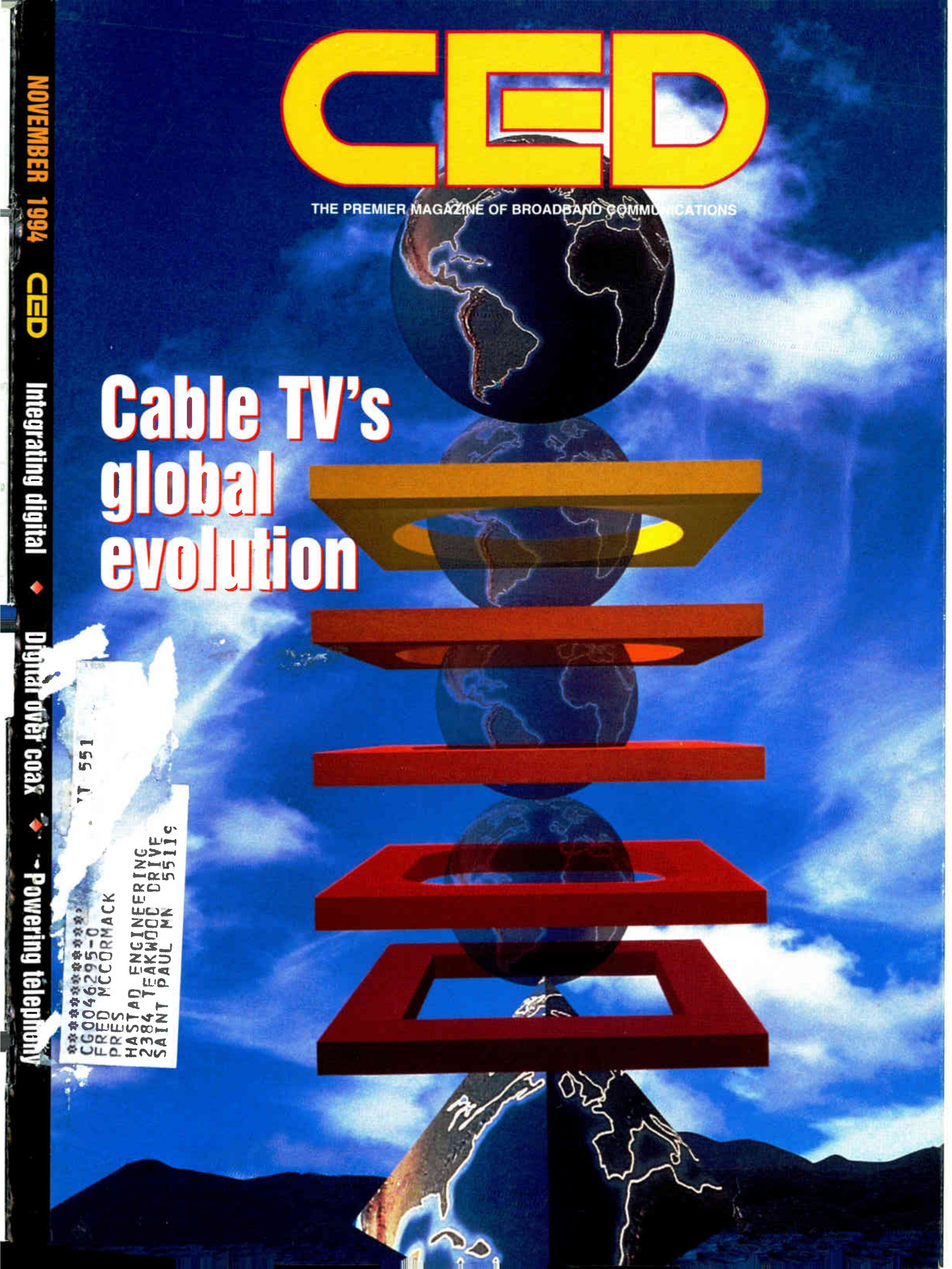

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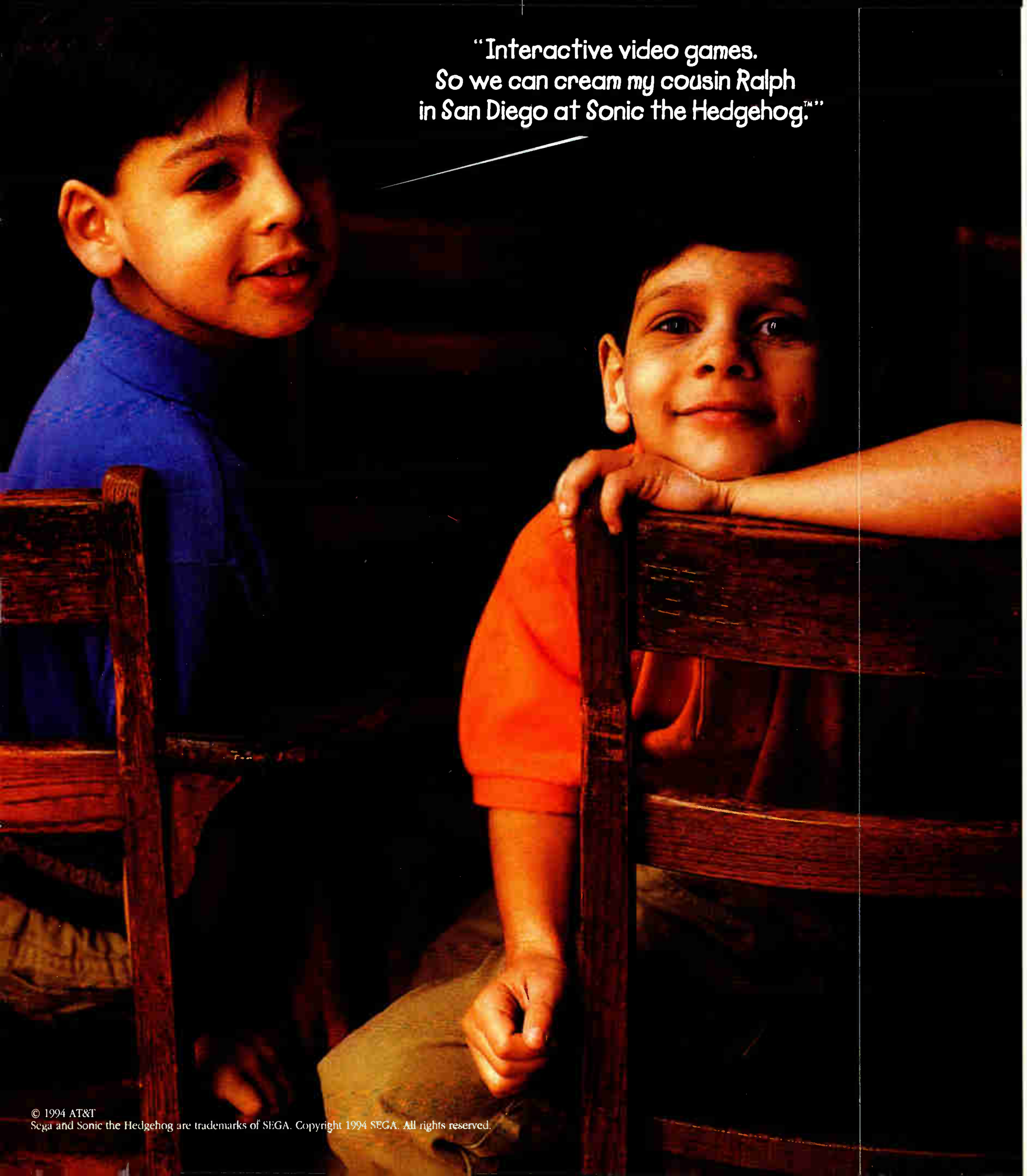

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Circle Reader Service No. 1

Resolving conflict and making progress

By Jeffrey Krauss, polishing apples in the information supermarket and President of Telecommunications and Technology Policy of Rockville, Md.

I have spent the last two months participating in the FCC's Negotiated Rulemaking on sharing of 27.5 GHz to 29.5 GHz between terrestrial Local Multipoint Distribution Service (LMDS), Fixed Satellite Service (FSS) links and Mobile Satellite Service (MSS) feeder links. LMDS is a potential competitor for cable TV. This is a new regulatory process, resolving disputes by forcing parties to negotiate rather than submit legal pleadings.

In this case, the parties could not fully agree on spectrum sharing arrangements, and calculations show that interference between satellite earth stations and LMDS is likely. But the information developed during the negotiations will help the FCC reach a decision on the issues.

The players and the issues

The FCC established a "Negotiated Rulemaking Committee" that consisted of three factions: LMDS, FSS and MSS. LMDS is proposed to be a two-way, point-to-multipoint service operating in the 27.5 GHz to 29.5 GHz millimeter wave frequency range. As proposed, two LMDS licenses would be granted in each area, one at 27.5 GHz to 28.5 GHz, and one at 28.5 GHz to 29.5 GHz.

Suite 12/CellularVision (my client) is the inventor of the LMDS system and is operating a service in New York. It uses omnidirectional transmissions, primarily for pay TV distribution. Other groups in the LMDS faction included Texas Instruments, Bellcore, Nynex, Bell Atlantic and a variety of universities and consumer groups.

The FSS players, who hope to use the 27.5 GHz to 29.5 GHz band as an uplink for large networks of very small earth stations, included Hughes, Teledesic, GE Americom and NASA. Hughes has filed a license application for a $3 billion system of geostationary satellites called Spaceway. Teledesic (owned by Craig McCaw and Bill Gates) has filed for a $9 billion network of 800 low earth orbit satellites that communicate with fixed earth stations. While LMDS is ready to be rolled out, these FSS players have little incentive to reach a spectrum sharing agreement now, because they don't plan to begin operations until the end of the decade.

The MSS players include Motorola Iridium, TRW, Loral/Qualcomm, Constellation and Ellipsat. Motorola wants to use 29.1 GHz to 29.3 GHz for links between its satellites and about eight fixed feeder link earth stations. The others may be forced into the 28 GHz band, but would prefer to use other frequencies. Only Motorola had an incentive to reach a compromise with LMDS interests, because it wants to begin construction of its system now.

Results of the process

The LMDS/MSS interference and sharing issue was partially settled midway through the negotiations by an agreement between Suite 12 and Motorola. Other LMDS proponents later joined in this agreement.

Regarding LMDS/FSS interference, calculations showed that LMDS systems were not likely to interfere with satellites, but earth stations could cause severe interference problems for LMDS receivers. Earth station transmissions could interfere with LMDS receivers that were hundreds or thousands of feet away, depending on relative pointing directions. But the high likelihood of shielding through building blockage was not taken into account in the calculations because no one could develop a way to model this mitigating effect.

Very late in the process, an antenna expert suggested that the earth station antenna patterns being used in the calculations were overly conservative, and that 20 dB to 40 dB of additional isolation was possible using antennas with improved sidelobe rejection. But there was no time left to do calculations using improved antennas. The committee concluded that FSS/LMDS sharing could not be shown to be technically feasible, using the technical designs that were submitted.

There are two things at stake here: the effectiveness of a new government procedure and a big chunk of radio spectrum.

Because the committee failed to reach total agreement, the FCC will issue a Notice of Proposed Rulemaking that proposes a resolution and gives some or all of the factions less spectrum than they wanted. Based on the partial agreement, Motorola is likely to get the spectrum it needs at 29.1 GHz to 29.3 GHz.

Among the possible results are:

✔ Give LMDS the entire 27.5 GHz to 29.5 GHz band and reject both Hughes and Teledesic.

✔ Give LMDS 27.5 GHz to 28.5 GHz and let Hughes and Teledesic fight each other for 28.5 to 29.5 GHz.

✔ Allow LMDS, Hughes and Teledesic to bid against one another in inter-service auctions.

This last approach seems practical, since both the LMDS and FSS transmitters would be widely deployed throughout each major metropolitan area. LMDS proponents supported this proposal, because they expected to participate in auctions against one another anyway, but Hughes and Teledesic hated it because they expected to get spectrum for free. The auction winner could be encouraged or required to sublease some of its spectrum to the losing faction.

