.

But a growing number of MSOs are recognizing the initial platform is going to be what was once considered second-generation, encompassing support for interactive video and HDTV, as well as broadcast standard definition digital TV. The shift in thinking is fueled by developments on separate fronts, where the success of Internet protocol and high-speed data technologies is opening opportunities for two-way multimedia just as the government and broadcasters have gotten serious about HDTV.

HDTV

"I think the industry, at the highest level especially, regards high definition as a top priority," says Richard Green, president of Cable Television Laboratories Inc. But, he acknowledges, the shift in focus is so new that engineers couldn't be blamed for declaring HDTV to be on a back burner, as some apparently did in recent discussions with a *New York Times* reporter about cable's digital TV agenda.

The article, which appeared May 5, asserted that "none of the major cable operators are making plans to provide high-definition programming." "The *Times* got it all wrong," Green says.

In fact, top-level attention is especially strong on the HDTV side at this point, given the industry's need to open a dialogue with broadcasters before it can formulate its own strategic approach to high definition. Cable CEOs, working through the executive committee of Cable Television Laboratories' board, have convened an ad hoc group under the leadership of Cox Communications CEO James Robbins to open a dialogue with broadcasters which they hope will help both industries to work cooperatively on bringing high definition and standard definition digital broadcast signals to cable customers.

"There are a lot of things we bring to the table that could benefit broadcasters as long as there's flexibility to do things in ways that aren't damaging to our interests," Green says. The crucial issue is how must-carry rules are applied in the digital domain, which is a major point of dispute between the National Association of Broadcasters and the National Cable Television Association as they lobby the FCC for an interpretation favorable to their interests.

Cable operators may want to transmit broadcasters' HDTV signals, Green notes, but they don't want to be forced, as they would be under a rigid interpreinformation to and from the subscriber. These RF channels are located in available channels in the forward spectrum, typically between 50 MHz and 550 MHz. In the reverse direction, RF channels bringing data back from the subscriber are generally situated in the 5 MHz to 30 MHz range. Newer and upgraded hybrid fiber/coax (HFC) cable systems are generally designed to extend the forward spectrum to 750 MHz and the reverse to 42 MHz.

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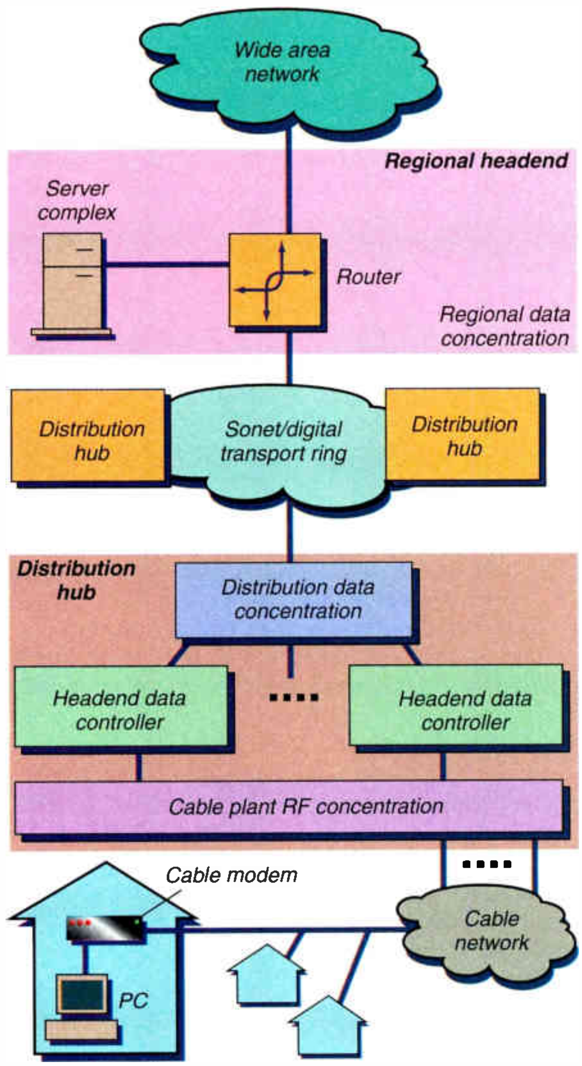
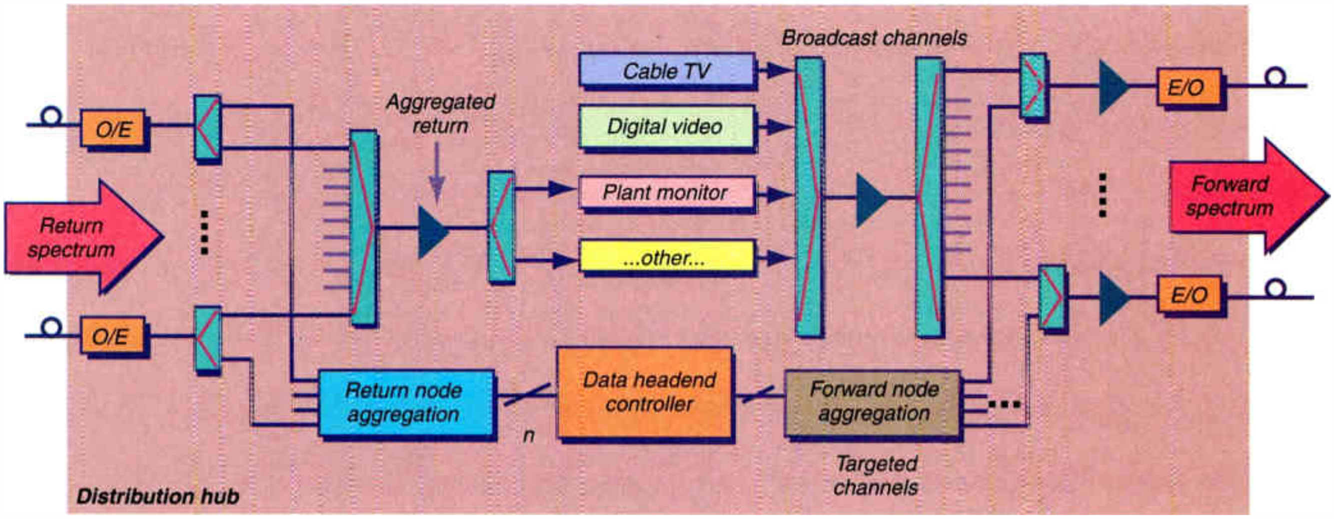


Efficient use of the reverse can defer or avoid unnecessary upgrades

Figure 4: Node aggregation within distribution hub



to provide a complete view of the operator's network and its elements allows for more comprehensive network performance monitoring, correlated fault analysis and more cost-effective failure recovery.

Data service and customer management functions that perform service administration, user billing, and configuration of new users also benefit from centralization. These functions can be coupled with existing operation and business support systems to provide the network operator superior customer service and more highly integrated business procedures.

Flexibility and efficiency

In order to provide data services that build upon, yet protect and optimize the operator's investment in his cable network, every effort must be made to ensure that these assets are used in the most efficient manner possible. Cable plant upgrades are often predicated on the need to increase either the forward or reverse spectrum capacity. Efficient use of the reverse spectrum can defer or even avoid unnecessary upgrades and can be accomplished in a number of ways, as follows:

Concentration of traffic in the RF domain is the most cost-effective way to utilize headend equipment

Node aggregation. This allows for flexible arrangement of the headend forward and reverse plant spectrum to optimize the use of headend equipment, allowing cost-effective scaling from low to high service penetration levels.

Figure 4 shows the arrangement of the forward and reverse spectrum in a stylized distribution hub and the concept of node aggregation. During initial data service rollout, the forward and reverse channel of a single data headend controller is shared by several combined nodes. As service penetration increases, additional headend controllers are added, and more channels are used. As service penetration increases, the level of combining may be reduced. For example, consider a 20,000-home passed distribution hub feeding 20 fiber nodes, each passing 1,000 homes. Assume also that each data channel can serve 500 users.

Figure 5 shows that by aggregating all of the nodes together, a single data controller can satisfy a service penetration of up to 2.5 percent. With the same architecture, adding another increases the penetration to five percent, and so on.

Figure 6 shows that by simple rearrangement of the passive splitting and combining elements in the distribution hub and adding headend data controllers, the operator has a flexible, controlled and low-cost method of increasing service to keep pace with demand.

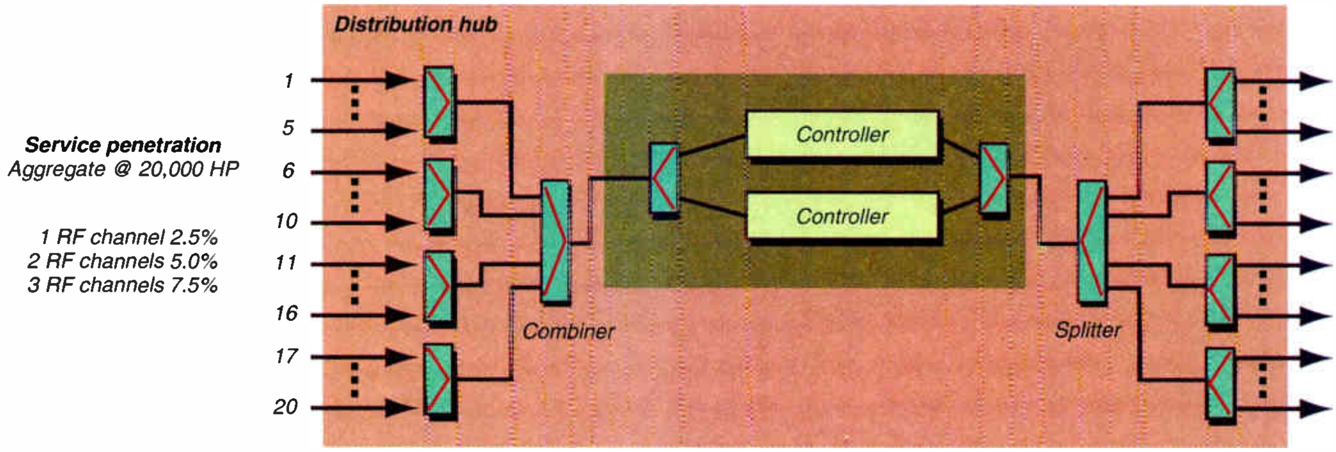
Concentration of traffic in the RF domain is the most cost-effective way for the network operator to utilize headend equipment. However, this type of concentration requires extremely robust RF modulation schemes that can cope with the combined noise of the aggregated node.