This negotiation process did not work perfectly, but it did work partially. The technical experts for all sides were able to reach agreement on a common method of analysis. Most importantly, the FCC staff who participated came away with a much better understanding of all of the technical issues than they could have acquired by reading written submissions. CED

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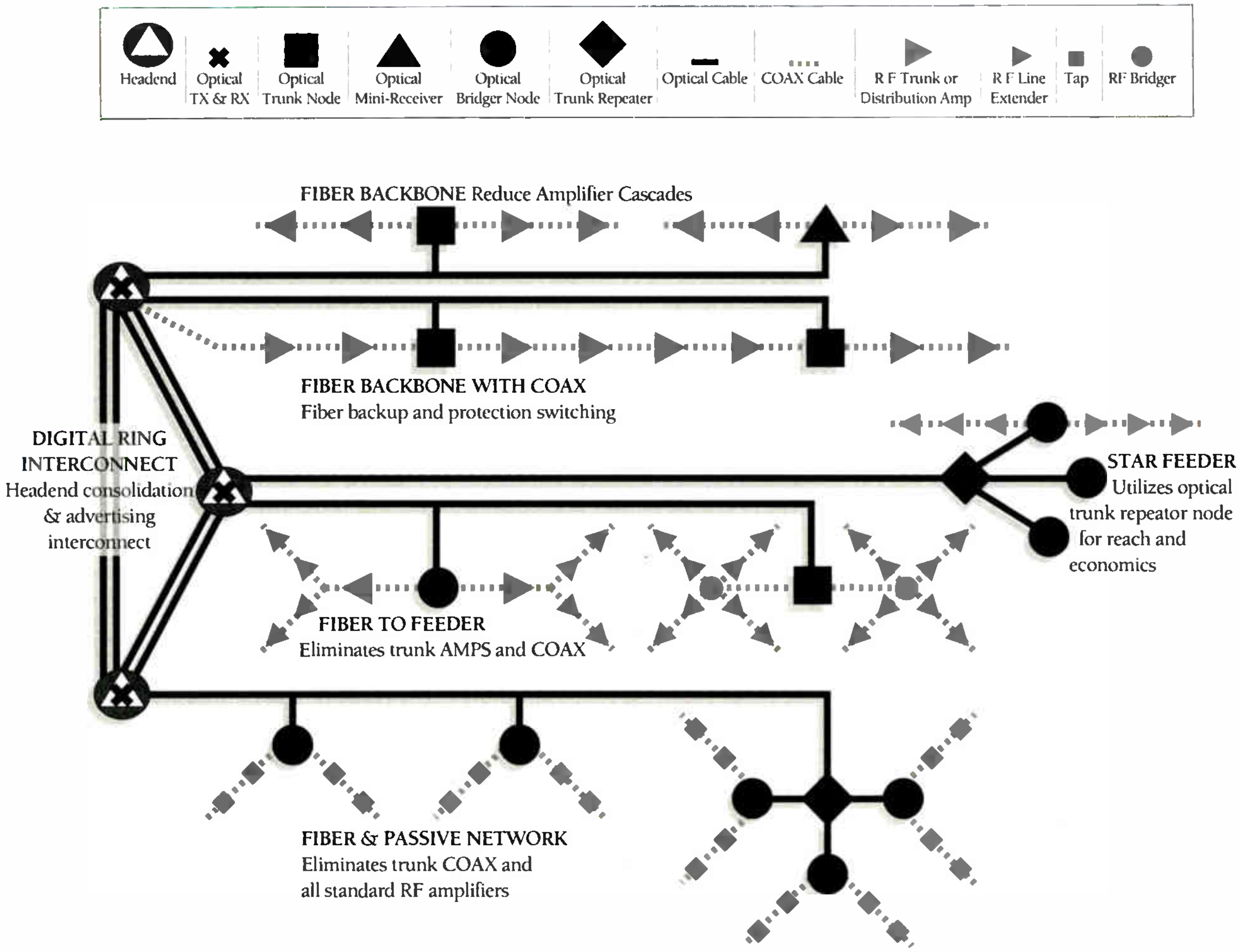

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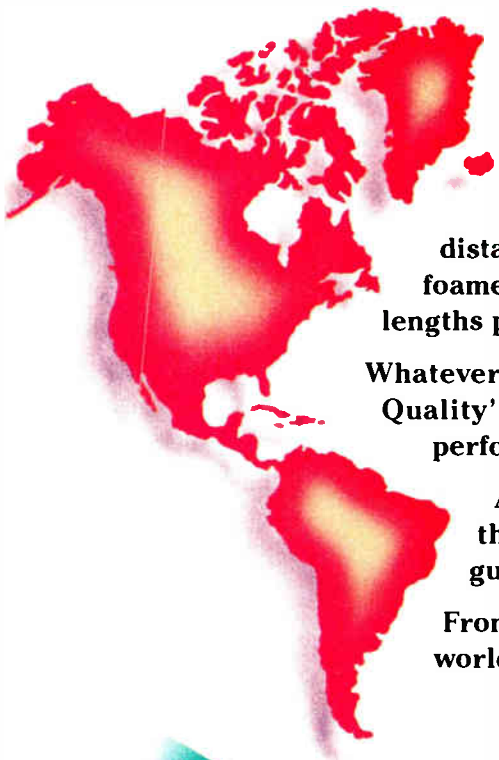

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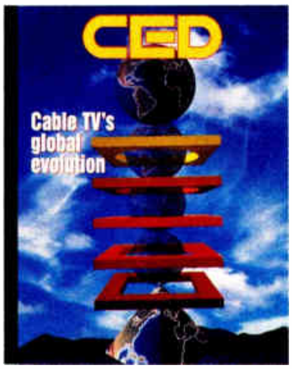

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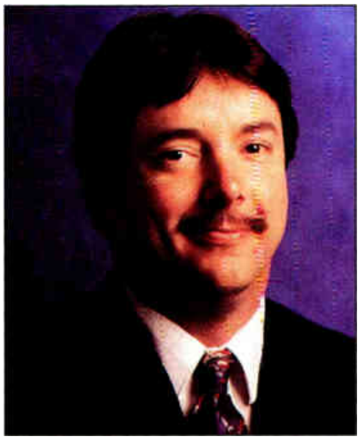

The hidden meaning behind CableNet '94

Visitors to this year's Western Cable Show in Anaheim will again be invited to attend the industry's showcase exhibit–CableNet '94–that demonstrates the might of a hybrid fiber coax network. The CableNet concept debuted during last year's show to rave reviews. Some even thought the message it conveyed about the cable industry's enviable position of having broadband networks already installed actually spurred the telcos to deploy broadband networks themselves.

This year, 45 companies have signed on to participate in CableNet, and the exhibit area will encompass 5,000 square feet, which forced the California Cable Television Association to expand the space it reserved at the convention center.

CableNet's message is indeed quite profound. It shows that the basic fiber/coax cable TV infrastructure can be used as the platform for a wide array of futuristic interactive applications. True video on demand, telephony over coax, video to the desktop and a host of other applications are shown to be possible.

The task of integrating all the players and making them "talk" to one another over the on-line exhibit falls to General Instrument, Intel, Northern Telecom, Scientific-Atlanta and Unisys. It will take a lot of work behind the scenes to make CableNet '94 work. The pieces and parts from those 45 companies don't just "plug and play;" they have to be specifically made to talk to one another.

In some ways, it's a marvel that CableNet can actually function as advertised. Although the cable industry has often gone out of its way to avoid developing and implementing standards, new players like Unisys, Sun, Tellabs and others rely on standards to make their products interoperate with someone else's. CableNet is akin to a technology melting pot in that all the different ingredients go in, and something entirely different comes out.

What comes out is truly astounding. Video whipping through the exhibit space at OC-48 speeds over a Sonet self-healing ring; a variety of video signals mixed and routed to their proper places via an Asynchronous Transfer Mode (ATM) switch; movies ordered at the touch of a button and then controlled by the viewer. Wow.

But within the promise of CableNet also lurks danger. As one engineer recently told me, "CableNet can be a very dangerous thing because it has the CEOs believing we can do anything–and they might get complacent." Conversely, the engineer argued, it provoked action from telco executives who saw all too clearly what CableNet can do.

For all its promise, CableNet is still an apparition. The engineering community needs to remind the CEOs of this to avoid becoming complacent. For if cable operators believe technology without vision of how to implement it will rescue them from competition, they're mistaken. And by the time they realize that, it's already too late. Keep building–or risk being an also-ran.

Roger J. Brown

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ALS doubles size of facility; may begin building RF gear soon

ADC Telecommunications, citing broadband network development growth, nearly doubled the manufacturing and R&D facilities of American Lightwave Systems in Meriden, Conn. ALS, acquired by the Minneapolis-based telecom supplier in 1990, has gone from $8 million in sales that year to a projected $60 million-plus for '95, said William Cadogan, chairman, president and CEO of ADC, in remarks at plant expansion ceremonies in Connecticut.

With the 50,000 square-foot facilities expansion ALS will be hiring 40 to 50 employees, bringing its work force to close to 200, said Farooque Mesiya, president and CEO of ALS. He and other officials said many more hirings would follow in '95.

Research is well along in development of new gear, possibly including a move into RF amplifiers

Farooque said that, for now, the company is concentrating on expanding output of existing product lines, which include analog optical distribution systems for hybrid fiber/coax (HFC) networks as well as digital supertrunking and distance learning equipment. "I think you'll see some major new products one to two years from now," he said.

Farooque declined to elaborate, but, according to other sources in the company, research is well along in development of new gear, possibly including a move into RF amplifiers and other electronics tied to HFC technology.

Presently, in any given project, ALS, as supplier of the optical portion of the network, is teamed with other vendors who supply the RF (coaxial) side of the system and other components. While this approach to winning contracts has worked so far, an official said, ALS would be more comfortable with more control over the overall performance of the network.

ALS has had significant success with its digital supertrunk line and is also expanding capabilities in this realm, officials said. "We're adding new ports into the DS-3 stream all the time," noted Wes Simpson, product line manager.

ADC's product line includes virtually every element of traditional telephone distribution plant, including wireless components marketed through ADC Kentrox. Increasingly, engineering expertise in various units is being pooled to expand the flexibility of the company's responses to customer requirements, Cadogan noted.

HDTV field tests show VSB shines

Results of a summer-long field trial of vestigial sideband (VSB) modulation technology for HDTV went well enough that some are saying the long-awaited HDTV standard could emerge by next Christmas.

"The field test results show that the digital HDTV transmission technology proposed by the Grand Alliance performs well in real-world conditions," said Richard Wiley, chairman of the FCC's Advisory Committee on advanced television, in a statement. Wiley called the effort an "important milestone" in recommending a system to the FCC.

Specifically, the field tests were designed to compare the system's broadcast coverage and cable robustness to the performance of current NTSC television systems. At 8-VSB and in the UHF band, "satisfactory reception" of the HDTV signal occurred 92 percent of the time, compared to 76 percent for NTSC signal reception. In the VHF band, transmissions were received "satisfactorily" in twice as many locations as NTSC.

The cable tests were just as encouraging. Even at cable sites which didn't meet FCC technical parameters, the directly-fed advanced television receivers were able to operate above the necessary threshold.

The combined over-the-air and cable tests took place in Charlotte, N.C. from May to June, and tested Zenith Electronic's 8- and 16-VSB system. The technology is a subset of the larger Grand Alliance HDTV system.

In the field tests, a broadcast site in Charlotte, N.C. sent one, 6 MHz advanced TV signal over the air using 8-VSB technology to eight local cable headends and a "roaming" receive station attached to a test vehicle. At the headends, the advanced TV signal was digitally reconstructed and a second, locally-generated advanced TV signal was added. The two were modulated with Zenith's 16-VSB technology for launch in a 6 MHz channel slot, over a variety of cable plant conditions, to 51 receive sites (41 remote locations and 10 headends).

The intent was to expose the 16-VSB format to worst-case plant conditions to test its ruggedness. Half of the locations had more than 25 amplifiers in cascade, and others were sent in the "rolloff" spectral region because the systems involved had no available 6 MHz channel chunks to accommodate the signal stream. In addition, the test used what became known as the "house in a box," which simulated worst-case in-home conditions such as a four-way split following a four-way split, with electrical shorts on each drop feed except the one feeding the ATV receiver.

Time Warner wins technical Emmy for HFC

Engineers with Time Warner Cable donned tuxedos last month to accept a Technological and Scientific Development Emmy award for a project some said "couldn't be done"–segmenting cable systems into "nodes," where broadband signals rode over AM fiber, then over coaxial cable, to subscriber homes.

The concept is widely known now as "hybrid fiber coax" design, and is acknowledged as the architectural bridge spanning existing and future network applications–from requisite entertainment video to interactive television, high-speed data and telephony.

Accepting the Emmy was Jim Chiddix, senior vice president of engineering and technology for Time Warner Cable, who passed along high praises to engineers Louis Williamson, John Walsh, Jim Ludington, Don Gall and several others.

The award is historically significant because it praises Time Warner's engineers, notably Chiddix and David Pangrac (now a consultant with CableLabs) for exercising enough technical vision to rise above some daunting challenges in the optical community during the mid-1980s.

Specifically, Chiddix and Pangrac channeled optical technologies in a direction that had never been intended, by using intensity modulation of laser transmitters to launch linear, analog signals down a piece of optical fiber.

"The especially satisfying aspect is that hybrid fiber/coax designs are the key factor behind the changes we're seeing in cable and telephone network topology," Chiddix said, and added that he's "really thrilled, and personally satisfied with the entire team involved

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with the project."

In 1987, Time Warner demonstrated a working model of a 40-channel link, which transported signals through 8 kilometers of singlemode, optical fiber. Viewing the demonstration were more than 40 members of the NCTA's engineering committee, who were meeting in Denver.

The engineers at the time, were "somewhat stunned and quite interested," said Wendell Bailey, vice president of the NCTA of the 1987 meeting. "There was definitely some skepticism in the room," said Bailey. "There were rumblings that what (Chiddix and Pangrac) were touting just couldn't be done."

MPEG encoders make their debut

Two MPEG-2 real-time digital video encoders were introduced last month, one from Toshiba and one from DiviCom.

DiviCom's product actually includes the encoder, a multiplexer and a system controller in what the company calls a fully integrated MPEG-2 broadcast system. DiviCom has already received orders for both digital encoders and decoders from Bell Atlantic, which plans to use those products in interactive TV trials.

DiviCom has chosen to use compression chips from C-Cube Microsystems. The modular encoder can be configured several different ways to accommodate different inputs. The unit outputs a single MPEG-2 compliant data stream. The multiplexer is used to combine MPEG-2 data streams generated by other DiviCom products into a a higher rate transport stream or to put local data inputs directly into the MPEG-2 transport stream. And the system controller uses SNMP management software to configure and monitor system components.

Toshiba says its product is the first MPEG-2 compliant encoder to offer both constant and variable bit-rate coding. Time Warner has already placed an order for two of the encoders and is expected to use them for high-capacity CD storage.

A decoder is currently under development by Toshiba, and both the encoder and decoder will be available to customers early next year, according to a company spokesman.

ICTV, Sybase partner to deliver interactivity

ICTV Inc. will work with Sybase Inc. to integrate Sybase's client/server-based software products and services with ICTV's interactive TV system. Sybase's family of software includes database servers, tools, connectivity and systems management products.

Specifically, ICTV has chosen to use the Sybase SQL Server 10 as its engine for message routing, control and delivery of real-time data from video and multimedia servers and to integrate it with business systems for billing, customer service and other functions.

The network is modeled after a telephone switching system and consists of multimedia cards

In addition, ICTV will use Gain Momentum as part of its authoring standard and will work with Sybase to build extensions to develop interactive applications. Also, ICTV will use Sybase's Gain Interplay as an execution engine on the ICTV "multimedia cards" to display interactive applications, and will gain consulting and development expertise from the Sybase organization.

ICTV's interactive architecture provides intelligence at the headend and requires only slight modifications to the set-top box. The network is modeled after a telephone switching system and consists of multimedia cards that are installed at the headend and software for the headend and set-tops. The system will be field tested by Cox Cable in Omaha next year.

Jottings

Hewlett-Packard has chosen LSI Logic to supply digital video and audio decompression chips for HP's first generation interactive set-top boxes. The HP boxes, scheduled for release in mid-1995, will provide on-screen program guides and will support a wide range of interactive applications. TCI and Comcast have placed orders for HP boxes . . . **IT Network** has chosen EDS to provide a database product and subscriber management information system to support IT's 1995 launch . . . **Probita Inc.** has been selected by Bell Atlantic Network Services to help it define and evaluate the operations support system (OSS) architecture that will be required for interactive services. The Boulder-based software company, which cut its teeth when TCI rolled out addressability nationally, will work with BA as the Baby Bell company deploys interactive services over its network. Specifically, Probita will evaluate the network plan and define the deployment topology of physical components like switches and controllers. A new OSS will be needed in the interactive age to track and account for all transactions made by viewers of interactive TV . . . **Zenith** has developed a faster version of its cable TV modem for connection with computers. The new HomeWorks Elite system operates at 4 Mbps (up from 500 kilobits per second) and is available now. In addition, Zenith announced it has partnered with Viewpoint Systems to supply interactive videoconferencing and collaborative computing capabilities over cable TV systems for people who work at home or other networking applications. Users can conduct meetings and work simultaneously from "Windows" on their PCs over Ethernet data networks. . .As this month's cover story points out, cable systems under construction in Latin America are indeed state of the art. To drive home that point, Brazil has launched its first complete digital TV service. **TVA**, the country's largest "pay TV" company, turned on a General Instrument DigiCipher compression system . . . Meanwhile, **Rochester Telephone** and **USA Video** have turned on their joint video on demand service to an apartment complex located in suburban Rochester. Approximately 50 customers are currently on-line. System hardware is located in a RochesterTel central office that is connected to the apartments via fiber. The signals are then integrated into the existing cable TV system and received via a set-top that is used to order movies and perform such functions as pause, rewind, fast forward, etc. . . . **MCI**, the long-distance telephony carrier, is knocking on cable's door. The company said it intends to use its network to deliver, store and insert advertising into cable systems and will develop video servers to deliver info and programs to cable systems. Horizon Cablevision in Lansing, Mich. will be the first to tie into the network. Separately, MCI said it made a $30 million investment in Interactive Cable Systems, a Los Angeles-based private communications company that provides cable, telephone and security services to MDU owners . . . There's a lot riding on who becomes the de facto standard for electronic program guides, but **Starsight Telecast** pocketed two more licensing agreements, adding Sony and Panasonic to the fold. Starsight, which is backed by Viacom, Cox, Times Mirror Cable and KBLCOM, among others, already has agreements with several other large TV makers as well as set-top makers General Instrument and Scientific-Atlanta. CED

Harris: Up to the (constant) challenge

By Dana Cervenka

Whether he was standing knee-deep in fish as he repaired a fishing fleet's two-way radios, or keeping U.S. skies safe from foreign missiles, Michael Harris has always held one deeply felt belief: the technology's the thing.

At 48, Harris, in his capacity as senior vice president of engineering and technology, is charged with overseeing all of the technical operations for Century Communications Corp. and Centennial Cellular. That includes everything from alternate access and strategic planning for PCS, to MMDS and DBS service rollout in Australia. He eats, sleeps and breathes technology, but then, he always has.

His parents must have known what path their son would take when he studied theory and Morse code, obtained his amateur radio license and started building radios and staying up late into the night to talk to Hams all around the globe–when he was just 15 years old. After graduating from college with a degree in electronics in 1966, Harris headed off for the wilds of Alaska and a job with the Red Salmon Canning Co., servicing mobile radios on fishing boats, flying around Alaska on a wing and a prayer, and eventually hooking up with RCA on the White Alice project, which was the continuation of the Defense Early Warning (DEW) line. "Alice" was a series of military radar installations along the western bank of Alaska and the edge of Canada which scanned the skies for incoming missiles (in the days before military satellites). Harris worked on RCA's high-power, Troposcatter system, a massive antenna array that sent transmissions soaring into the troposphere, where they would scatter, and return to earth.

The Alaskan adventure came to an abrupt end when Uncle Sam called, and Harris was inducted into the army, eventually to operate a calibration lab for both electronic and physical standards. After finishing up his final tour of duty in Vietnam, he returned to his hometown of Richland, Wash., embarking on his adventure in cable when he joined Teleprompter in Seattle as northwest regional engineer. Then the real challenge began, when Leonard Tow invited Harris to join the fledgling Century Communications in its California cable operations.

One man's mailbox...

As Century's engineering point man, he was faced with quite the task. "We had 12-channel equipment in all of our systems, and most of the homes we passed could receive 18+ channels off the air," recalls Harris. "Needless to say, we had very poor saturation and only serviced the homes that could not receive off-air signals. The amplifiers were terrible, and some of the technicians would adjust the signal levels by tightening the housing screws."

Imagine his excitement when Tow purchased some new systems in Virginia that were *not* 12-channel systems. This is going to be great, Harris thought—until he discovered that the new acquisitions were actually *five*-channel systems.

In what was to become another engineering challenge, it rapidly became apparent that there was something a little strange about the construction of the new systems: the amplifiers were built in what appeared to be old, rural mailboxes. When Harris inquired as to what the brand name was, he was told simply, "Ralph." "I'm sure that there were many rural mailboxes missing whenever Ralph did a production run," he smiles.

Century, and Harris, have come a long way since Ralph. Most of these early systems are now at 750 MHz and are operating off of self-healing optical rings. What's more, Century now has its hand in radio broadcasting and cellular telephony and boasts more than one million cable subscribers, plus 6.2 million cellular POPs in Centennial. As for Harris, he has climbed the ladder from director of engineering for Century to senior vice president, engineering for both Century and Centennial Cellular.

Wearing his cable hat, he's currently overseeing rebuilds in California, Indiana, West Virginia, Ohio, Kentucky, Arizona and San Juan, Puerto Rico, among other locations. "I'm trying to build all of the networks with as wide a bandwidth as I can reasonably buy, and I'm also trying to build each system that I have with redundancy," notes Harris, "so that if our fibers get cut, we don't go off the air."

He finds Century's new foray into Australia to be both fascinating and rewarding, as the country has been video-deprived until the present (only four broadcast stations), and the company will be bringing both MMDS and direct to home satellite service to subscribers.

And if overseeing a wide scope of technical operations doesn't keep him busy, his family will: wife, Louise; daughters Sarah (3) and Julia (15 months); sons Raymond (17), Michael (25), Robert (18), David (23); and pets Riley (Heinz 57) and Annie (beagle).

Personally and professionally, this man is leading a very full life. "The last 21 years at Century have been fantastic," notes Harris, "and have gone by in a heartbeat." Those many years spent in communications have provided him with an interesting perspective on how to approach the information superhighway.

"You can talk about video on demand, you can talk about telephony, you can talk about Compuserve. And it doesn't matter. . .that's totally irrelevant," Harris emphasizes. "What matters is that you have to build the network that will reliably provide these data services and TV services. . .to and from the home. Once you build that network, you can put in anything you want." CED

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Powering options for cable telephony

By Chris Bowick, Group Vice President/Technology, Jones Intercable

In order for us to compete with the entrenched providers of telephony, one of the most challenging issues still to be resolved is that of network versus subscriber powering. Do we power the subscriber's telephone service via our network infrastructure, or via power taken from the subscriber's premises? When the local power company fails, is back-up power best supplied by the network, or via a battery co-located with the subscriber's interface device?

Network powering is the option the telcos use. In the telco world, normal operating and back-up battery power are supplied via the central office and transported via the copper twisted pair into the home. Unfortunately, in CATV networks, powering is not that simple.

One option is to simply use the existing coaxial drop to power the electronics required in the home. Power inserted on the coaxial center conductor must be allowed to pass through to the drop. Existing taps must therefore be replaced with power-passing taps to allow network power down the drop to the customer interface device.

The *output* of the customer interface device, usually located on the side of the residence, consists of both a normal coax (without center conductor power) for the entertainment portion of the network and a twisted pair connection to the existing house wiring. One issue yet to be resolved is the potential for accelerated corrosion caused by power carried over coaxial drops constructed with dissimilar metals.

The Siamese twin

Another drop architecture being considered for network powering is the "siamese" drop cable that would provide coax along with either a single copper wire, or multiple twisted pairs of copper wire into the home. If the customer interface device were located on the side of a home, for example, a single copper-wire siamese drop cable could be used to bring power *around* the RF tap to the home, thus eliminating the need for a power-passing tap. The copper would be used to carry power *only*, while both video and telephony services would still be carried on the coaxial portion of the drop.

If, on the other hand, the customer interface device were located at the tap in a remote location away from the home, a siamese drop cable with one, two or more twisted pairs could be used. In this case, each of the individual copper twisted pairs would carry a DS-0 (64 kB) telephony signal (separate phone lines) as well as network powering from the remote electronics into the home, while the coax would continue to carry only the entertainment services. Note that with this approach, the number of phone lines each subscriber could have would be limited by the number of twisted pairs provided in the siamese cable between the remote electronics (tap) and the home.

The problems associated with network powering are fairly obvious. The use of siamese cable in either of the above scenarios would require replacing every drop for those subscribers who take the telephony service. If, on the other hand, coaxial powering is used, every tap plate will have to be replaced with a power-passing tap for those subscribers who take the service.

In any event, depending upon the configuration of the existing network, there would be some costly rearrangement required with either the addition of more standby power supplies, or perhaps beefing up the current capacity of the existing power supplies, in order to supply the additional power to run the electronics in the customer interface devices. The additional power required will increase monthly operating costs.

Note, however, that since these supplies are accessible via public rights-of-way, and each will be capable of handling many homes, the associated maintenance and battery technology upgrades should be easily managed when compared to subscriber powering.

Subscriber power

Power may also be supplied to the customer interface device either via direct connection to 120 VAC at the subscriber's circuit breaker junction box, or via a power convertor/transformer that plugs into a standard wall outlet inside the home. The customer interface device would also contain standby battery power. What could be easier? In fact, this approach allows the customer, rather than the operator, to pay the cost of powering the unit. Taps and drops don't have to be replaced as subscribers are added.

Unfortunately, subscriber powering isn't a panacea. Because we're dealing with a lifeline service, liability becomes a major issue. The service must be reliable in the event of a power outage. Yet it must also be readily installed and maintained. With standby battery power located at every subscriber's home, even if each supply and its standby battery capacity can be remotely monitored, the burden placed on technicians (or the customer?) to maintain the reliability of these standby power supplies might be overwhelming.

Upon initial installation, access to the junction box and 120 VAC would require electrician certification for the technicians. And with the outlet-mounted transformer, there is concern the unit could easily be removed or could accidentally fall out of the outlet, leaving the batteries dead and the phone not working. In addition, current battery technology, while improving, will not yet provide a level of back-up equivalent to what the phone companies provide today.

These issues are solvable, but it will require a significant effort from manufacturers and operators working together to create an economical solution that is easily installed and maintained, and reliable. Just don't make me change out all of my drops or tap plates! CED

suggestion to require that cable operators provide component decoders to subscribers with "cable-ready" equipment when we finalize the Decoder Interface standard."

Regarding Digital Signals, from the R&O:

§ 3: ". . . the cable and consumer electronics industries are close to agreement on a new Decoder Interface standard that will serve both existing analog cable operations and also incorporate flexibility to support new technologies and services, including digital cable service. . ."

§ 30: ". . . we expect that the Decoder Interface connector will be flexible enough to accommodate most, if not all, of the attributes of cable digital service . . ."

§ 34: "We also noted that the CAG, in connection with the Joint Engineering Committee (JEC) of the EIA and the NCTA, was developing an updated version of this standard to provide a hybrid analog/digital Decoder Interface that would be able to be used for both present analog signals and new digital TV signals."

Footnote 26: "The CAG included a copy of the Interim Report of the JEC's Decoder Interface Subcommittee on EIA IS-105 that presents the current state of the work developing the new Decoder Interface standard. This interim report states that the new EIA IS-105 standard will provide complete compatibility with all of today's analog scrambling systems and has also been designed to be extensible to future digital services. . . ".

§ 34: ". . . We also proposed to require cable system operators that do not use "in-the-clear" signal delivery technology to supply their subscribers with component descrambler/decoders to process scrambled and/or digital video service through the Decoder Interface and to provide service in a form that is compatible with a component descrambler/decoder . . . "

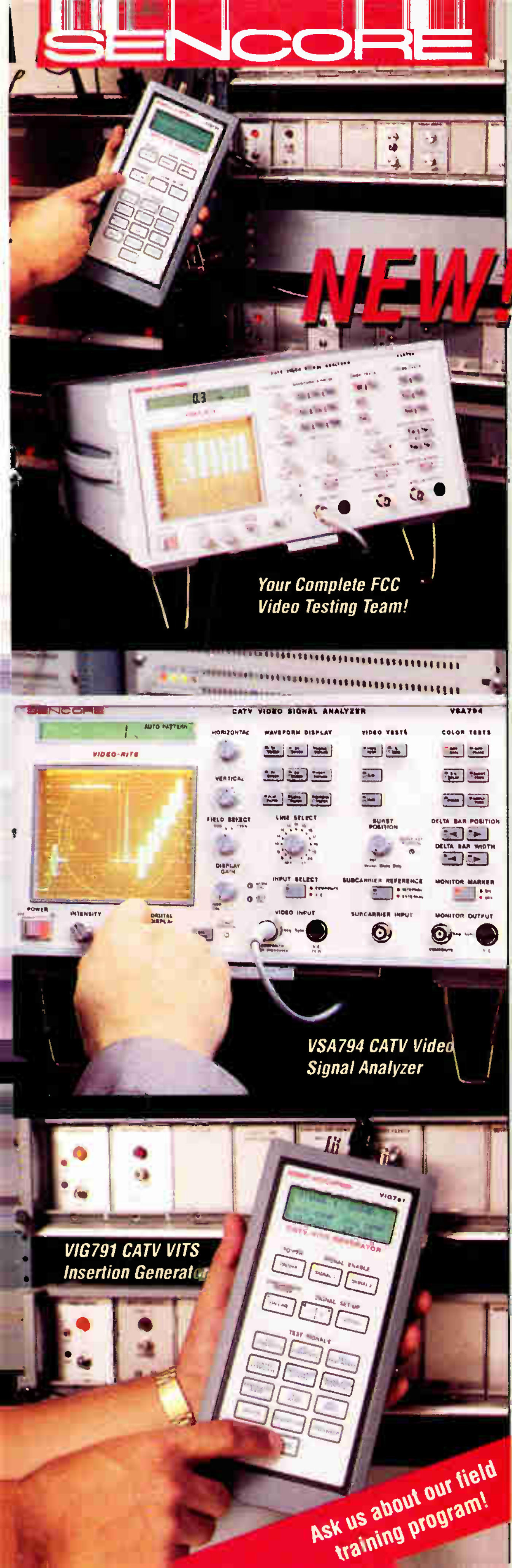
"...The Joint Cable Commenters and Zenith submit that the improvements in the new standard ...are worth the wait..."