Field trials with S-CDMA (synchronous code division multiple access) have demonstrated acceptable performance in large node aggregations of 30,000 to 60,000 homes passed. S-CDMA takes advantage of a combination of direct spread spectrum robustness and long symbol length to provide resilience against narrowband and impulse noise–the two most common ingress components in the upstream.

This modulation method results in significant reductions in headend equipment space, as well as minimizing power consumption and the load on air-conditioning. In addition, equipment spares and maintenance are kept to a bare minimum–a significant cost reduction over the life of the service.

Modem robustness. The cable industry has expended considerable effort over the past several years in improving the reliability and availability of their networks to support new services. While much of the effort has gone into improving network architectures and increasing the reliability of system components, the ability to offer highly reliable and available services still heavily depends on the robustness

Figure 5: *Example of cable node aggregation (RF concentration) for initial service introduction.*



of the RF modem systems under real-world plant conditions.

The major factors affecting service reliability are: the inherent robustness of the RF transport system to noise conditions, and the way in which the system responds to increasing levels of noise.

Robust modem technologies allow the operator to use the entire return spectrum

Many cable modem systems must either avoid known "noisy" bands, or attempt to dodge ingress noise as it occurs–often referred to as frequency hopping. Here, the transmission is first affected by the noise before it can take remedial action. If, and when a "clean" channel is located, all modems are re-tuned and re-initialized on it; in the meantime, however, all transmitted data is either lost or delayed. This "after-the-fact" recovery is a poor fit for some applications, such as telephony and videoconferencing, which require guarantees of timely data delivery. In addition, extra spectrum has to be allocated for these "hopping" channels that further reduces the overall spectrum efficiency.

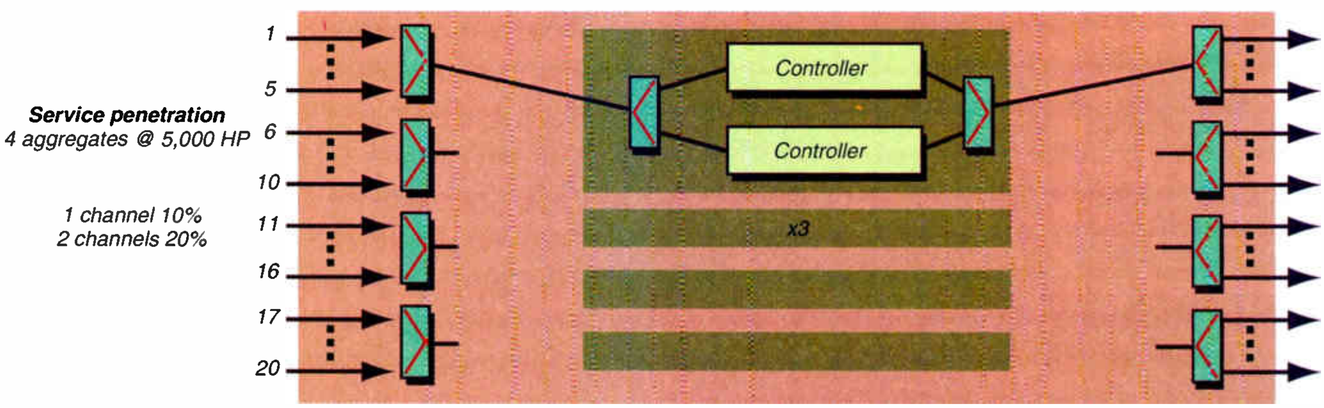
Supporting the most users per MHz of spectrum. Generally speaking, a larger pool of resources will support a greater level of traffic concentration. As the bandwidth of an RF channel increases, the number of users supported increases more rapidly. Thus, the higher the bandwidth, the more efficiently it is used.

When an upstream channel provides nearly 10 Mbps of data capacity to be shared by multiple users, many times greater capacity, and hence users, are supported compared to most single carrier systems.

Optimal use of available spectrum. Spectrum below the "glass floor" of 15 MHz to 20 MHz is often too noisy to be used by most modem vendors–leaving approximately 30 percent to 50 percent of the return spectrum unused. Robust modem technologies such as S-CDMA allow the operator to use the entire return spectrum. The operator can support more users on a given system and can defer upgrading or subdividing the plant. This allows more time to plan the upgrade, while offsetting the cost of the upgrade with greater service revenue. CED

Next month's article will focus on setting up a headend to provide multiple classes of service, how to architect the headend to allow the operator to scale services efficiently and how to interface the headend most efficiently to a wide-area network.

Figure 6: *Simple rearrangement of node aggregation to accommodate increasing service penetration.*



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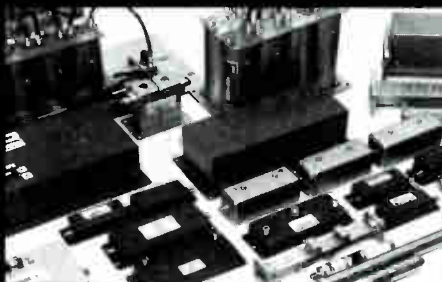

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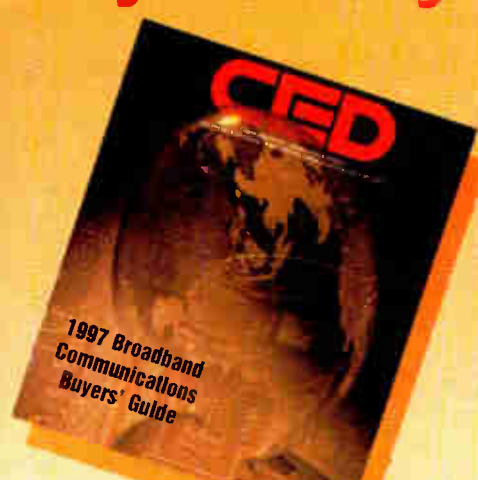

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Will digital roll-out speed ITV, HDTV deployment?

Delays lead to more options

By Fred Dawson

The cable industry's move into digital TV has suddenly become much more complicated than the first phase of that process was expected to be, thanks in large measure to how long it has taken to get started.

Through the four-plus years since Tele-Communications Inc. CEO John Malone spelled out plans for the 500-channel digital TV system, operators waited for the boxes to arrive at price points they could work with, anticipating that first-generation digital represented a means of offering the customer more choices without eating up a lot of bandwidth.

Enhancements like high definition TV, on-demand video and fully interactive services were viewed as components of a fairly distant and largely indecipherable future that would be addressed once the initial digital platform was in place.

But a growing number of MSOs are recognizing the initial platform is going to be what was once considered second-generation, encompassing support for interactive video and HDTV, as well as broadcast standard definition digital TV. The shift in thinking is fueled by developments on separate fronts, where the success of Internet protocol and high-speed data technologies is opening opportunities for two-way multimedia just as the government and broadcasters have gotten serious about HDTV.

HDTV

"I think the industry, at the highest level especially, regards high definition as a top priority," says Richard Green, president of Cable Television Laboratories Inc. But, he acknowledges, the shift in focus is so new that engineers couldn't be blamed for declaring HDTV to be on a back burner, as some apparently did in recent discussions with a *New York Times* reporter about cable's digital TV agenda.

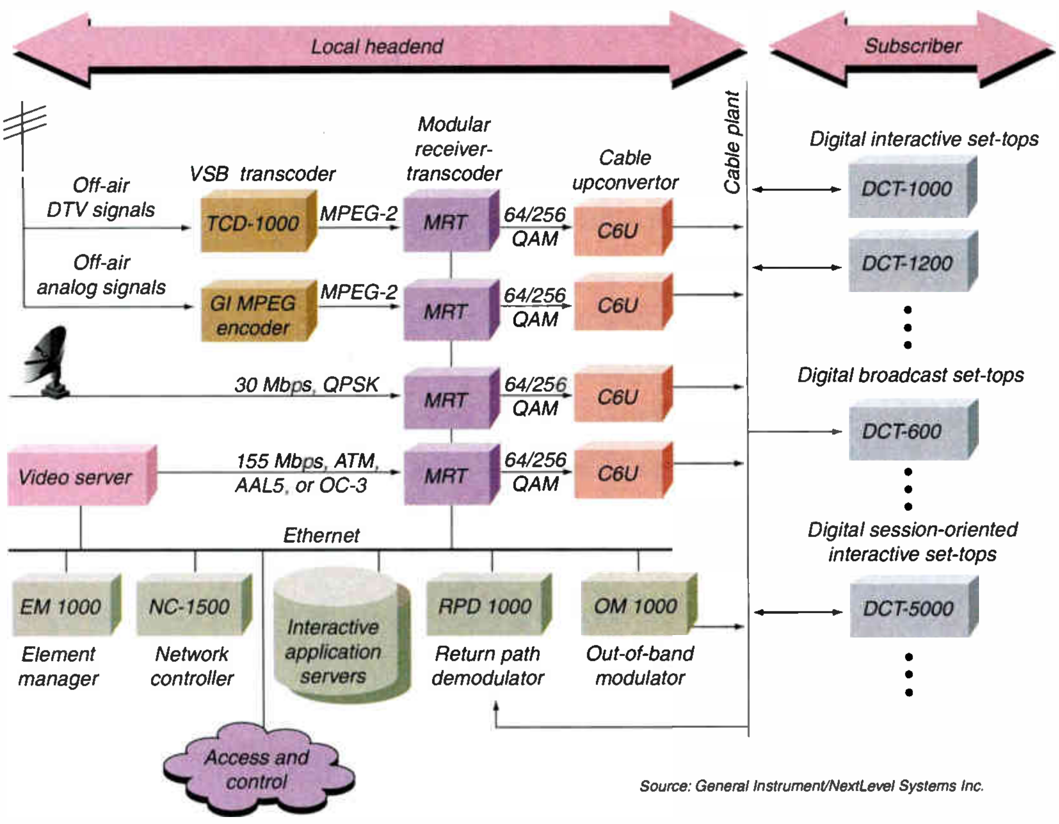
The article, which appeared May 5, asserted that "none of the major cable operators are making plans to provide high-definition programming." "The *Times* got it all wrong," Green says.