§ 36: ". . .The Joint Cable Commenters and Zenith Electronics Corporation (Zenith) submit that the improvements in the new standard, particularly the ability to accommodate all current analog scrambling methods and to provide a solid transition path to digital transmissions, are worth the wait for the new standard . . ."

§ 36: ". . . NCTA, in its reply comments, indicates that the design of the updated Decoder Interface will provide the necessary avenues for new services whether transmitted in analog mode or modulated digital or baseband digital modes."

§ 39: ". . . the forthcoming standard . . . serving all existing scrambling systems, for accommodating new cable technologies and services and for providing a migration path to digital cable service, make it a clear choice over the existing EIA/ANSI 563."

§ 59: ". . . the Decoder Interface approach that we are pursuing should provide for processing of compressed video signals." CED



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"Myopic" is a term used to describe a narrowly focused or short-sighted view of anything. Occasionally, a myopic approach has merit. For instance, in an emergency, there may be only one course of action to save a life. But in most situations, a broader look usually provides a better plan and a more desirable result.

Myopia often disguises itself as comfort. By that, I mean doing things we know best and not pushing ourselves to do more. To grow as a person and a professional takes a conscious effort to absorb knowledge from every source. This means forcing yourself to do or read things that aren't "warm and fuzzy." The main point is not to limit your career opportunities by learning through "tunnel vision."

You are all familiar with *CED* and *Communications Technology* and probably read them from cover to cover. But what about *Cable World*, *Multichannel News*, *Cablevision* or other industry publications? Do you force yourself to read operations and marketing articles, or do you focus only on "techno-wizard" sections? If you do the latter, myopia may have crept in. Don't miss the opportunity to better understand your business–don't exclude the views of other disciplines helping to shape its future.

Even the most myopic person cannot escape the fact that competition is coming to cable TV. The driving force behind this competition is an unprecedented number of new or improved signal delivery methods. Telephone, DBS, LVDS and MMDS providers all believe they can deliver more and better services to our subscribers. Competing effectively in this new environment will require at least a basic understanding of these alternative technologies. How do they function? What are their strengths and weaknesses? Why do they think they can take our subscribers? The answers to these questions are available, if you take the time and know where to look.

To that end, you must broaden the scope of your reading to include source material from other technologies like broadcasting, telephony and computer networking. It may surprise you to discover how many good trade publications are available free for the asking. A few examples are: *TV Technology*, *Microwave Journal*, *Telephony*, *Wireless Design & Development*, *Communications News*, *Installation & Maintenance*, *LAN Computing*, *LAN Times* and *Processor*.

In addition, there are numerous vendors and equipment manufacturers that provide excellent documentation and manuals for free. Combining these resources into your normal learning process will provide a clearer picture of the competition. These materials can also augment your existing training program.

"Myopia is not a life-threatening condition." That's a fair statement, unless you're crossing a crowded street. If you don't bother to turn your head and look both ways, you'll be broadsided on the information superhighway. Take advantage of every resource available–learn what other technologies and people have to offer and use it to compete and win.

Michael Gardner
Insight Communications

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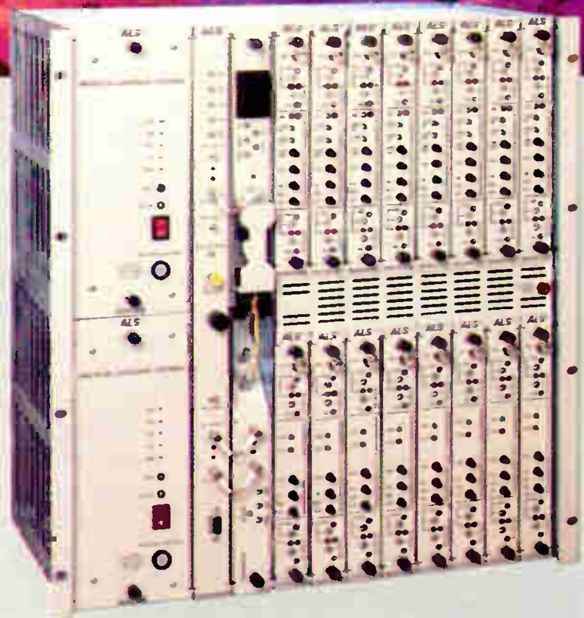

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COVER STORY

Suppliers squeezed to meet demand

Get your orders in now

PHOTO BY STEVEN HUNT VIA THE IMAGE BANK

By Leslie Ellis

Got a network rebuild planned and can't get equipment?

The number of operators who are feeling the pinch of a short supply of equipment and long lead times is growing because cable television is booming globally, according to the equipment manufacturers.

Indeed, network operators both internationally and in the U.S. may soon feel the pressure of an unprecedented equipment supply squeeze, triggered by simultaneous orders for high bandwidth products from three swelling markets: cable operators, telcos and international network operators.

Historically, international cable companies have fit a different supply profile, demanding mostly used/refurbished, lower-bandwidth electronics, industry experts say. But all that has changed, according to several swamped hardware suppliers. This year, in fact, that trend has almost completely reversed itself, with operators in Latin America, Europe and the Pacific Rim demanding the same equipment as their U.S. cable colleagues.

"There was a time when you could pass along the lower bandwidth components to (Latin American operators)," says Fred Rogers, president of Quality RF Services, a supplier of upgrade electronics for amplifiers. "That's just not the case anymore."

It used to be that 300 MHz and 400 MHz refurbished equipment satisfied the needs of overseas cable operators. Now, those entities are instead lobbying for new, 750 MHz gear. "We're seeing orders for new equipment, at bandwidths of at least 450 MHz and higher," agrees John Weeks, president of John Weeks Enterprises. "We're seeing that trend all over Mexico, and in Central and South America."

Manufacturers including Philips Broadband Networks, Scientific-Atlanta and General Instrument are all citing remarkable growth in international orders for high bandwidth products. S-A, for its part, said international sales represent 30 percent of its overall revenues. General Instrument is also seeing all-time records in international and domestic distribution sales, says Andy Devereaux, vice president of strategic planning.

"International activity is off the charts," Devereaux says, noting that GI formed a "strategic business unit" to handle international customer demands last fall, in response to the high growth.

The situation is the same at Philips Broadband Networks, says Al Kernes, vice president of sales for the company. "We're seeing extremely high levels of demand for new, 750 MHz equipment from all points," Kernes says.

Notably, Philips is in the midst of worldwide integration effort within its European and U.S. divisions to provide a true end-to-end broadband network product line for U.S. and international operators, from digital servers to set-top terminals, Kernes said.

Fiber sales up

Sales of fiber optic cable are also on the rise, internationally, suppliers say. "With everyone we talk to (in South America), if they're planning any kind of rebuild, they're considering using fiber more often than not," says David Morales, president and CEO of Communicaciones Broadband, a South American equipment distribution firm jointly owned by ANTEC and Scientific-Atlanta.

A case in point is Wharf Cable, which expects to

"We're seeing orders for new equipment, at bandwidths of at least 450 MHz and higher"

A robust digital link for in-residence distribution

Two-stage modulation

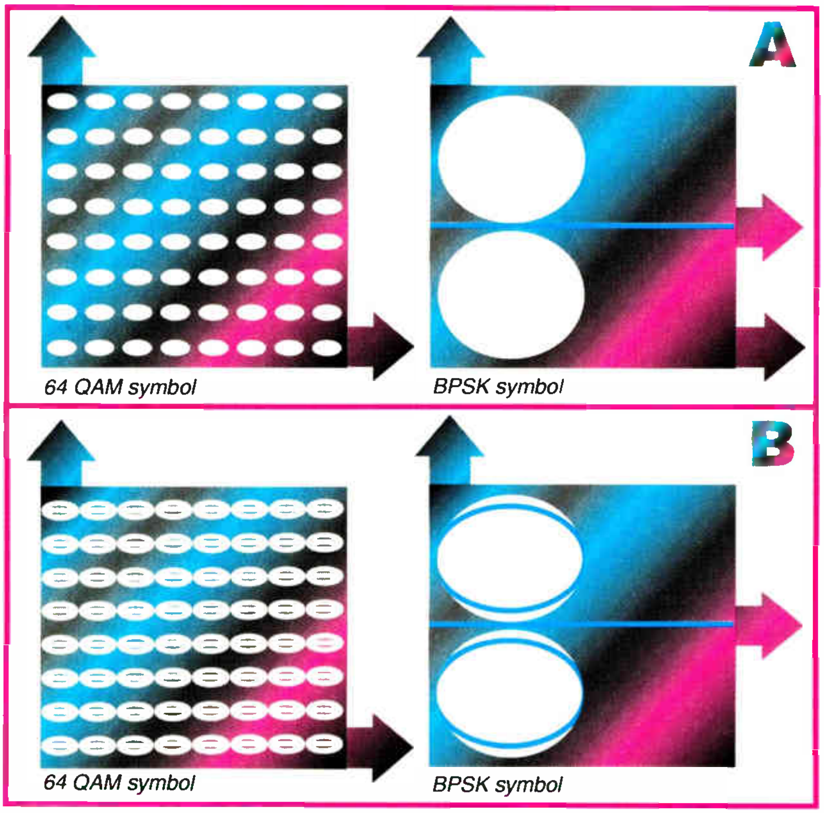

Figure 1: *This stylized representation of 64 QAM and BPSK symbols shows why BPSK has a higher noise immunity. In "A," at the top, there is no noise ingress and the oval data "eyes" remain open. In "B," noise ingress to one of the 64 QAM data eyes has been replicated in all, causing signal failure. The same amount of noise ingress to the larger BPSK data eyes has not impaired the signal.*

By Alastair Warwick, Manager of Broadband Access Technology Applications, and Robert Thomas, Member, Scientific Staff, Broadband Access Technology Applications, BNR

As cable companies prepare to shift from analog to the digital world promised by the MPEG II standard, it has been assumed that a single modulation scheme will transmit digital signals all the way from the cable headend to the in-home set-top box. High-density modulation schemes have been proposed, such as 64 QAM (Quadrature Amplitude Modulation) and 16 VSB (Vestigial Sideband), which are known for their spectral efficiency. Extending the high speed and high bandwidth of these schemes into the home seems the simplest way to build cable architecture.

But closer scrutiny reveals that while high-density modulation schemes work well up to the home, a more robust solution will be required for in-residence distribution. Unlike the wiring in the distribution network, the in-home portion of cable TV plant varies widely in quality, with consequent interference because of noise ingress and reflections.

"Noise" is random disturbance of a signal due to poor connections and damaged cables. Common noise sources within the home are electric appliances; cable-affecting noise from outside the home comes from car ignition systems, ambient signals from local TV and radio stations and cellular telephone use.

"Reflections" are signals that arrive at the receiver at different times from the primary signals, producing "echoes" or "ghosts" on the TV screen. Reflections most often result from open cable jacks in the home and inferior, poorly-installed splitters and connectors (such as VCR connectors). In addition, reflection patterns change each time a TV changes channels, causing interference (See Figure 2).

While analog cable signals can survive relatively high levels of interference without unacceptable image deterioration, digital signals are more vulnerable. The advantage of digital signals is that in the presence of normal amounts of noise ingress and reflection, they can recreate themselves perfectly. But as interference levels rise, the signal undergoes what is known as the "waterfall effect"—at one point the signal is intact; but with an incremental level of noise, it ceases abruptly. Digital transmission does not fail gracefully.

The interference introduced by poor in-home wiring is not limited to the individual subscriber's home: it can affect an entire neighborhood. An improperly-installed splitter could channel interference to surrounding homes connected to the same cable. Cable signals that arrive at an open (unused) jack in one home may be sent back out into the rest of the network as a reflection. Both of those conditions can cause failure of a digital signal.

Bell Northern Research (BNR) estimates in-home wiring conditions severe enough to disrupt digital signal delivery could exist in up to 10 percent of all homes. One solution, of course, is for cable technicians to upgrade in-home wiring as needed. That solution promises to be expensive. Assuming technicians might spend from two to three hours correcting the quality of splitters, connectors and the quality of the in-home cable itself, the cost per home could be from $10 to $30, posing a significant barrier to entry for digital services.

In investigating solutions, BNR assumed that the spectral efficiency required in the distribution network would be unnecessary in the home. In a cable architecture that provides selection at the wall box, the drop need only carry signals for one, or at most, a few subscribers. That offers the opportunity to employ a transmission system that trades spectral efficiency for simplicity, ruggedness and low cost.

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In lab tests conducted last winter, BNR employed a two-stage modulation scheme, in which separate types of digital links are used for the distribution and in-home portions of the network. In the two-stage scheme, high-density modulation (such as 64 QAM or 16 VSB) is used from the cable headend to the home. The signal then is remodulated for the home according to a second scheme with less spectral efficiency but high noise immunity.

Bipolar Phase Shift Keying

For remodulation at the home, BNR has taken a new look at an old technology. Bipolar Phase Shift Keying (BPSK) was developed as a modulation technique for digital radio communication. BPSK has a much greater noise immunity than high-density modulation schemes such as 64 QAM. While 64 QAM has six times the data capacity of BPSK for a given bandwidth, its relatively small data sites (more properly called "eyes") are easily blocked by noise or reflections (see Figure 1).

BPSK "eyes" are relatively immune from blocking. Because of its vulnerability to noise, 64 QAM requires sophisticated echo cancellation to avoid interference. Since echo cancellation sufficient for the distribution network is not enough for the increased levels of interference to be expected in the home, a more sophisticated echo cancellation scheme would have to be developed in order for 64 QAM to operate in 100 percent of subscriber homes.

For example, changing TV channels changes the echo pattern associated with those channels; the digital receiver must detect the

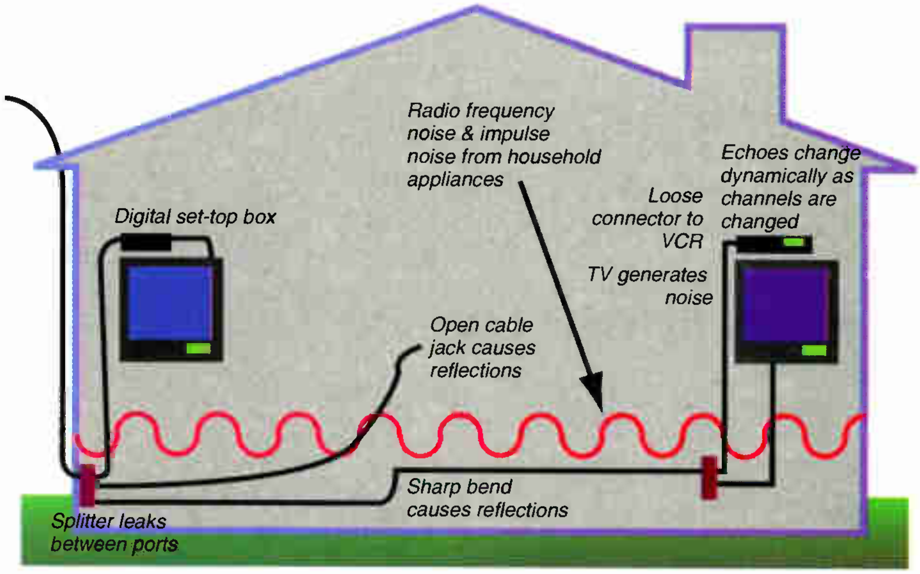

Figure 2: Sources of in-home interference for digital cable TV

new echo pattern and develop a new cancellation pattern. BPSK's larger data eyes can tolerate much more noise, making them virtually immune to echoes; echo cancellation is unnecessary. In part for this reason, BPSK demodulation is about one-third the cost of QAM.

BPSK also causes less channel interference than an analog TV channel. For example, closely-spaced analog channels can cause "walking" patterns on the screen. Digital channels with BPSK modulation cause little interference with neighboring analog channels.

Lab tests

In early 1994, BNR staff members in Ottawa, Canada created a typical home environment to conduct a series of cable tests using BPSK modulation. The purpose of the tests was to determine the reliability of BPSK in the presence of various levels of in-home interference, and to ensure that BPSK digital transmission would not interfere with analog channels.

The lab setting replicated the recreation room and living room of a home, with a TV and VCR in each served by 350 MHz of bandwidth from the local cable franchise in Ottawa. The BPSK signal was placed above the 350 MHz signal. One of the TVs received digital signals with 150 Mbps of BPSK modulation. Three cable "arms" issued from a basement splitter: one to the recreation room, one to the living room and one to an open jack.

In the first phase of the test, lab technicians picked up ambient broadband radio frequency noise on a small antenna and allowed it to be picked up by the open jack. At the point that interference began appearing on the analog TV channel, the digital TV signal with BPSK remained unaffected.

The second phase of the test involved moving a BPSK signal incrementally closer to an analog channel, to determine whether the BPSK signal would cause interference. As the BPSK signal encroached on the analog channel, however, the image remained intact, with only a slight "fuzziness" indicating the proximity of the signals.

Summary

As cable goes digital, it is expected that poor in-home wiring will cause digital signals to fail in as many as 10 percent of homes, due to the inferior quality of much in-home wiring and the noise sensitivity of commonly-proposed high-density modulation schemes such as 64 QAM and 16 VSB. Inspecting and upgrading the quality of in-home wiring on a house-by-house basis could increase the cost of introducing digital services by as much as $10 to $30 per home.

Last year, BNR tested a simple, cost-effective solution—a two-stage modulation scheme. The scheme calls for high-density digital links in the distribution network, where spectral efficiency is at a premium and cable quality is high. Providing a more robust high-speed link with lower capacity, BPSK has emerged as a viable solution for improving cable reception in the home, where ruggedness, rather than high capacity, is called for.

BPSK has high noise immunity, and it's less expensive than 64 QAM and 16 VSB. In BNR lab tests, BPSK has easily handled typical adverse in-home wiring conditions, while not encroaching on analog signals. CED

Bell Northern Research (BNR) is the research and development subsidiary of Northern Telecom.

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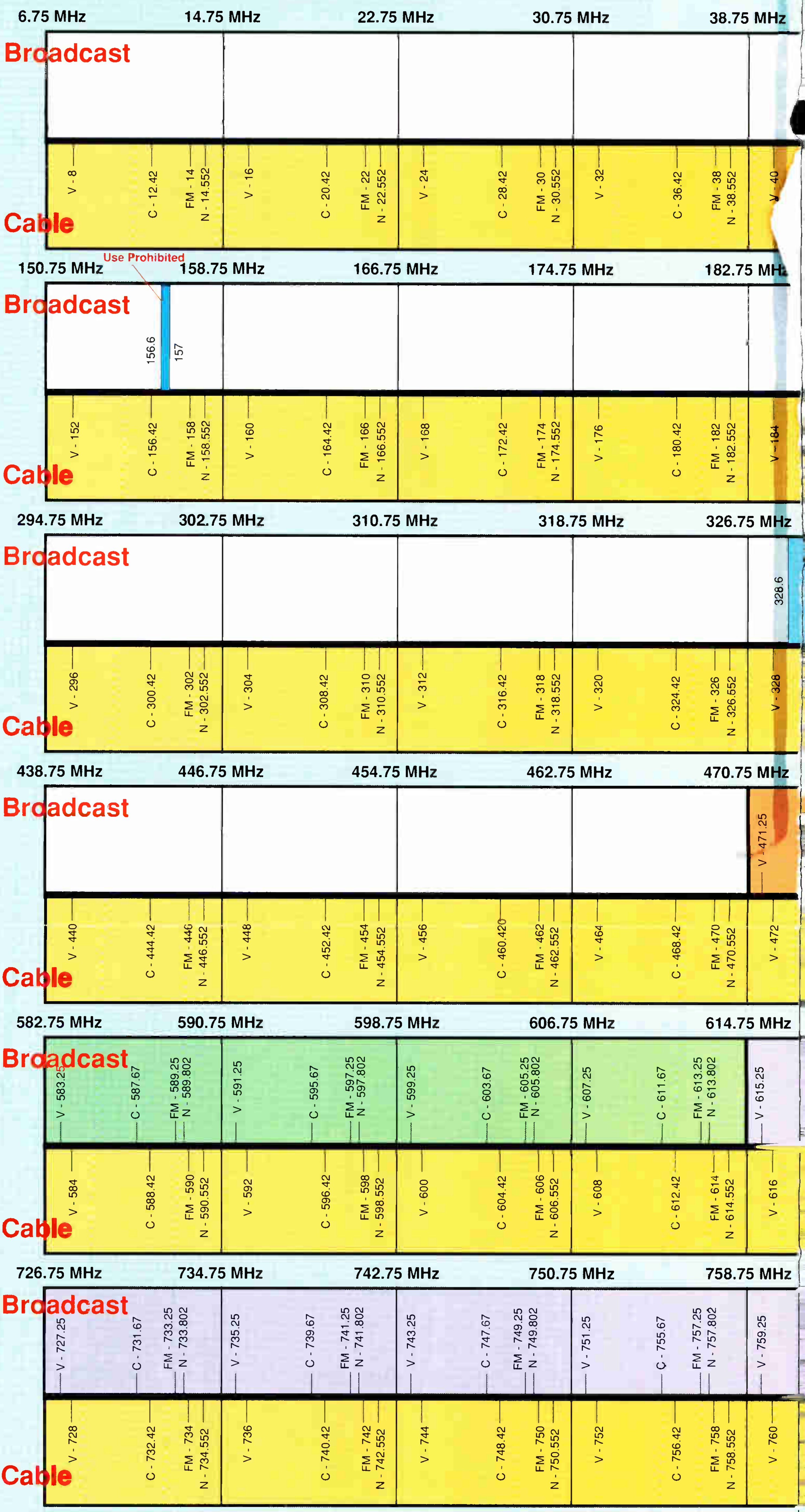

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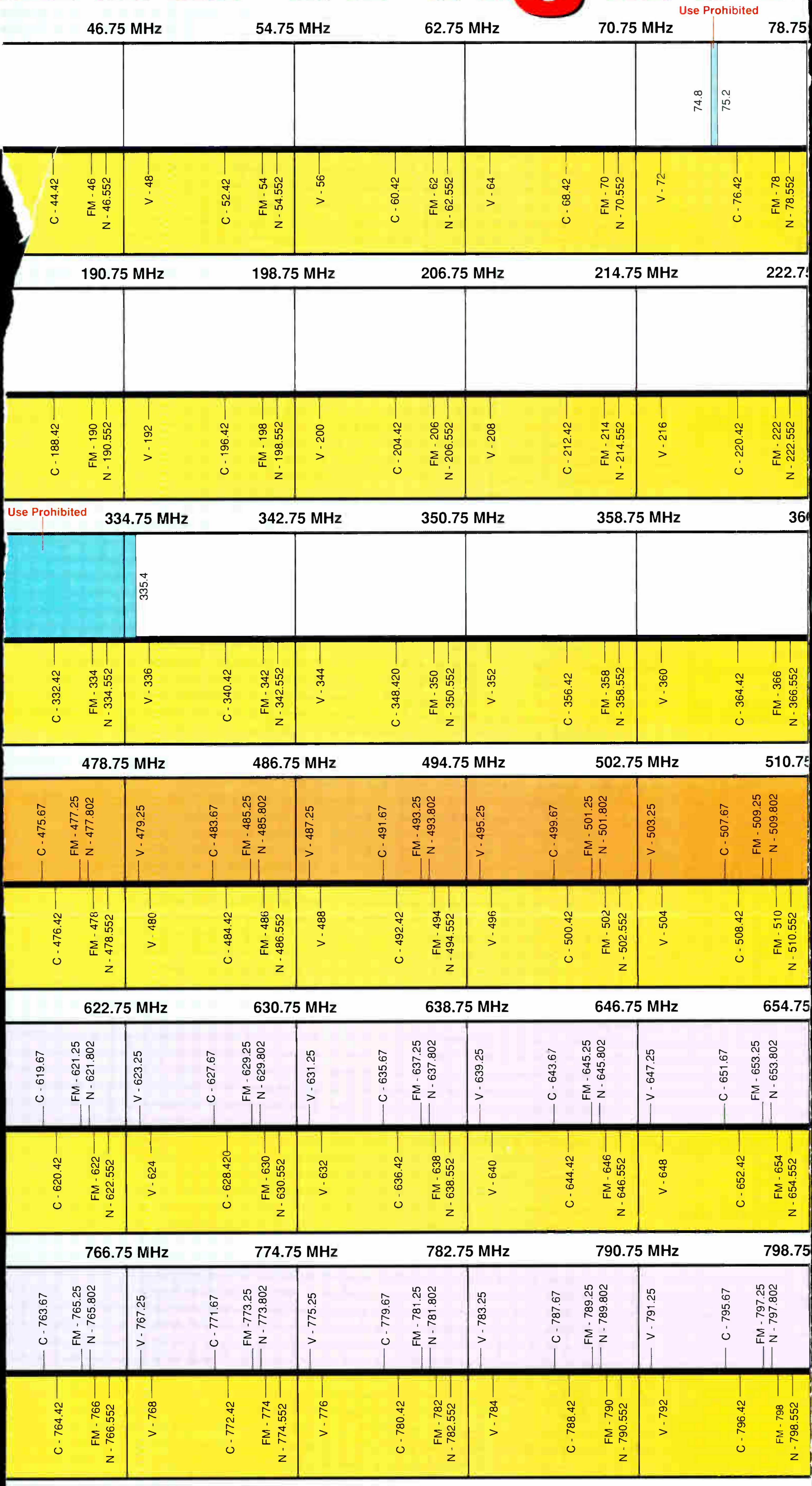

and color sub-carriers in this frequency range is
s of any sidebands or of any intermodulation prod-
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FM broadcast band

Band IV

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MHz	86.75 MHz	94.75 MHz	102.75 MHz	110.75 MHz

Use Prohibited

87.5

108

V - 80, C - 84.42, FM - 86, N - 86.552, V - 88, C - 92.42, FM - 94, N - 94.552, V - 96, C - 100.42, FM - 102, N - 102.552, V - 104, C - 108.42, FM - 110, N - 110.552, V - 112, C - 116.42

5 MHz	230.75 MHz	238.75 MHz	246.75 MHz	254.75 MHz

Use Prohibited

242.8

243.2

V - 224, C - 228.42, FM - 230, N - 230.552, V - 232, C - 236.42, FM - 238, N - 238.552, V - 240, C - 244.42, FM - 246, N - 246.552, V - 248, C - 252.42, FM - 254, N - 254.552, V - 256, C - 260.42

.75 MHz	374.75 MHz	382.75 MHz	390.75 MHz	398.75 MHz

Use Prohibited

V - 368, C - 372.42, FM - 374, N - 374.552, V - 376, C - 380.42, FM - 382, N - 382.552, V - 384, C - 388.42, FM - 390, N - 390.552, V - 392, C - 396.42, FM - 398, N - 398.552, V - 400, C - 404.42

MHz	518.75 MHz	526.75 MHz	534.75 MHz	542.75 MHz

V - 511.25, C - 515.67, FM - 517.25, N - 517.802, V - 519.25, C - 523.67, FM - 525.25, N - 525.802, V - 527.25, C - 531.67, FM - 533.25, N - 533.802, V - 535.25, C - 539.67, FM - 541.25, N - 541.802, V - 543.25, C - 547.67, FM - 549.25

V - 512, C - 516.42, FM - 518, N - 518.552, V - 520, C - 524.42, FM - 526, N - 526.552, V - 528, C - 532.42, FM - 534, N - 534.552, V - 536, C - 540.42, FM - 542, N - 542.552, V - 544, C - 548.42

MHz	662.75 MHz	670.75 MHz	678.75 MHz	686.75 MHz

V - 655.25, C - 659.67, FM - 661.25, N - 661.802, V - 663.25, C - 667.67, FM - 669.25, N - 669.802, V - 671.25, C - 675.67, FM - 677.25, N - 677.802, V - 679.25, C - 683.67, FM - 685.25, N - 685.802, V - 687.25, C - 691.67, FM - 693.25

V - 656, C - 660.42, FM - 662, N - 662.552, V - 664, C - 668.42, FM - 670, N - 670.552, V - 672, C - 676.42, FM - 678, N - 678.552, V - 680, C - 684.42, FM - 686, N - 686.552, V - 688, C - 692.42

MHz	806.75 MHz	814.75 MHz	822.75 MHz	830.75 MHz

V - 799.25, C - 803.67, FM - 805.25, N - 805.802, V - 807.25, C - 811.67, FM - 813.25, N - 813.802, V - 815.25, C - 819.67, FM - 821.25, N - 821.802, V - 823.25, C - 827.67, FM 829.25, N - 829.802, V - 831.25, C - 835.67, FM - 837.25

V - 800, C - 804.42, FM - 806, N - 806.552, V - 808, C - 812.42, FM - 814, N - 814.552, V - 816, C - 820.42, FM - 822, N - 822.552, V - 824, C - 828.42, FM - 830, N - 830.552, V - 832, C - 836.42

Band V

V = Video carrier frequency
C = Color carrier frequency
FM = FM sound carrier frequency
N = Nicam sound carrier frequency

Note: Channel numbers are not standardized.