In fact, top-level attention is especially strong on the HDTV side at this point, given the industry's need to open a dialogue with broadcasters before it can formulate its own strategic approach to high definition. Cable CEOs, working through the executive committee of Cable Television Laboratories' board, have convened an ad hoc group under the leadership of Cox Communications CEO James Robbins to open a dialogue with broadcasters which they hope will help both industries to work cooperatively on bringing high definition and standard definition digital broadcast signals to cable customers.

"There are a lot of things we bring to the table that could benefit broadcasters as long as there's flexibility to do things in ways that aren't damaging to our interests," Green says. The crucial issue is how must-carry rules are applied in the digital domain, which is a major point of dispute between the National Association of Broadcasters and the National Cable Television Association as they lobby the FCC for an interpretation favorable to their interests.

Cable operators may want to transmit broadcasters' HDTV signals, Green notes, but they don't want to be forced, as they would be under a rigid interpre-

Figure 1: Sample system—Broadcast DTV signals integrated onto QAM modulated interactive digital cable plant.



Source: General Instrument/NextLevel Systems Inc.

tation of must-carry, to provide only one HDTV channel per 6 MHz channel if the digital modulation system they are operating can support two. Moreover, cable operators want some flexibility in instances where broadcasters choose to multiplex several digital channels into the 6 MHz over-the-air feed rather than using the spectrum for a single HDTV channel. "If one of the broadcaster's digital channels is a CNN feed, you don't want to have to consume capacity for that when you're already delivering CNN," Green says.

Cable leaders hope to reach a compromise on a business framework that recognizes the mutual benefits of cooperation rather than engaging in a protracted battle that could end up in the courts. "What we have is a digital box that can translate broadcasters' (standard definition) signals for viewing over conventional TV sets, which gives them a market base they wouldn't otherwise have if they waited for consumers to go out and buy digital TV receivers," says a senior cable executive, asking not to be named. "One of the things we'd like to explore is the possibility of them sending us their signals over a separate feed using our modulation scheme, which would allow a direct pass-through to the set-top without incurring the costs of modulation conversion."

At some point, cable also hopes to get a better idea of the actual HD format broadcasters will use, though, at this point, most cable engineers assume their broadcast brethren will stay with the entrenched and bandwidth-efficient interlace approach rather than going to the progressive scan favored by the computer industry. So far, CBS is the only network to announce its choice, which is the "1080-I" interlace option.

Fortunately for cable, it can win an advantage no matter who chooses which format by being flexible enough to accommodate both, notes a senior industry executive, asking not to be named. "If we play our cards right, we'll be the one outlet through which consumers can get access to programming in both formats," he says. "To the extent we support both sides in this religious war, we'll help persuade manufacturers to offer receivers that are dual-purpose, and that will be a win for everyone."

By fall of next year, HDTV receivers will be on the market and, if broadcasters live up to their commitments, the big four network owned-and-operated affiliates will be putting out HD programming over the newly-allocated digital broadcast spectrum. That doesn't give engineers much time to sort through their options, notes Bob Zitter, senior vice president of technology operations at HBO, which has committed to providing an HDTV feed of at least some of its programming in tandem with the earliest broadcast startups.

Much remains to be worked out in the company's plans for the HDTV feed, Zitter says, including a choice of formats and a decision on whether to include programming created in NTSC along with the high-resolution, widescreen film and video material that accounts for about 70 percent of the network's content. "My staff and I are going to be quite busy dealing with these issues over the next year," he notes.

HBO and Madison Square Garden Network are the only cable programmers to make known their HDTV plans, but industry CEOs clearly expect more suppliers to step up to the challenge of providing an early package of product that would give cable a strong position in HDTV. "Comcast (Corp.) is prepared to make the technological commitment" to HDTV, says Comcast President Brian Roberts, but he adds, "Of course, we would welcome more programmers to help fill the digital pipeline we're building."

Cablevision Systems Corp. subsidiary MSG plans to begin an HDTV feed in 1999, with occasional HDTV broadcasts of major events slated to get underway in an earlier, as yet unspecified timeframe. Cablevision executives believe the popularity of sports, especially regional sports, could drive HDTV acceptance in advance of its acceptance through broadcast networks.

"Because we have a bandwidth-rich distribution system, we can close the loop on getting high-appeal regional sports programming to customers no matter what the rest of the country is doing," says Marc Lustgarten, vice chairman of Cablevision. "By 1999, virtually all of our New York ADI will be served by 750 MHz capacity networks, which gives us the ability to support HDTV as well as a wide variety of discrete digital programming."

Cable interests hope to persuade TV manufacturers to include a QAM chip in the receiver

More than just programs

At this point it seems quite possible that cable engineers will be dealing with a larger cable networking dimension to HDTV than that represented by broadcasting alone, possibly even involving more cable programming feeds than broadcast. As Zitter notes, there's a fundamental business imperative behind HDTV that makes moving in this direction an obvious step for suppliers of premium and expanded basic programming. "The initial purchasers of HDTV sets will probably be HBO subscribers," he says.

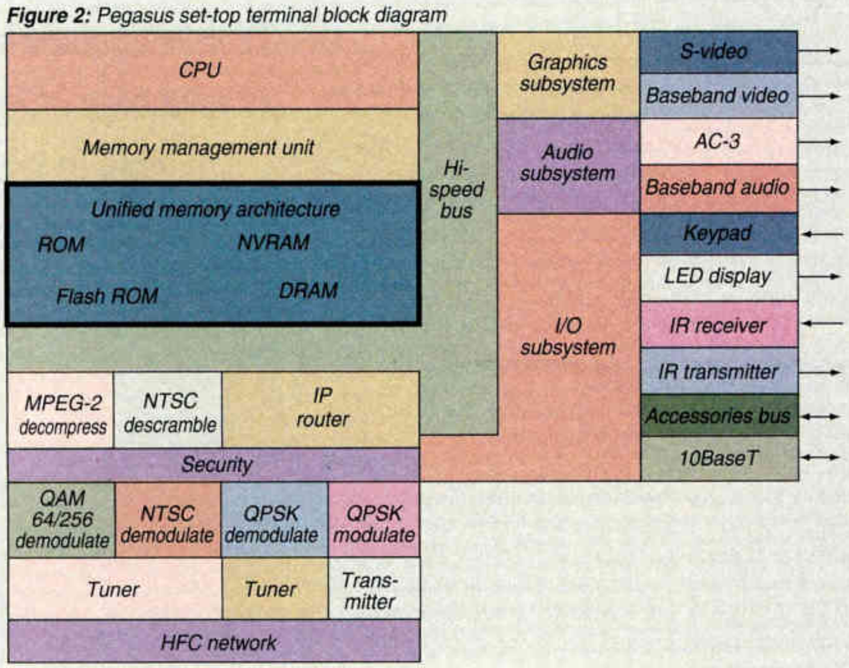
"Cable guys have enough on their plates already, but it's really important that we as an industry have a strategy where HDTV is concerned," Green says. "As we study these issues, people are going to become more and more concerned. It's a real puzzle when you start to think about it."

No HDTV-related technical issue is more important to cable than figuring out what new functionalities broadcast standard and high definition as well as cable-programmer HDTV feeds will impose on set-top boxes. Initially, cable can expect to pass HD signals through on channel without decoding them at the set-top, given the fact that all HD receivers will be equipped with decoders. Cable interests hope to persuade television set manufacturers to include a QAM (quadrature amplitude demodulation) chip in the receiver, but might ultimately want to perform the demodulation function themselves so as to be able to mix different types of feeds at the set-top, such as might be used in providing a cable-derived data feed to enhance the value of a broadcast HDTV feed delivered in VSB (vestigial sideband) modulation.

Fortunately for operators, consumer electronics manufacturers appear open to cable's needs. "They're generally fairly receptive to having a QAM receiver in the cable-ready HDTV receiver," says Bill Wall, chief scientist for Scientific-Atlanta's subscriber systems unit. Working with both the Society of Cable Telecommunications Engineers and the broadcast digital-oriented Advanced Television Systems Committee, Wall says he and his colleagues have been in regular contact with consumer electronics manufacturers.

"It's no great leap technically to build a single chip to do both VSB and QAM demodulation, because the two techniques are quite similar," Wall says. However, he adds, "I'm not aware of anybody building this part today."

Figure 2: *Pegasus set-top terminal block diagram*



Source: Scientific-Atlanta

But merely being able to pass the HDTV signal through to the receiver for decoding won't placate cable's needs for long, says Bob Van Orden, director of digital video systems for Scientific-Atlanta. "It's very hard to predict demand, but I'd venture that it will be the set-top, in our case a next-generation version of the Explorer, that does both HD and standard digital decompression," Van Orden says.

There are two primary reasons operators would want to do the decoding in the set-top rather than relying on the HDTV receiver, Wall notes. For one thing, he says, operators are likely to want to feed the HDTV formatted programming to analog TV sets to expand the market base for highly appealing programming that might not be simulcast by broadcasters in analog iterations.

In addition, he says, "There's an issue with reception of other services with HD programming, such as data content." Boxes like S-A's Explorer are built to support the combining of IP-based data with digital TV, which is seen as the basis for the new generation of interactive programming and gameplaying.

Fortunately, the headend changes needed to accommodate HDTV appear to be significantly less challenging than those involving the set-top and its interface with the TV receiver. "Getting HDTV into the headend and putting it into the QAM modulated channel doesn't present insurmountable obstacles," Van Orden notes. "It's relatively straightforward." In fact, he adds, most stations in large markets are already supplying their TV feeds via fiber and so will present no conversion problems at all for cable headends in their areas.

NextLevel Systems Inc. has begun development of an 8-VSB-to-QAM transcoder that's slated for shipment by the end of next year (see Figure 1). The modules will be compatible with existing headend products and will supply an add/drop multiplexing capability to support operator flexibility in packaging the different types of digital feeds from broadcast and other sources, says David Fritch, senior manager of marketing strategies for digital network systems at NextLevel.

ITV

This packaging capability is especially important as the action on the interactive side of the digital house gains momentum. The converging of the forces propelling interactivity, HDTV and standard digital TV has already brought high-speed data and set-top work groups together for frequent discussions at many MSOs and is certain to do likewise elsewhere as time goes by.

"We're all working very closely together to make sure we make the right decisions as we go forward," says Will Richmond, vice president of business development for MediaOne Express, MediaOne's high-speed data unit. "The delivery of video-enhanced types of applications is going to be a key differentiating factor for our services."

The technical components are in place to support a new class of service, typified by a news-on-demand site the MSO is preparing to introduce. Along with local news, the video-enhanced content will include local sports with streamed video clips and other "hometown" content running at up to 20 frames per second (fps) in three-quarter-screen resolution at the PC. This is a far cry beyond the postage-stamp sized, 1-10 fps streamed video clips now available over analog dialup links.

Time Warner's Excalibur group is another high-speed data unit staying in tune with activity on the digital TV side of the company's operations. In May, Time Warner officials and vendors responding to the MSO's request for information covering VOD and Internet protocol-enhanced applications met in Denver to get a better understanding of how the company can exploit the modem and VOD capabilities of its Pegasus set-top box (see Figure 2).

"There's a lot of cooperation going on between our group and theirs," says Excalibur Senior Vice President of Programming Carl Rogers. The focus within Rogers' group is on multicasting, where streaming technology is used to distribute live events, games or other content at specific times to customers, complementing the video-on-demand and HDTV features inherent to the design planning on the Pegasus project side.

"We're really focusing on the service strategy as the way to extend appeal of Road Runner beyond the early-adopter phase," Rogers says. Some unspecified pieces of these new services, with local as well as national content, will soon be tested over various Road Runner systems, with the intention that, by the second or third quarter of next year, the company will be in a position to re-release Road Runner, Rogers adds.

While Cablevision Systems Corp. hasn't announced the vendors for its newly-revised digital TV strategy, its approach is looking a lot like that of Time Warner and MediaOne, where the set-top is designed to handle IP-enabled content components as well as to support delivery of video-on-demand. After testing VOD in a 400-customer market trial over the past year, the company has decided to make movies-on-demand and other interactive services part of the venue as it moves to digital TV, says Wilt Hildenbrand, vice president of engineering at the MSO.

"We're migrating the online data side of the interactive technology into digital TV technology now," Hildenbrand says, declining to specify a rollout date. "With the capabilities that manufacturers are building into the digital set-tops, linking online elements across to the TV is almost root-level stuff."

Better tools for digital

Indeed, with network operators now getting serious about rolling out digital TV, vendors are scrambling to come up with means to add flexibility while reducing the costs of moving signals over networks and processing them at headends. Along with spurring activity among traditional suppliers of headend and set-top gear, the move to digital is drawing in new players, such as Lucent Technologies Inc., which has taken the extraordinary step of moving new digital TV encoding and decoding products into production under the direction of its Bell Labs R&D unit.

"There's still a lot of uncertainty about timing and strategies, but digital is an area we have to be prepared for, because it is an important part of the communications future," says Carl Hsu, vice president of advanced technologies at Bell Labs.

Lucent, like other vendors, sees opportunities for lower-cost, high-performance encoders, protocol convertors, media servers and many other products that are essential to widescale, efficient distribution of digital TV content. "We have to move cautiously because of all the uncertainty that's out there, but we're addressing the needs as they become clearly defined," Hsu says.

Harmonic Lightwaves Inc., too, has added MPEG and other digital video components to its product development activities, recognizing that integration of the pieces with the transmission gear at the headend is essential to lowering costs and making more efficient use of headend space. "We see integration of digital at the headend as a major need in the industry," says John Dahlquist, vice president of marketing at Harmonic.

The company's first product along these lines will be a QAM module that fits into Harmonic's optical transmission platforms, with initial units due for delivery by mid-summer, Dahlquist says. "The QAM modules will take up three rack units of height and be under software control for changing the QAM levels from four all the way to 256," he adds, noting the company thinks it can cut 30 percent off current QAM costs of $5,000-$7,000 per channel.

Similarly, Harmonic is working on integratable MPEG-2 encoder cards with software interfaces for direct management control. "We're designing the product so that 10 encoder cards fit in an eight-rack unit," Dahlquist says, again citing cost reductions over existing gear in the 30 percent range.

Harmonic encoders went into interoperability testing in June, with rollouts slated for later in the year. The initial versions, generating signals at two to 15 megabits per second, will operate at constant bit rates within any given speed domain, with variable bit rate and statistical multiplexing capabilities to be added later, Dahlquist says.

Statistical multiplexing is moving into the headend

Statistical multiplexing, used in conjunction with variable bit rate encoders, has become a hot development in the push for ever more bandwidth efficiency in the MPEG domain. Now it's moving into the headend.

One of the companies in the vanguard of this effort is Imedia Corp., which has decoupled the stat mux from the encoding process so that operators can add a local MPEG programming or advertising insert into a stat-muxed satellite MPEG feed without having to decode and recode the local signal. "We can take a constant-bit-rate encoded as well as variable-encoded feed," says Adam Tom, vice president of business development for Imedia.

"We're able to separate the statistical multiplexing from the encoding location because we don't require any feedback between the two processes," Tom says. "The encoder can be in L.A., and the statistical multiplexer can be in Denver, which not only cuts encoding costs in managing and packaging content but also allows operators to purchase the most cost-efficient encoders without having to use that vendor's statistical multiplexing system."

Manufacturers remain hampered by indecision about digital strategies on the part of cable operators and broadcasters, notes Lucent's Hsu. But the market message is clear enough now to move things into high gear, he adds.

"All the action is in data and video, so, we as a communications systems supplier, have to go where the action is," he says. For example, he notes, it's logical to assume that Lucent, after working closely with Time Warner and Silicon Graphics Inc. on the now-defunct Interactive Digital Solutions venture, would be ready to respond to calls such as Time Warner's recent RFP for video-on-demand technology.

"I can't comment on specific projects, but you can draw your own conclusions," Hsu says. CED

The issue: Emergency alerting

Although it has been delayed, perhaps until next year, emergency alerting will soon be a responsibility cable operators will be adding to their suite of services. A recent FCC rulemaking overhauled the Emergency Broadcasting System and is requiring participation by most cable systems. Despite the delay, are you ready to comply?

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The questions:

1. Is your system active in the current EBS locally?

❑ Yes ❑ No ❑ Don't know

2. Is your local geographic area prone to numerous emergencies on an annual basis?

❑ Yes ❑ No ❑ Don't know

3. Are you aware of the FCC proceeding that made the cable industry part of the new national alerting system?

❑ Yes ❑ No ❑ Don't know

4. Does your franchise agreement require emergency alerting capability?

❑ Yes ❑ No ❑ Don't know

5. Do you have plans to add emergency alerting equipment to your headend in the next year–or have you already done it?

❑ Planning to ❑ Already did ❑ Don't know

6. How much will your system have to spend, per channel, to comply with the EAS rules?

❑ More than $1,000 ❑ $500 to $1,000 ❑ Don't know

7. Does your system presently have programming override equipment in place in the headend?

❑ Yes ❑ No ❑ Don't know

8. If so, does it override audio only, or audio *and* video signals?

❑ Audio only ❑ Audio and video ❑ Don't know

9. If your system has such equipment, does it override all channels, including broadcast?

❑ Yes ❑ No ❑ Don't know

10. If you have emergency alerting equipment, how often has it been activated and/or tested?

❑ Monthly ❑ Few times a year ❑ Don't know

Your comments:

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RESULTS

The issue: DBS competition

When DBS burst on the video scene, its acceptance was immediate. While the initial growth was explosive, there are now signs that growth is slowing. That hasn't meant that DBS is going away anytime soon, however. This survey asked what you thought of DBS.

In an odd conundrum, most cable operators report that DBS is doing a less-than-stellar job of signing up cable subscribers, yet half say their cable systems have either lowered prices or offered special promotions to ward off DBS competition.

Surprisingly, one-quarter of those who responded say DBS has already had a measurable impact on their operations, and a huge majority say the success of DBS will hasten cable operators to add interactivity and Internet services–something DBS cannot do easily.

Given the recent retrenchment by telephone companies from entering the video arena, nearly half of the cable respondents now say that DBS will be a more formidable competitor over the next three years.

Digital compression will likely be a winner here, too, as a wide majority say their systems have at least some interest in implementing digital compression to increase channel counts.