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es UHF Broadcast and HRC cable channels for PAL/I System

118.75 MHz | 126.75 MHz | 134.75 MHz | 142.75 MHz | 150.75 MHz

Use Prohibited

117.975, 121.3, 121.7

FM - 118, N - 118.552, V - 120, C - 124.42, FM - 126, N - 126.552, V - 128, C - 132.42, FM - 134, N - 134.552, V - 136, C - 140.42, FM - 142, N - 142.552, V - 144, C - 148.42, FM - 150, N - 150.552

262.75 MHz | 270.75 MHz | 278.75 MHz | 286.75 MHz | 294.75 MHz

FM - 262, N - 262.552, V - 264, C - 268.42, FM - 270, N - 270.552, V - 272, C - 276.42, FM - 278, N - 278.552, V - 280, C - 284.42, FM - 286, N - 286.552, V - 288, C - 292.42, FM - 294, N - 294.552

406.75 MHz | 414.75 MHz | 422.75 MHz | 430.75 MHz | 438.75 MHz

405.85, 406.25

FM - 406, N - 406.552, V - 408, C - 412.42, FM - 414, N - 414.552, V - 416, C - 420.42, FM - 422, N - 422.552, V - 424, C - 428.42, FM - 430, N - 430.552, V - 432, C - 436.42, FM - 438, N - 438.552

550.75 MHz | 558.75 MHz | 566.75 MHz | 574.75 MHz | 582.75 MHz

N - 549.802, V - 551.25, C - 555.67, FM - 557.25, N - 557.802, V - 559.25, C - 563.67, FM - 565.25, N - 565.802, V - 567.25, C - 571.67, FM - 573.25, N - 573.802, V - 575.25, C - 579.67, FM - 581.25, N - 581.802

FM - 550, N - 550.552, V - 552, C - 556.42, FM - 558, N - 558.552, V - 560, C - 564.42, FM - 566, N - 566.552, V - 568, C - 572.42, FM - 574, N - 574.552, V - 576, C - 580.42, FM - 582, N - 582.552

694.75 MHz | 702.75 MHz | 710.75 MHz | 718.75 MHz | 726.75 MHz

N - 693.802, V - 695.25, C - 699.67, FM - 701.25, N - 701.802, V - 703.25, C - 707.67, FM - 709.25, N - 709.802, V - 711.25, C - 715.67, FM - 717.25, N - 717.802, V - 719.25, C - 723.67, FM - 725.25, N - 725.802

FM - 694, N - 694.552, V - 696, C - 700.42, FM - 702, N - 702.552, V - 704, C - 708.42, FM - 710, N - 710.552, V - 712, C - 716.42, FM - 718, N - 718.552, V - 720, C - 724.42, FM - 726, N - 726.552

838.75 MHz | 846.75 MHz | 854.75 MHz | 862.75 MHz | 870.75 MHz

N - 837.802, V - 839.25, C - 843.67, FM - 845.25, N - 845.802, V - 847.25, C - 851.67, FM - 853.25, N - 853.802

FM - 838, N - 838.552, V - 840, C - 844.42, FM - 846, N - 846.552, V - 848, C - 852.42, FM - 854, N - 854.552, V - 856, C - 860.42, FM - 862, N - 862.552, V - 864, C - 868.42, FM - 870, N - 870.552

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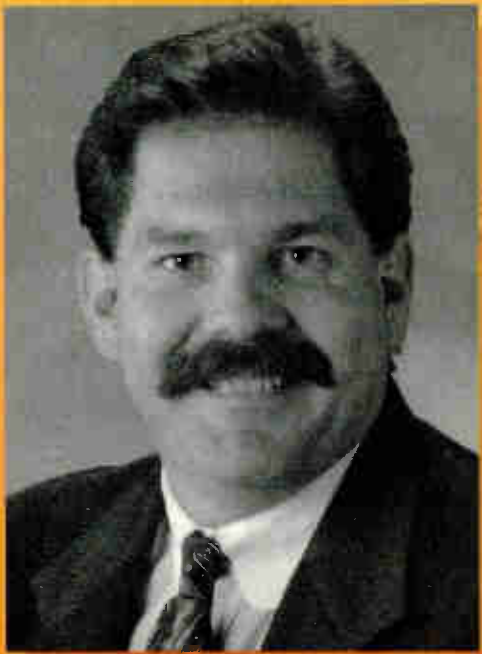

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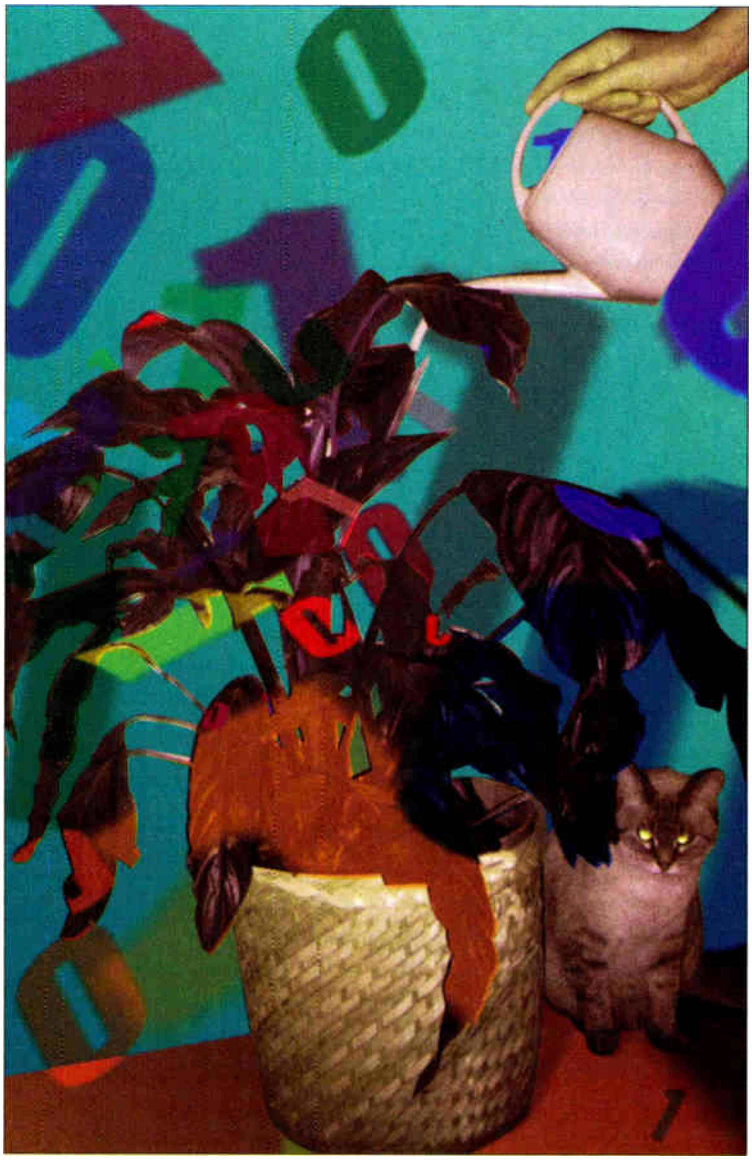
The care and feeding of your existing plant

Integrating digital with analog

By Joseph B. Waltrich, DigiCable Project Manager, GI Communications Division, General Instrument Corp.



Initial rollout of digital transmission will involve the introduction of a few digital channels into existing analog cable systems. Furthermore, mixed analog/digital systems will probably become commonplace over the next few years. By following certain guidelines, the operation of a mixed signal system should pose no more problem than operation of current analog cable systems. This article discusses factors to consider when introducing digital video into current analog systems.

The introduction of digital video into existing cable systems should be relatively straightforward, provided the effect of cable channel characteristics is taken into consideration. Generally, those channel impairments that have the most effect on analog transmission do not greatly affect digital signals. Some impairments that have a negligible effect on analog signals, however, can cause severe impairments to digital transmission.

We are fortunate that the cable environment is a relatively benign medium compared to satellite or terrestrial broadcast. This is why a bandwidth-efficient technique such as 64 QAM should perform well in transmission of digital data over cable and associated media. Nevertheless, care must be taken when introducing digital transmission into existing cable systems.

Differing sensitivities

As a rule, the noise problems associated with transmitting analog signals over long cascades are not particularly severe as far as digital transmission is concerned. The error correction applied to digital signals provides good protection against random noise, even if the digital signal is operated at a lower power relative to the adjacent analog carriers. As long as the digital carrier/noise ratio is above the threshold level of the forward error correction (FEC), the system will operate without errors. Most FEC techniques will provide adequate error correction down to CNR levels of 24-28 dB. If the digital signal power is maintained at 3-6 dB above threshold, there should be no problem in transmitting the signal over existing trunks. The replacement of long trunks by fiber optic links further alleviates this problem. If system CNR is maintained within FCC specifications, random noise should not be a problem for digital transmission.

Although random noise may not be a severe problem on cable, impulse noise is another matter. This is particularly true of the 5-30 MHz return path that will very likely see more use with the introduction of digital transmission. In all probability, 64 QAM will not be used on the return path since a more robust form of transmission such as QPSK would be better suited to this application. Although FEC interleaving provides some protection against impulse noise, return path noise caused by RF ingress from short wave and amateur broadcast can render some portions of the return path totally unusable. RF ingress must be minimized to achieve maximum use of this part of the cable spectrum.

The common analog distortions CS and CTB do not have much effect on digital transmission. However, distortion introduced by multiple digital channels can affect adjacent analog channels. This appears as an increase in the noise floor of the analog channels (1).

It will probably not be noticeable when operating with a single digital channel, but if a number of digital channels are grouped together, the digital power will probably have to be reduced to avoid a decrease in analog CNR. Distributing individual digital channels throughout the analog spectrum instead of combining them into one contiguous group can reduce the effect of digital distortion.

Microreflections are another example of impairments that do not have much effect on analog cable signals, but which can produce severe errors in digital transmission. Since digital symbol rates are on the order of 5 MHz, the symbol period is only about 200 nS. Therefore, the symbol stream is susceptible to short range ghosts, such as those found on cable distribution systems and in the subscriber home (2). Good construction practices minimize distribution system echoes.

The subscriber environment poses a particularly difficult reflection problem because the system operator has very little control over this area. Using splitters and A/B switches having poor return loss and isolation with active devices such as cable-ready TV receivers and VCRs can generate relatively high amplitude short-term echoes. All digital convertors will incorporate adaptive equalization that does a good job of compensating for static echoes. However, dynamic echoes, such as those caused by channel surfing on a cable-ready receiver connected to the same splitter as the digital convertor, may be shorter than the convergence time of the equalizer. In this case, the only effective solution is to provide sufficient isolation between the echo generator and the digital convertor. In most cases, a good quality splitter should be sufficient. However, for severe echoes, it may be necessary to run a separate drop to the digital convertor.

Adaptive equalization is also capable of compensating for the effects of spectral tilt and group delay. Most adaptive equalizers will handle tilt and group delay in the normal operating range of the cable spectrum without placing undue demand on the equalization budget.

FCC requirements provide good guidelines for maintenance of systems intending to employ digital

Some operators have expressed interest in using the roll-off area for digital transmission. Although operation in this area may be possible, it should be evaluated on a channel-by-channel basis since some channels may be made unusable by group delay peaks or other impairments. In addition, it may be necessary to increase the digital signal power to maintain adequate carrier/noise ratios. When considering roll-off operations, it would be best to proceed with caution and to do a reasonable amount of testing at worse case points in the system before launching digital transmission.

Although FCC technical requirements for cable systems have caused operators some additional expense, those requirements provide good guidelines for proper maintenance of systems intending to employ digital transmission. In general, if a system meets FCC requirements for analog transmission, it should be able to handle digital signals without difficulty. CED

References:

(1) J. Waltrich, "Distortion Produced by Digital Transmission in Mixed Analog and Digital Systems," *Communications Technology*, April 1993.

(2) R. Prodan, "Analysis of Cable System Digital Transmission Characteristics," 1994 NCTA Technical Papers, 254-262.

Can coax support digital?