Congratulations to Mindy Harris of Greater Media in Chicopee, Mass., who won $50 for her response. To register for a future drawing, fill out the survey on the previous page and fax it in!

The results:

1. How well would you say DBS is doing at signing up customers–both your subscribers and people who have never subscribed–who reside in your cable system?

Excellent	Good	Fair	Poor
11%	**36%**	**46%**	**4%**

2. How soon do you think DBS will have a measurable impact on your system, in terms of number of subscribers served?

Already has	Within 1 year	1-3 years	4 years or more
25%	**11%**	**36%**	**29%**

3. Do you think consumers see DBS as a better financial investment than cable TV over the long run?

Yes	No	Don't know
32%	**46%**	**21%**

4. To what degree has the launch of DBS affected your system's rebuild or upgrade schedule?

A lot	Some	Very little
18%	**29%**	**54%**

5. In your opinion, what is DBS' "weak link" when compared to a cable system?

Hardware cost	Programming cost	No return path	Broadcast-only	No local programs	Other
25%	**29%**	**11%**	**0%**	**68%**	**7%**

6. What percentage of your former subscribers have already switched to DBS services?

1-4%	5-10%	10%-20%	More than 20%
93%	**7%**	**0%**	**0%**

7. How likely is it that the success of DBS will hasten your system to upgrade to more channels and/or new services like data and interactivity?

Very likely	Somewhat likely	Not at all
36%	**39%**	**25%**

8. Do you think most DBS subscribers are rural residents who haven't been wired for cable?

Yes	No	Don't know
57%	**36%**	**7%**

9. Which do you think is a more formidable competitor to your system over the next three years–DBS or the telcos?

DBS	Telcos	Don't know
46%	**36%**	**14%**

10. Has your system either lowered prices or offered any special promotions to ward off DBS competition?

Yes	No	Don't know
50%	**32%**	**18%**

11. How interested is your system in implementing digital compression to increase your channel count?

Very	Some	Little	Don't know
39%	**32%**	**4%**	**25%**

Your comments:

"The impact of DBS on an independent cable system (can be) dramatic. We have lost an average of 15-20 subs per month to DBS, and my staff is delivering the best service and reception."

– Brian Fraser, Full Channel TV, Warren, RI

"When DBS was launched, I didn't think it would be much of a problem. But now, as I ride through our system, I see more and more DBS dishes."

– Larry Langevin, Greater Media Cable, Ludlow, Mass.

Time Warner plans on-line svc. in Hawaii

STAMFORD, Conn.–Time Warner plans to launch its high-speed, on-line news and entertainment Road Runner service on Oceanic Cable serving Oahu, Hawaii during the fourth quarter of this year. The cable modem service is already available in San Diego; Akron/Canton, Ohio; Binghamton/Elmira/Corning, N.Y. and Portland, Maine. It will launch in Albany, N.Y.; Columbus, Ohio; and Tampa Bay, Fla. during the summer months.

The key technology providers for the deployment are Microsoft Corp. and Digital Equipment Corporation. Oceanic will use a customized version of Microsoft's Internet Explorer browser and the Microsoft Commercial Internet System (MCIS), a set of Internet server software targeted at commercial service providers. Digital will be the system integrator and is providing the planning, design and system integration, as well as the Digital Prioris server platform.

Bosch to buy TI's Multipoint Systems

DALLAS–Robert Bosch Gmbh has reached an agreement with Texas Instruments Inc. to purchase TI's Multipoint Systems business, as part of its growing presence in wireless telecom under its Bosch Telecom Inc. subsidiary.

As part of the agreement, Bosch will acquire all assets and technology associated with the business, and will hire all Multipoint employees, according to a statement released by TI. The acquisition will enhance Bosch's position for participation in the Local Multipoint Distribution Service (LMDS) industry.

SCTE calls for papers at ET

EXTON, Pa.–The Society of Cable Telecommunications Engineers (SCTE) is seeking proposals for technical papers to be presented at its 1998 Conference on Emerging Technologies, January 28-30, in San Antonio, Texas. Submission topics should address critical technical decisions that will affect the future of the business and cutting-edge research and development, including digital television transmission, as well as other technologies of value to the future of cable telecommunications, according to SCTE officials.

The submissions should include a title, author's name, presenter's name, affiliation, full address, telephone/fax numbers, e-mail address and a one-to-two page abstract detailing the technology or issue and its significance to the industry. Proposals may be sent via mail, fax or e-mail to Roberta Dainton, SCTE, 140 Philips Rd., Exton, PA 19341-1318; fax (610) 363-5898; e-mail: rdainton@scte.org.

The SCTE Emerging Technologies Program Committee will announce the selected presentations in October. Accepted authors must be prepared to submit a camera-ready manuscript to the SCTE by December 15, 1997, for publication, as well as present a 15 to 20 minute oratory based on their chosen conference paper.

FONS to supply Ohio rebuild

NORTHBORO, Mass.–FONS (Fiber Optic Network Solutions) Corp. has been selected to provide Massillon Cable TV Inc. (Massillon, Ohio) and Clear Picture Inc. (Wooster, Ohio) with headend cross-connect equipment and splicing, as well as all of the outside plant cable for the $9 million rebuild converting the current coaxial wiring system to an upgraded fiber optic system.

Rebuild and upgrade activity is heating up across the industry.

To better serve Western Stark County and Central Wayne County customers, Massillon Cable and Clear Picture are implementing a comprehensive redesign and rebuild of the system that includes the installation of more than 250 street miles of fiber optic cable. The conversion, which will allow providers to reliably deliver more channels and services, including the Internet, began in mid-1996 and is expected to be completed by the end of this year.

Harmonic opens U.K. office

SUNNYVALE, Calif.–Harmonic Lightwaves Inc. has opened its first international sales and technical support center in the United Kingdom. The move is part of a strategy to bring resources closer to customers worldwide to support its fiber optic, digital and element management products.

A wholly-owned subsidiary of Harmonic Lightwaves Inc., Harmonic Lightwaves Ltd. will be headed by John Green, U.K. sales manager. Green has worked with Harmonic in a sales role in the U.K. for the past three years. In addition, sales, technical support and administrative personnel will be based at the U.K. office. Harmonic Lightwaves Ltd. is located at Unit #17, Alban Park, Hatfield Rd., St. Albans, Herts., AL4 0JJ, United Kingdom. Phone: 44 1727 853855; fax 44 1727 853558.

Charter to upgrade with S-A gear

ATLANTA–Scientific-Atlanta Inc. is supplying hybrid fiber/coax transmission equipment to Charter Communications for a significant series of upgrades in several states.

Charter is planning to upgrade up to 10,000 miles of plant with S-A equipment for subscribers in communities in California, Connecticut, Georgia, Louisiana, Illinois, North Carolina and South Carolina. The upgrades will enable Charter to deliver greater channel capacity and position its networks to offer advanced multimedia services, including high-speed Internet access. Under the arrangement, Charter will purchase S-A's optoelectronics, which include fiber nodes, RF electronics featuring System Amplifier II and Line Extender II, and multimedia taps and passives. The majority of Charter's HFC networks that are built with these products will be positioned for operation with bandwidths up to 750 MHz.

Com21 gets modem orders from Norway

MILPITAS, Calif.–Com21 Inc. has received an initial order from Baerum KabelTV of Baerum, Norway for high-speed cable modem systems. Initial deployment of the systems is in a residential area just west of Oslo, the capital of Norway. The cable system, which will bring residential users high-speed access to the Internet and other on-line services, is being upgraded for two-way information flow. Baerum Kabel anticipates ordering additional Com21 systems as it completes system upgrades and rolls out full commercial service to its 30,000 subscribers.

"We selected the Com21 system because of its ability to offer multi-tiered services, allowing us to charge our subscribers according to the bandwidth they have requested," said Erling Dyrhaug Andresen, project director for Baerum Kabel. "The underlying ATM architecture offers seamless interconnection to our planned ATM network."

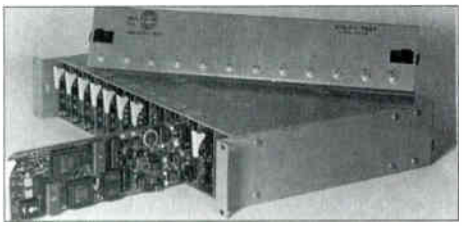
CAI Wireless to buy GI digital gear

HATBORO, Pa.–General Instrument Corporation's NextLevel Broadband Networks Group announced that CAI Wireless Systems Inc. will purchase its MPEG-2 digital network system technology and equipment for its digital wireless deployment in the Boston/Providence area.

NextLevel will provide CAI with a complete, end-to-end solution, which will include digital wireless terminals with telco return path capability, related headend equipment and systems integration services. The system will serve as the foundation for CAI's service offerings, such as digital-quality video and audio. CED

Character generator

LOCUST VALLEY, N.Y.–Multidyne has introduced its TS12-CARD, which offers 16 precision test signals, five dedicated black burst outputs, character source ID, APL settings, bounce and stereo audio tone in a modular card for the Multidyne UTIL-200 and the Grass Valley 8500/8800 Modular Trays. The character generator produces a message stored in battery-backed RAM. The user can program 32 characters over the test signal or 16 characters hidden in the vertical interval of the test signal.



Multidyne's TS12-CARD

With television signals transmitted by satellite, ENG, fiber optics and coax, it often becomes difficult to identify multiple video and audio feeds. The character messages are ideal for identifying video feeds, says the company. The NTSC test signals include SMPTE Color Bars, Multiburst, Multipulse, Cable 5 MHz Sweep, cable (SIN X)/X, NTC-7 Composite and Combination, plus others.

Also new from Multidyne is the CG-200 Modular Video Character Generator, which inserts a character message over an external video feed. The unit provides 16 field programmable character messages; each message can have up to 15 lines with 30 characters.

Circle Reader Service number 51

Rack mount fiber cabinets

PAWCATUCK, Conn.–Ortronics Corporation has introduced its ORMMAC Multi-Port MiniMod Rack Mount Fiber Cabinets. The cabinets, which have been designed to maximize flexibility, density and performance, patch up to 144 fibers using the Mini-Mod modules, or 108 fibers using 45° exit Mini-Mod modules. The cabinets are available in one-, two- or three-drawer configurations.

Fiber optic attenuators

SOUTH PLAINFIELD, N.J.–Radiant Communications Corp. has announced its new line of fiber optic In-Line Low Backreflection Attenuators.

The Series ILBR attenuators are designed for telephone and cable TV applications. The attenuators utilize a proprietary attenuated fiber which eliminates the use of air gaps, filters and other types of attenuating techniques to guarantee lower system back-reflections (≤ -55 dB). The units are available for SC/PC, FC/PC and SC/APC interfaces at standard values of 3, 5, 10, 15 and 20 dB. 1 and 2 dB attenuators will be available in September, says the company. The Series ILBR Attenuators are wavelength independent between 1.3 μm and 1.55 μm and are polarized insensitive.

Radiant's attenuators

Circle Reader Service number 52

Video processor system

ORLANDO, Fla.–General Instrument Corporation's NextLevel Broadband Networks Group has introduced its flexible Quad Video Processor system, which can simultaneously house and control up to four video processor cards. NextLevel designed the QVP chassis to give operators a flexible way to use the various lines in the vertical blanking interval to provide more attractive data services and generate additional revenues.

Each Data Inserter Unit (DIU) video processor card installed in the QVP can insert two, in-band data carrying lines during VBI. The lines carry in-band data to subscribers to provide optional services such as virtual channels, and third-party applications like Internet access and interactive program guides. The DIUs installed in the QVP enable operators to choose among 16 VBI lines and blank the contents of any selected line, as well as insert the appropriate data on one or two lines.

The company has also introduced its new Commander 6 Broadcast Demodulator (model C6BD). The new unit allows broadband operators to "easily" integrate local broadcast signals into their channel lineup, says NextLevel.

The unit's space-efficient design holds two demodulating units in a one rack-unit high space. The advantage of such a feature allows the C6BD to deliver all local broadcast channels, while leaving space for the growing number of headend components that operators need to offer expanded services.

Circle Reader Service number 53

Ortronics' ORMMAC Rack Mount Fiber Cabinets

The ORMMAC cabinets feature drawer faceplates, designation labels and slide-out drawers that provide convenient front and rear access. The cabinets also offer hinged backs and removable top panels for easy access–cable entry top, sides and bottom– as well as bend limiting jumper management.

Each drawer faceplate accommodates nine 2X wide or 18 standard snap-in Mini-Mod modules for moves, adds or changes.

The Mini-Mod fiber modules support singlemode or multimode fiber. Interfaces include ST, SC and FC connectors. All modules are front removable for easy access.

Circle Reader Service number 50

Customer management

RANCHO CORDOVA, Calif.–CableData Inc. has announced a customer management solution designed to increase the productivity of field service organizations, and to lower the costs of service calls. The system has also been designed to enhance the revenue potential of routine and special service calls.

Called TechConnect, the system extends the functionality of CableData's DDP/SQL customer management and billing software to a service provider's installers and field technicians.

Development is also underway to integrate the TechConnect capability into the company's Intelecable software system.

Using industry-standard data communications protocols and readily-available hardware, TechConnect allows field service personnel direct access to job and customer information via the Internet.

With the system, installers and technicians use cellular phones with built-in data displays to receive information about jobs, customers, system outages and more.

Circle Reader Service number 54

Customer drop enclosures

HICKORY, N.C.–Siecor Corporation has released its new HouseBox cable demarcation enclosure CDP series of network interface devices for broadband applications.

Designed for easy mounting, the HouseBox enclosures come in three sizes that feature thermoplastic construction which is highly resistant

Siecor's HouseBox enclosures

to degradation of ultraviolet light and will not deform when in it comes into contact with common household insecticides. The Siecor enclosures are also equipped with rubber grommets that help secure the cable entry points and also help seal the network components for better protection from the environment.

Circle Reader Service number 55

Software interface

ENGLEWOOD, Colo.–Integration Technologies (IT) and Superior Electronics Group Inc. announced they have developed an interface between their software products—model•it and CheetahNet.

Working together to bring advanced operational support architectures to the broadband community, IT and Superior produced a scalable application interface that system operators can deploy in entry-level systems or systems with more advanced requirements.

IT's model•it enables the design, documentation and management of fiber, coaxial cable, rack-mounted equipment and copper cable in broadband networks. CheetahNet is a UNIX or NT-based system that coordinates systems integration and network monitoring functions that can integrate with billing and fleet management systems as well.

Circle Reader Service number 56

Fiber optic cables

ROANOKE, Va.–Optical Cable Corp. has announced its B-Series Breakout tight-buffered fiber optic cables, which are capable of surviving the outdoor environment, and which meet the flammability requirements for use inside buildings. This offers many advantages to the end user, as well as to the installer and the distributor, says the company, because only one cable has to be purchased, installed and terminated.

For example, in installations between and inside buildings, the use of only one type of cable can save hours of labor and higher material costs by eliminating the need to splice outdoor cables to flame-retardant indoor cables.

The tight-buffered B-Series Breakout indoor/outdoor fiber optic cables further save on termination cost by permitting direct installation of connectors on the fibers, rather than requiring the splicing of preterminated pigtails onto the fibers. Eliminating the splicing not only saves installation costs in time and materials, but also greatly improves the cable plant's reliability by eliminating discontinuities and stresses on the fibers associated with splices, according to the company.

Also new from Optical Cable is a complete line of tight-buffered, GX-Series Subgrouping fiber optic cables which can be manufactured with 12 to more than 800 multimode and/or singlemode fibers separated into small subgroups within a single cable outer jacket. These cables can be manufactured for riser or plenum specifications.

Circle Reader Service number 57

Optical receiver

MELBOURNE, Fla.–Broadband Communications Products Inc. has unveiled its Wavelength Tunable 3 GHz Optical Receiver (Model 330A). The receiver has been designed to select a particular wavelength in the

BCP's Wavelength Tunable 3 GHz Optical Receiver

DWDM spectrum, perform an optical to electrical conversion and amplify signals for input to high-level instruments such as a bit error rate tester.

Operating in the 1550 nm band, the receiver's filter can resolve wavelengths as close as 1 nm. The front panel control features allow direct wavelength entry, automatic spectrum search to detect and store peaks, and recall of up to 99 previously stored wavelengths.

Circle Reader Service number 58

Advanced Networking

C-COR Electronics, Inc. Circle # 16
C-COR's RF amplifiers, AM headend equipment, digital fiber optics, and customized service and maintenance provide global solutions for your network. p. 31

General Instrument Corporation Circle # 9
GI/NextLevel Broadband Networks Group is a worldwide market leader in digital and analog set top systems for wired and wireless cable television networks. p. 17, **Freq. Chart**, p. 84

Construction Equipment

Belden Wire & Cable Circle # 33
Belden® broadband cable products, including our new coax/twisted pair Composite Cables, are ideal for all your video, voice, data, and even voltage applications. p. 56

CommScope, Inc. Circle # 6
CommScope: ISO 9001 registered manufacturer of a comprehensive line of coaxial and fiber optic cables for all telecommunications applications. p. 10-11

Telecrafter Products Circle # 4
Supplies drop installation products for CATV, DBS, and wireless operators, single and dual cable fastening products, identification tags, residential enclosures. p. 8

Datacom Equipment

Ortronics Inc. Circle # 17
A leading manufacturer of flexible structured cabling networking systems, providing fiber optic cross-connect products, adapters, patch cords, patch and splice accessories, fiber management, multimedia workstation outlets and more! p. 33

Distribution Equipment

Alpha Technologies Inc. Circle # 10
World leading manufacturer of power conversion products, widely used in cable television, telecommunications, and data networks around the world. Offer a complete line of AC and DC UPS systems. p. 19

Lindsay Electronics Circle # 22
Focused on the last mile, our revolutionary new technology creates 1 GHz communication amplifiers, passives, taps, and subscriber materials to solve system problems before they become subscriber problems. p. 42

Philips Broadband Networks Circle # 24
Philips Broadband Networks, a global supplier of broadband RF and fiber optic transport equipment, is also a leading provider of advanced systems used to access broadband telephony and data services. p. 45

Thomas & Betts Corp. Circle # 20
Thomas & Betts, LRC, offers a complete line of high quality CATV RF coax connectors backed with superior customer service and a worldwide distribution network. p. 40

Distributors

Cable Services Co.
Strand mapping, design, engineering, coaxial, fiber optic turnkey construction, stocking supplier of major CATV manufacturers Repair for headend, distribution equipment. **Freq. Chart**, p. 84

ITOCHU Cable Services Circle # 8
iCS, Inc. is a leading full service stocking distributor, operating ten sales offices and nine warehouses conveniently located in North and South America. p. 15

TeleWire Supply Company Circle # 11
TeleWire Supply is a leading nationwide distributor of products needed to build and service a broadband communications network. p. 21

Fiber Optic Equipment

Corning Incorporated Circle # 14
The Corning Optical Fiber Information Center gives you FREE access to the most extensive fiber-optic library in the industry. p. 27

Siecor Corporation Circle # 29
Siecor, recognized as a telecommunications technology leader, specializes in optical fiber cable, interconnect hardware, termination and splice equipment, test equipment and training. p. 50

Synchronous Group Inc. Circle # 42
The Actair and Antares 1550nm external modulation transmitters offer outstanding performance and the best specifications in the industry. Perfect for super trunks and direct distribution. p. 69