How basic characteristics affect the signal

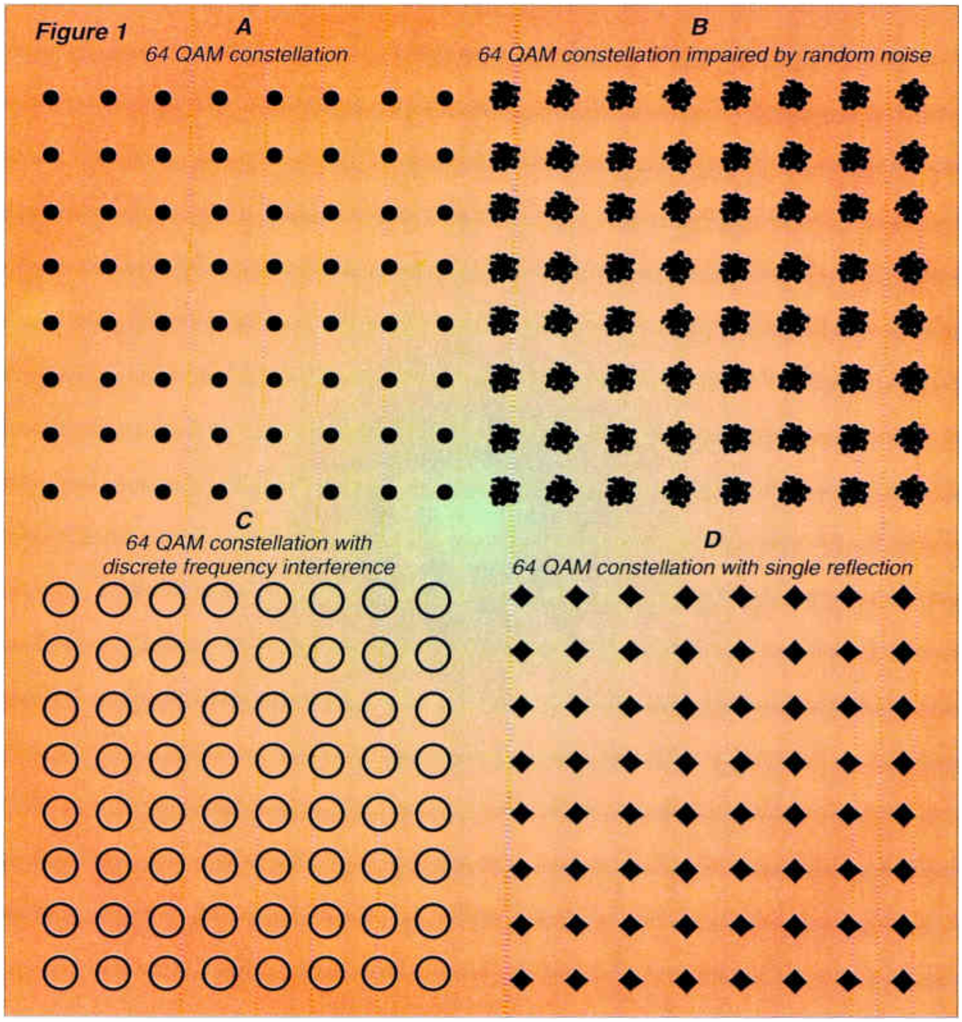


Figure 1

By Bruce Carlson, Director, Research and Development, CommScope Inc., General Instrument Corp.

There is concern in the industry as to whether a coaxial cable system will allow for adequate transmission of a digital signal. The three major areas of concern are noise ingress, micro-reflections and loose/corroded contacts. These impairments are not new to analog NTSC transmissions, but can be (and are) tolerated by the human eyes and ears. Digital signals, on the other hand, are fundamentally different because the natural analog signals are quantized for compression, transmitted, received and converted back into analog information. In the digital scenario, if an impairment occurs, the signal might shift out of its intended level. This type of change could then completely change the content of the information. It is for this reason that the characteristics of coaxial cable need to be revisited with a "digital" perspective.

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In the following sections we will discuss a few of these positive attributes, but the primary focus will be on the fundamental concerns and how they will affect digital signals.

Digital versus analog

The fundamental difference between an analog and a digital signal is that of continuous versus quantized. This is true whether it is a simple two level binary system, a complex 64 QAM (quadrature amplitude modulation) or 16 VSB (vestigial-sideband modulation). In all cases, analog voice and video signals are sliced up and put into specific states or positions. This quantized information is then sent over cable and converted back into the analog format. The heart of the issue is how the transmission of the signal is affected as it travels over a cable system. If a signal is knocked out of its state by some external means, then an error is generated. If too many of these are experienced in a short period of time, unacceptable impairments will be generated.

Figure 1a shows the constellation diagram for a 64 quadrature amplitude modulated signal that has not been altered by noise.[1] The generalized equation for a QAM signal is:

$$S(t) = I(t)\cos(2\pi f_c t) + Q(t)\sin(2\pi f_c t)$$

where I(t) is the in-phase component, Q(t) is the quadrature component and f_c is the frequency of the carrier.[2]

An ideal transmission medium will not change the shape of a signal, it will only attenuate the amplitude and shift the phase of the signal. It's very important that the attenuation and phase shift characteristics are constant. This means that the amount of attenuation is independent of the applied voltage or current, and the phase shift (or velocity) is independent of frequency.

Coaxial cable has good linearity and non-dispersive properties which make it an ideal medium for both analog and digital transmissions. It is important that both of these properties be considered when designing a cable system.

Cable should be linear

A signal can be distorted when it passes through a non-linear component or device. A non-linearity is considered to be any device that does not have a linear voltage-to-current relationship over the signal's operating range. When a signal with one or more frequency components is applied to the input of a nonlinear device, the resulting output signal will have the original frequency component plus additional harmonic and intermodulation frequencies. This will cause the output signal to be distorted.

Non-linearities can exist in linear passive transmission devices. There are three basic mechanisms which can theoretically generate intermodulation products:[3]

A transmission medium with dispersive properties will also cause the shape of the signal to be distorted.

1. Magnetic conductor materials such as steel and nickel.
2. Thermal heating from skin effect in conductors.
3. Contact nonlinearity known as either the "rusty bolt" or "diode" effect.

The thermal effect is typically only a problem in very high power transmission lines, and even then, the intermodulation products that are generated are at extremely low levels. The magnetic and rusty bolt effects are usually the dominant factors in a communications system. Their characteristics are very well documented and usually cause system problems when multiple transmit and receive carriers are co-located and add or subtract into a receive band.

Cable should be non-dispersive

A transmission medium with dispersive properties will also cause the shape of the signal to be distorted. Dispersion is generated by variations in the velocity of the medium the signal is traveling through. Waveforms that have spectral content (more than one frequency component) will travel through the medium at varying speeds. This will result in a shape modification to the signal. This is why it's important to understand the velocity properties of cable.

The phase velocity, v_p, is the velocity at which a discrete frequency will travel through a medium. For coaxial cable at RF, the phase velocity is dependent solely on the dielectric constant of the insulation between the center and outer conductor and can be expressed as:[4]

$$v_p = \frac{\omega}{\beta} = \frac{1}{\sqrt{\mu\epsilon}} = \frac{c}{\sqrt{\mu_r\epsilon_r}} = \frac{c}{\sqrt{1.0\epsilon_r}}$$

where: ω = radial frequency in rad/sec.
β = phase constant
μ = permeability in H/m
ϵ = permittivity in F/m
c = speed of light in free space (3.0×10^8 m/s).

Group velocity defines the dispersion level of a cable and is expressed as a change in phase velocity with frequency and can be written as:[4]

$$v_g = \frac{v_p}{1 - \frac{\omega}{v_p}\frac{dv_p}{d\omega}}$$

At RF, coaxial cable has very constant velocity of propagation characteristics (82 percent for drop cable and 88 percent for foam dielectric distribution cable)–causing all signals to arrive at the same time. Examples of dispersive transmission lines are waveguides and fiber optic lines.

Reflections, return loss and SRL

Reflections in a cable system are generated when the transported signal hits an impedance change. The impedance change will cause a portion of the incident signal to be reflected back towards the transmitter, causing a voltage standing wave. This relationship can be seen by:

$$RL = -20 \log(|\Gamma|) = -20 \log\left(\left|\frac{75 - Z_0}{75 + Z_0}\right|\right)$$

where Γ is the reflection coefficient, Z_0 is the impedance discontinuity in ohms, and RL is the return loss in dB.[5]

R	$\lvert\Gamma\rvert$ x 100%	RL
75.01	0.0067	83.5
75.10	0.067	63.5
76.00	0.66	43.6
80.00	3.2	29.8

Table 1: Return loss values for a 75 ohm line

Return loss is the term used to describe the total reflected power. A system's return loss is made up of both major reflections caused by discrete components and devices (connectors, splitter, taps, amplifiers, receivers, etc.), and multiple minor reflections from the cable.

An impedance change in a coaxial cable or connector is caused by a change in either dimensions or dielectric constant. This can be seen from:

bend it into position.

Physical damage, whether generated by plant wear (movement) or handling and installation, is by far the primary concern when considering noise ingress and egress issues in the coaxial distribution plant. This might help to explain why the mechanical characteristics are carefully studied and improved upon by cable manufacturers.

Flexibility vs. shielding

The shielding performance of drop cable is significantly more complex. Coaxial drop cables are used because of their flexibility and ease of installation. All drop cables consist of a laminated aluminum foil tape which is bonded to the dielectric core and an outer aluminum braid. Higher levels of shielding are obtained by adding extra layers of tape and braid.

Flexibility and shielding are opposing characteristics. You typically have to give up one for the other. Extra shielding also costs more because it requires more material and labor. The aluminum foil tape is a good high frequency shield, but it lacks mechanical strength. Both of these are attributed to the thinness of the tape. The braid, on the other hand, is a good low frequency shield with excellent mechanical strength and durability. The braid is a poor high frequency shield because magnetic fields are more easily coupled through the openings in the braid.

Coaxial cable is inherently linear and non-dispersive, which makes it ideal for digital signal transmission.

The bottom line is that the conventional standard drop cable shield is not the ideal high frequency medium. Extra levels of shielding will buy additional shielding effectiveness performance. A good rule of thumb is 20 dB delta for every extra layer of shielding. A standard shield will have 60 to 80 dB of shielding.

Loose and corroded connections

The impact that loose and corroded connections have on digital signals is paramount. A connector's primary role is to establish and maintain an electrical connection between a cable and another device (splitter, tap, amplifier, etc.). The connector, like the cable, should be as transparent to the signal as possible.

A loose or corroded connection creates multiple problems. One of the first signs of a bad connection is noise ingress and egress. The outer conductor of a cable is carrying longitudinal currents. As was discussed previously, the internal signals are being kept in isolation from the external noise signals by the natural skin effect. When both of these separate longitudinal currents impinge on an interface, they will be allowed to change paths if the joint is electrically open. The joint will then radiate RF energy.

If the loosening or corrosion becomes severe enough, complete signal loss (or large attenuation) will occur. This is usually an intermittent effect that occurs only when external stresses such as wind or temperature act on the connection. DC or low frequency signals are usually lost first, due to the coupling or capacitive effect that exists as two conductors become microscopically separated. This can be seen by writing the impedance of a capacitive joint:

$$Z = \frac{1}{j2\pi fC}, \quad \text{ohms}$$

where f is the frequency and C is the capacitance.[3] From this, it's clear that the impedance of the joint decreases as the frequency increases for the same given geometry (or capacitance).

Coax's impact on digital transmission

The impacts of return loss, shielding and connections on a digital signal can be seen by studying the I-Q constellation of a 64 QAM signal. Figure 1a is the pattern of a received signal with minimal distortion. Figure 1b illustrates what would happen if random noise were to interrupt the signal. Random noise, like an impulse lightning strike, can ingress through a coaxial cable through the following means:

✔ drop cable with insufficient shielding,
✔ a loose or corroded connector to cable interface, or
✔ a damaged distribution cable with a radial crack.

Figure 1c is the pattern of a 64 QAM signal that has been disturbed by a discrete (single) frequency signal. An example would be that of a nearby TV station.

Figure 1d illustrates the impact of return loss on a digital signal. This particular example shows what effect a reflection from a single discrete component can have on the received signal.

In summary

✔ Coaxial cable is inherently linear and non-dispersive, which makes it ideal for digital signal transmission.
✔ A coaxial cable's structural return loss can be kept to an acceptable level by quality manufacturing processes.
✔ Micro-reflections generated by individual component return loss characteristics will degrade digital performance.
✔ A coaxial cable's outer conductor has built-in shielding characteristics. Distribution cable's 120 dB of shielding can be altered by radial cracks or loose connectors. Drop cable shielding varies significantly, depending on the design of the outer conductor (60 to 115 dB).
✔ Problems of loose and corroded connectors can be avoided with proper product selection and installation. CED

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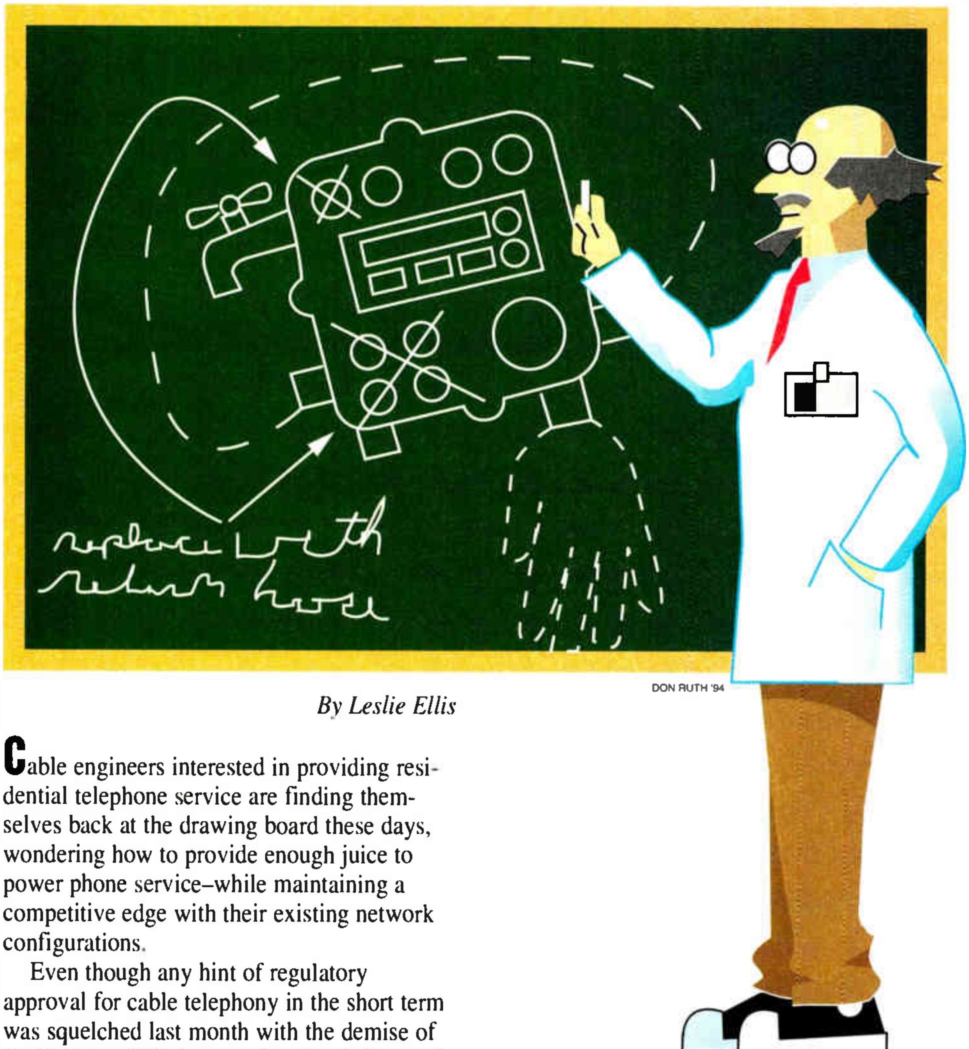
Network powering: Looking beyond 60 volts

Cable ops say they'll need more juice



By Leslie Ellis

Cable engineers interested in providing residential telephone service are finding themselves back at the drawing board these days, wondering how to provide enough juice to power phone service–while maintaining a competitive edge with their existing network configurations.