Headend Equipment

ADC Telecommunications, Inc. Circle # 1
Leading global supplier of transmission and networking systems. The company holds a preeminent market position in physical connectivity products for fiber optic, twisted pair, coaxial and wireless networks worldwide. p. 2-3

Barco, Inc. Circle # 37
BARCO's Gemini Upconverter is an ideal alternative to conventional modulators for hub site headends, accepts digital or analog IF inputs and saves cost and space. p. 63

Blonder Tongue Laboratories Circle # 38-39
Quality manufacturer of headend equipment (including pre-fabricated headends), reception, distribution, MDU interdiction products and test equipment. p. 65

Dawn Satellite Circle # 15
Dawn Satellite offers technical information and competitive prices on products such as: satellite "dish" antennas, satellite receivers, digital ready LNBs, modulators, processors and a wide variety of related products. p. 29

FrontLine Communications Circle # 41
FrontLine Communications manufactures patented, field proven, Emergency Alert and PC-based Character Generator products to fulfill the needs of cable and other multi-channel system operators. p. 67

Harmonic Lightwaves, Inc. Circle # 7
Harmonic Lightwaves is a worldwide supplier of highly integrated fiber optic transmission, digital headend and element management systems for the delivery of interactive services over broadband networks. p. 13

Microwave Filter Co., Inc. Circle # 44
Passive electronic filters, traps and filter networks for interference elimination and signal processing at the TVRO, headend and distribution equipment. p. 81

Pico Macom Inc. Circle # 28
Pico Macom offers a full line of quality headend components including satellite receivers, agile modulators and demodulators, signal processors, amplifiers, and completely assembled headends. p. 49

Scientific-Atlanta Circle # 48
Scientific-Atlanta's new Continuum™ Headend System for analog and digital applications. This features a vertical packaging design which allows for up to forty front-loaded modules to fit into a standard 70" rack. **Freq. Chart**, p. 84, p. 104

SkyConnect Circle # 35
SkyConnect meets the demands of the growing cable advertising industry by offering the most complete digital advertising solutions available. p. 59

Spectrum Circle # 32, 49
The Sub-Alert utilizes the advanced features of the Sage Endec for total automation and will interface with your headend by IF, baseband video or comb generator. p. 28-29, 55

Standard Communications Circle # 3
The industry's leading manufacturer of rebroadcast quality satellite reception and RF broadband products. Delivering programs to thousands of CATV and SMATV systems. p. 7

TV/COM, International Circle # 34
TV/COM, a subsidiary of Hyundai Electronics, is a leading provider of open architecture-based digital compression solutions for cable, satellite, PC and terrestrial providers. p. 57

Services

National Cable Television Institute (NCTI) Circle # 43
National Cable Television Institute (NCTI) is the world's largest independent provider of broadband industry training; both technical and non-technical. p. 71

TCS Communications Circle # 40 p. 66

Subscriber Equipment

Pioneer New Media Tech. Circle # 31
Manufactures advanced analog and digital CATV terminal featuring interactive functions, as well as controller software. p. 52-53

Test Equipment

Anritsu Wiltron Circle # 18
The Cable Mate cable analyzer is a single, rugged tester for return loss/SWR, insertion loss, RF power and Distance-To-Fault measurements designed for the rigors of field maintenance. p. 37

Cable Leakage Technologies Circle # 21
With the FCC imposing stiff fines for leakage, CLT presents operators with the only sure, comprehensive method of locating and documenting the nearest street address of system faults/signal leakage. p. 41

ComSonics, Inc. Circle # 30 p. 51

CTV Inc. Circle # 46
CTV Inc. offers quality repair and calibration of CATV test equipment, and specializes in the upgrade of CALAN 1776 RX and 1777 TX. Also available, refurbished CALAN equipment. p. 81

Hewlett-Packard Company Circle # 5, 19, 23
Hewlett-Packard offers a comprehensive range of test equipment to keep your entire broadband system at peak performance - from headend to subscriber drop. p. 9, 38-39, 43

Noyes Fiber Systems Circle # 25
Noyes Fiber Systems is a manufacturer of fiber optic test equipment including mini-OTDRs, light sources, power meters, visual fault identifiers, network simulators, microscopics, optical fiber indentifiers, talksets and test kits. p. 46

Sencore Circle # 12
Sencore designs and manufactures a full line of CATV, Wireless CATV, QAM and MPEG-2 test instruments. Each instrument is designed to meet your system analyzing and troubleshooting needs. p. 23

Superior Electronics Group, Inc. Circle # 47
Leading system solution for monitoring your HFC plant. Providing full compatibility with multi-vendor distribution devices and third-party OSS systems, Cheetah will integrate with your network now and in the future. p. 103

Tempo Research Corp. Circle # 45
Manufacturer of test and measurement equipment for installation and repair technicians, including TDRS, Step TDRs, and Coax Tracer systems. p. 81

Trilithic, Inc. Circle # 13
Trilithic manufactures test equipment for the CATV and LAN industries and components for aerospace and satellite communications. Key products are SLMs, leakage detectors, and a comprehensive line of return test equipment. p. 25

Wavetek Corporation Circle # 2, 26, 36
Manufactures equipment for CATV, telecommunications, wireless, and general purpose test. CATV equipment includes signal level, analysis, and leakage meters, sweep and monitoring equipment. p. 5, 47, 61

RESOURCE CENTER

AUGUST

5-7 Broadband-LAN Laboratory, produced by C-Cor Electronics Inc. Location: State College, Pa. Call (800) 233-2267 for more information.

6 Great Plains SCTE Chapter, Testing Session. Location: Bellevue, Neb. BCT/E and Installer certification exams to be administered. Call Herb Dougall (402) 597-5666.

12-14 Broadband Communications Technology, produced by C-Cor Electronics Inc. Location: State College, Pa. Call (800) 233-2267.

14 Music City SCTE Chapter, Testing Session. Location: Nashville, Tenn. BCT/E and Installer certification exams to be administered. Call Ken Long (615) 244-7462, ext. 319.

14 Shasta/Rogue SCTE Chapter, Testing Session. Location: Medford, Ore. BCT/E and Installer certification exams to be administered. Call Mike Smith (541) 779-1814.

15 Oklahoma SCTE Chapter, Testing Session. Location: Edmond, Okla. BCT/E certification exams to be administered. Call Doug Huston (405) 348-4225.

19-20 Network and Service Management for ATM, produced by ICM Conferences Inc. Location: Ramada Congress Hotel, Chicago, Ill. Call Chip Heflin (312) 540-5694.

19-22 Fiber Optic Training, produced by The Light Brigade. Location: Helena, Mont. Call (800) 451-7128.

20 New England SCTE Chapter, Testing Session. Installer certification exams to be administered. Location: Worcester, Mass. Call Tom Garcia (508) 562-1675.

20-21 Profiting from Wireless Cable and LMDS, produced by ICM Conferences Inc. Location: Chicago, Ill. Call Kimberlee Mulherin at (312) 540-5698.

20-21 Mastering Telecommunications Fundamentals, presented by Two Rivers Technologies. Location: Raleigh, N.C. Call (201) 798-3311.

25 Broadband Communications Network Overview, produced by General Instrument. Location: Rochester, N.Y. Call (215) 674-4800 for more information.

25-28 Fiber Optic Training, produced by The Light Brigade. Location: Idaho Falls, Idaho. Call (800) 451-7128 for additional information.

27-29 Fiber Optic Network Installation, produced by Pearson Technologies Inc. Location: Columbus, Ohio. Call Eric Pearson (800) 589-2549.

Trade shows

August

18-20 Great Lakes Cable Expo. Location: Indianapolis, Ind. Call (317) 845-8100.

September

10-12 PCS '97 (Personal Communications Showcase). Location: Dallas, Texas. Call PCIA at (703) 739-0300 for more information.

21-25 NFOEC '97. Location: San Diego, Calif. Call (619) 467-9670.

28-30 Atlantic Cable Show. Location: Baltimore, Md. Call (609) 848-1000.

October

8-10 Private & Wireless Show, produced by National Satellite Publishing Inc. (NSP). Location: Wyndham Anatole Hotel, Dallas, Texas. Call (713) 975-0030, ext. 28; or (800) 555-0224.

20-22 Eastern Cable Show. Location: Atlanta, Ga. Call the Southern Cable TV Association (404) 255-1608 for more information.

21-23 1997 National Communications Forum/InfoVision97. Location: Chicago. Call (312) 559-4600.

December

10-12 The Western Cable Show. Location: Anaheim, Calif. Call the CCTA at (510) 428-2225.

SEPTEMBER

6-10 NATOA Conference (National Association of Telecommunications Officers and Advisors). Location: Tucson, Ariz. Call (202) 429-5101.

7-9 HFC '97, High Integrity Hybrid Fiber/Coax Networks, Second Annual Technical Workshop, jointly sponsored by the SCTE and the IEEE Communications Society. Location: The Wigwam Resort, Litchfield Park, Phoenix, Ariz. Call Anna Riker (610) 363-6888.

8-9 CDMA System Engineering & Optimizations Workshop, produced by WIT. Location: Dallas. Call (510) 490-6459.

11-12 Bellcore's Competitive Local Access Seminar. Location: Richardson, Texas. Call (800) 832-2463.

11-12 Operating RF-IPPV Systems, produced by Scientific-Atlanta Institute. Location: Atlanta. Call (800) 722-2009, press "3."

15-19 Broadband Communications Network Design, produced by General Instrument. Location: San Francisco. Call (215) 674-4800.

16 Network Reliability & Interoperability Council ComForum, presented by the International Engineering Consortium. Location: Hyatt Regency, Reston, Va. Call (312) 559-4600.

16-18 Digital Network Engineering Training, produced by General Instrument. Location: San Francisco, Calif. Call (215) 674-4800.

23-25 i+e intranet + extranet Conference & Exposition, sponsored by Gartner Group. Location: Moscone Convention Center, San Francisco. Call (203) 256-4700.

24-26 Fiber Optic Network Installation, produced by Pearson Technologies Inc. Location: Morristown, N.J. Call Eric Pearson (800) 589-2549.

OCTOBER

20-24 Fiber Optic Splicing and Testing, produced by Nynex. Location: Nynex Learning Center, Marlboro, Mass. Call (800) 239-3300.

27-29 Rocky Mountain SCTE Chapter 2nd Annual Cable TEC Symposium. Location: Holiday Inn, Ft. Collins, Colo. Call Hugh Long (303) 603-5236.

27-11/7 Outside Plant Engineering–Basic (OPE-BX), Bellcore TEC Training from Nynex. Location: Marlboro, Mass. Call (800) 832-2463 or (708) 960-6300.

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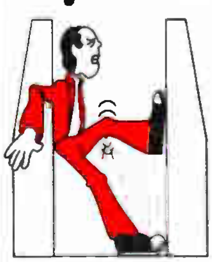

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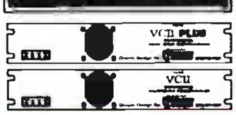

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Spectrum waste and digital must-carry

By Walter S. Ciciora, Ph.D.

I just returned from the 1997 International Montreux Television Symposium. One of the sessions, "The Changing Regulatory and Management Landscape," had a paper: "Must-carry Affirmed: Just In Time for Digital TV," by Charles E. Sherman, Ph.D., Sr. vice president Television, National Association of Broadcasters. His approach was very confrontational, not at all polite, and "in your face." He insisted that the NAB's position is that "must-carry" applies to digital television, and that there is no compromise on this.

What about viewers' (My!) rights?

I couldn't contain myself–I had to ask a question. I asked about my rights *as a viewer.* I told him that must-carry forced out several of the channels on my cable system that I wanted, and instead, gave me two of each of the networks, and three of the public broadcasting stations. I told him that as a viewer, I was alarmed that he wanted to squeeze out even more of the channels I want, and put on digital signals which I can't even receive until I buy a very expensive receiver. And that receiver will cost me around $5,000 sometime around Christmas 1998, estimates Gary Shapiro of the Consumer Electronics Manufacturers' Association (CEMA), of the Electronic Industries Association (EIA). Because I use a VCR a lot (I have five of them), I'll need one or more digital VCRs as well. So until I'm willing to spend all that money on receivers, I will lose channel capacity. I asked Dr. Sherman who was looking out for my interests as a viewer in this regard. His response was that this was a complicated issue, and he'd be willing to talk to me afterwards. I told him I'd rather he answer the question during the session. He refused!

I also told Dr. Sherman that I thought must-carry has created a new monopoly. The broadcaster has carriage independent of user satisfaction with his product. In fact, the discipline of the marketplace is circumvented. No matter how poor the programming, no matter how few the viewers, carriage is guaranteed! While it is true that poor programming might cause the loss of viewers and even sponsors, it will not lose cable carriage. Even if the broadcaster's programming only serves to warm up terminating resistors, it must be carried!

This all seems like an incredible waste of cable spectrum space and the exclusion of programming viewers want. This offends my sense of fair play.

Robust digital signals

I dropped in at the end of another session called "The Great Modulation Debate," for a paper by Gary Sgrignoli titled, "ATSC Transmission System: Field Tests Results." These actual field tests dramatically demonstrated that digital signals can be much more robust than analog signals. Sgrignoli said that anywhere there was a usable, though very poor, analog signal, there was a perfect digital signal. Of 169 receive sites, Channel 6 in analog yielded satisfactory reception in only 36.6 percent of the locations, while the digital signal was satisfactory in 81.7 percent of the sites. Of 199 receive sites, Channel 53 in analog yielded satisfactory reception in 76.4 percent of the locations, while the digital signal was satisfactory in 91.5 percent of the sites. Now this is serious food for thought!

The ATSC Digital Television standard has two modulation formats: 8-VSB and 16-VSB. The 8-VSB format is intended for broadcast purposes and can carry one high definition TV(HDTV) program, or several (four or more, depending on video quality trade-offs) Standard Definition TV (SDTV) programs. The 16-VSB format is intended for cable carriage. It has double the program capacity, but not double the capacity for carrying bits. How is this possible? The answer is instructive. The cable spectrum is cleaner and has fewer distortions and sources of interference. So the number of signal levels can be increased, while the amount of digital error protection is reduced. Even though the total number of bits has not doubled, the number of them which are available for the carriage of programming has doubled. Fewer are required for error protection. So cable can carry two HDTV signals in 6 MHz, while the broadcast signal can carry just one. Also, cable can carry eight to 10 SDTV programs (even more with statistical multiplexing), while the broadcast signal can carry just four or five.

Now this is an argument that can be played in the other direction! When we consider SDTV, and look at the ATSC Transmission System, we see that there is defined a 4-VSB and even a 2-VSB format. These formats are even more robust than the 8-VSB. They can provide perfect digital signals in places where the analog signal is absolutely useless! The trade-off? Fewer programs! Maybe two SDTV signals or even just one–but perfect in areas where no analog signal can go!

The rabbit ears solution

This leads logically to an alternate approach to the carriage of digital signals. If broadcasters utilize the full power of digital techniques, they can provide one or two standard definition TV signals to on-set antennas–what we used to call rabbit ears–in more locations than could have been served by roof-top antennas. That is, anyone who could have received an analog signal with a roof-top antenna, will be able to receive a perfect digital signal with rabbit ears, if the broadcaster utilizes the full power of digital signal protection rather than trying to cram in as many programs as possible. A significant benefit to the perceptive broadcaster: portable reception like never before. This portability is an advantage cable will likely never enjoy. CED

Have a comment?
Contact Walt via e-mail at: wciciora@aol.com


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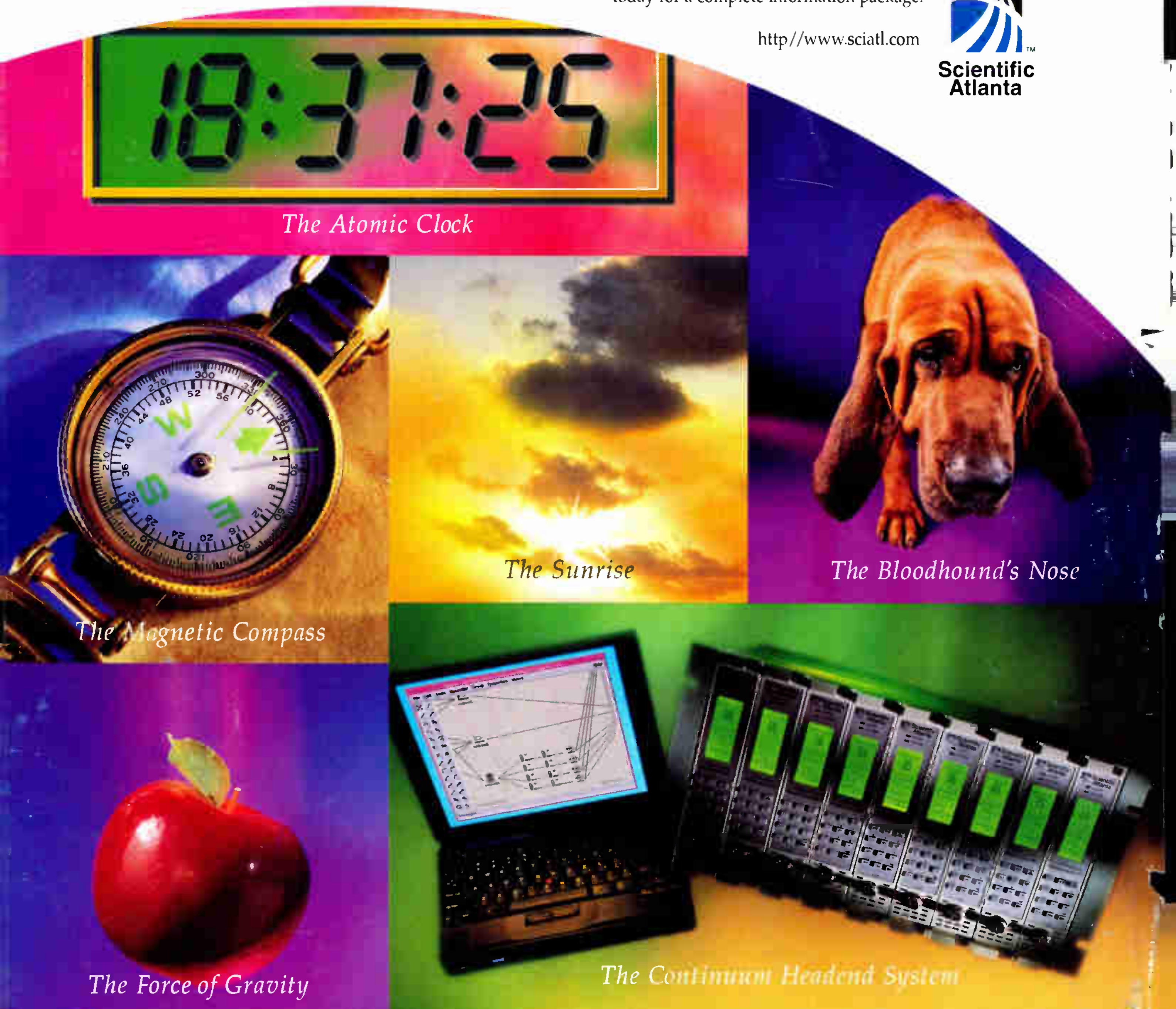

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