Even though any hint of regulatory approval for cable telephony in the short term was squelched last month with the demise of the Hollings Bill, issues related to timing and strategic technical positioning remain.

The reason is simple: MSOs feverishly want to provide telephony over their networks, believing themselves well-positioned to compete in the local loop. Perhaps a more elementary motivation is an understandable thirst for even a small percentage of the multibillion dollar local exchange revenues.

"Considering that 45 cents of every phone bill dollar goes to the local exchange, it's a powerful driver," says Bill Bauer, president of Windbreak Cable, a small operation with systems in Nebraska. Bauer, who is also active on CableLabs telecommunications committee, believes that even a minor portion of local exchange cash could match or exceed current cable industry revenues.

Further, MSOs don't want to waste precious time–or execute any network faux pas that could strangle telephony provisioning–before Congress reconvenes next year to (presumably) define cable telephony.

Engineers agree that the powering question has enormous ramifications, saying that the most troublesome aspect is figuring out how to provide dialtone service even when the power is out.

"This is clearly an issue our industry cannot take lightly," says Tom Elliot, vice president of engineering and technology for Tele-Communications Inc., who adds: "How to handle (telephony powering over cable broadband networks) has enormous strategic and economic implications."

Many of the technical hurdles facing operators as they chalk out telephony plans will likely crystallize within the coming months, as the responses to CableLabs' request for proposals on telephony are sifted through. At press time, the Oct. 7 RFP deadline had just passed, and CableLabs executives said the responses were "streaming in."

But the issue goes beyond mere technological minutae to encompass basic business strategy. TCI's Elliot, for example, advises that operators need to first think carefully about their competitive advantages.

"If we have to re-engineer how we power from the plant, we lose the competitive advantage of time and installed plant," says Elliot. "The strategic implications are enormous."

Even tiny operators, like Windbreak, agree that network powering issues are critical. "I'd say it's one of the top three issues related to telephony that I'm dealing with," says Bauer.

Power issues ring loud

While the powering issue rings loudly, there seems to be little consensus among engineers about how to solve the conundrum.

"I've seen probably 15 or so different approaches," says Tom Osterman, president of ComNet Systems, who has traveled extensively over the last year to speak with numerous Regional Bell Operating Companies and major cable MSOs to discuss powering options.

And, says Windbreak's Bauer, who has reviewed heaps of vendor proposals in response to the Labs' earlier request for information on telephony: "What could be troublesome is that even the MSOs aren't in agreement about how to handle powering. Some like the idea of a Siamese twisted pair/coaxial drop; others are completely opposed to that approach."

Two camps currently typify the powering debate: Those who favor network powering, and those who want to draw power from subscribers' homes and use advanced, rechargeable batteries that kick in when the power goes out.

"I don't think anyone firmly feels that

there's only one answer," says Bob Luff, chief technology officer for Scientific-Atlanta Inc., which is hedging its bets by developing both plant-powered and home-powered equipment. "Both plant powering and home powering have their own sets of pluses and minuses."

It is the network-powered solution that stands to unearth the most significant technical challenges, in addition to the obvious additional expense–which may be why TCI's Elliot says his interests lie with advanced rechargeable battery technology.

"I'm planning some methodical, detailed research in this area," Elliot says. "I think it's crucially important to think about how to use in-home batteries. Battery technology is moving so fast that by the time residential telephony becomes a reality, two to three years from now, in-home distributed power could use battery technology."

S-A's Luff also sees advantages in a home battery solution, particularly because the general public is becoming more accustomed to the need to check and replace batteries for other in-home devices, such as smoke alarms. "With standby batteries on a telephone circuit, it's feasible to install some type of friendly device with an alert when the batteries need to be changed," Luff says.

"Moving to carry 90 volts means replacing all existing amplifiers and line extenders out there."

That "friendly" reminder could even come from a prompt on the television, says Dave Frankenfield, national sales manager for Alpha Technologies, who says at least two major MSOs have inquired about sending a low-voltage signal from future network interface units to televisions to alert subscribers about battery conditions.

Telephone companies allegedly provide eight hours of battery backup on local phone service during power outages–a statistic that some cable executives take issue with.

"I have yet to see the local exchange operator in my area give eight hours of battery backup," said one engineer, speaking on background. "In my systems, I've seen some pretty serious ice storms that bring the power down for long periods of time–much longer than eight hours. My phone usually stays up for about two or three," he offered.

Still others think a cable phone backup time of two to three hours is more reasonable.

More voltage

Cable operators historically have used 60-volt AC power supplies to feed network amplifiers. But now they realize they'll need even more power, backed up with batteries, to support a side-of-the-home "network interface unit" that will be a key component of any future delivery of residential telephone service.

"The amount of power cable operators will need is likely to be roughly an order of magnitude higher than it is now, because of the power needed by the network interface device," explains Ron Cotten, president of Engineering

Technologies Group, who also has been examining powering solutions for both cable and telephone companies over the last year.

Power requirements, Cotten and others explain, will likely rise to 90 volts. However, there is little agreement on cycle times at the higher voltage, with some manufacturers examining 60 Hertz and others opting for cycle times of 1 Hertz, for safety reasons.

According to several vendors, the use of 1 Hertz cycle times poses less physical risk to line technicians and others who come into contact with power-passing lines than 60 cycles.

But a move to 90 volts shouldn't be taken for granted, cautions Windbreak's Bauer, who calls himself the "reality check" person on CableLab's telephony-related subcommittee. "Moving to carry 90 volts means replacing all existing amplifiers and line extenders out there. It's a bit unrealistic, at least for me."

"The cable industry has never really had to deal with (the issue of backup powering) before," Cotten continues. "It's not a big issue in today's network–but in the future, it'll be a major, major deal if not planned for correctly."

There are also serious economic challenges related to plant powering. Says Neil Phillips, president of SignalVision Inc.: "Telephones don't need very much power to provide ring voltage and dialtone–it's negligible. But when you talk about using the plant to power the convertors, phones, return transmitters and whatever else. . . my calculator doesn't go that high."

The power-passing tap

There's another snag for telephone-over-cable applications: taps. Traditionally, power signals stop before the tap–so questions remain about how to send power through a device which, to date, is passive.

"The single biggest concern for those MSOs considering plant power is sending that power down the drop," says S-A's Luff, who adds: "We've been powering plant for 30 years, and backing up that power for the last 15 years–but we've always stopped at the tap."

Sending voltage down the network and through the tap to the home requires a complete re-examination of the tap, Luff and others say. "F-fittings were never really designed to pass power, and drop cable itself was designed for RF shielding, not to pass voltage," he says.

Tap manufacturers are aware of the industry's needs, although some are holding their plans close to the vest "for competitive reasons."

Another potential snarl is a phenomenon called "galvanic corrosion," which occurs when two dissimilar metals attempt to pass current off from one to the other. The effects of galvanic corrosion, explains one engineer, are similar to what happens to an automobile battery after years of use–the involved metals become coated with corrosion and need to be replaced.

Ad Index

Two vendors, Philips Broadband Networks and SignalVision Inc., have apparently solved the corrosion problem, but for competitive reasons, declined to discuss details. But if their claims are true, one major problem has already been eliminated.

Not surprisingly, tap manufacturers are aware of the industry's needs, although some are holding their plans close to the vest "for competitive reasons."

Still, manufacturers like Scientific-Atlanta, Antec, Philips Broadband Networks, SignalVision and Raychem are all racing to create a tap that passes power. Most are targeting this year's Western Show for product prototypes.

Passing power through taps

Philips Broadband Networks, for example, holds a patent on a device that attaches to a tap, extracts power and sends it along to the home either on twisted pair or coaxial cable. Antec is also developing what it calls a "power-directing tap," which extracts power from the feeder plant and, through an inductor and capacitor within the tap, directs it to a separate, copper twisted pair interface on the faceplate of the tap.

"We worked at directing power through the tap, through the F-port, and onto the coaxial plant for a long time," says Jim Jennings, vice president of passive products for Antec. "We found that it's possible to send power down the coaxial drop, but what you end up with is a product that either sends power pretty well or sends RF pretty well, but not both."

SignalVision Inc. is also hard at work on a power-passing tap, says Phillips, who notes that his company has been approached by both cable and telco network operators for such a device.

"I've seen specifications for three different versions," says Phillips. "One is a tap that simultaneously sends power and RF signals down the drop. Another is a four-port device with eight taps–four for power and four for RF, in which the four power ports use twisted pair through an IDC block."

The last, and the one Phillips calls "a grand idea," is to leave the system as it is and not pass power through the drop, but instead send power through the twisted pair telephony cable. "The twisted pair is already there," Phillips explained.

Jennings says the use of a power-directing tap may not require a complete rebuild of existing drop plant, but would call for a separate, twisted pair cable along the existing drop plant. "It's an economical concern, but I don't see it as a huge problem," says Jennings.

The new Antec tap is in the tooling stage now, and a formal announcement will likely occur at the Western Show. The tap will likely cost twice as much as existing tap products, Jennings said during the recent National Communications Forum event in Chicago, where a prototype of the product was displayed.

Through all the technical and economic challenges–including first-step decisions like whether to use plant- or home-powering all the way down to the nuances of providing reliable, battery-backed dialtone service on a network that has never carried power signals so far–operators remain bullish on telephony.

"Cable's entrepreneurial spirit is probably stronger now than I've ever seen it," says Bauer. "If there's a way to get this done, the cable industry will identify it. No question about it." CED

Satellites have operators looking skyward

Competition from yet another location?

Iridium plans to use 66 LEOs to cover the Earth.

By Fred Dawson

Like it or not, advanced satellite systems loom very large on the agendas of strategic planners at the wireline networks. While Hughes' successful launch of its high-power DSS (Direct Satellite System) has the marketplace buzzing over the perceived threat to traditional cable TV, accelerating preparations for launch of next-generation satellite systems hold implications for all categories of landline services, including full service telecommunications.

Fortunately for cable and telephone companies, these implications include prospects for using the technology to strengthen as well as to challenge terrestrial network operators. In late September, Motorola-backed Iridium Corp. announced completion of $1.57 billion in equity funding for its global low earth orbit (LEO) system, smoothing the way to raising another $1.83 billion in debt financing to cover costs of putting its 66-satellite system into orbit sometime in 1998.

The company says its partners now include consortiums in India, South Korea, Europe and Latin America, which are vital not only to financing but also to winning government licenses and to serving as gatekeepers for operations throughout much of the world. The development marked an important milestone in progress toward implementation of next-generation satellite technology, which includes a bevy of proposed LEO launches as well as fixed satellite wideband telecommunications.

If at least one proposed operation in each emerging category of service were to launch as scheduled by the turn of the century, the public would be able to order mobile and fixed multimedia services of every description, including video telephony and interactive TV.

But how far toward realization of this possibility the cluster of deep-pocketed entrants will go by the year 2000 is a matter of some skepticism in the marketplace. Talk of hype-saturated billionaires losing their sense of direction was laced liberally through media coverage of the recently announced Teledesic project, a $10-billion venture proposed by Bill Gates and Craig McCaw, CEOs, respectively, of Microsoft Corp. and McCaw Cellular Communications.

But if the 840-satellite LEO project offering multimedia to the masses struck some observers as a wasteful overbuild of land-based broadband networks, no one was debunking it from a technology standpoint. As the very real, worldwide investment and political support for Iridium suggests, the technology making practical direct interactive communications with satellites from handheld wireless devices is likely to come together in time to support commercial launch of a voice and data version of such service before the deacde is out.

The emerging cable strategy

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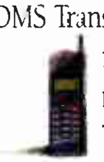

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How to measure carrier-to-noise

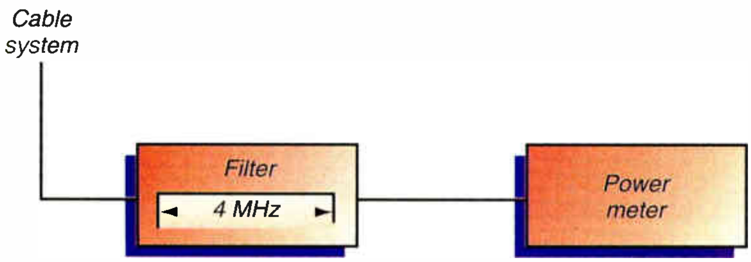

Figure 1: *Ideal world setup*

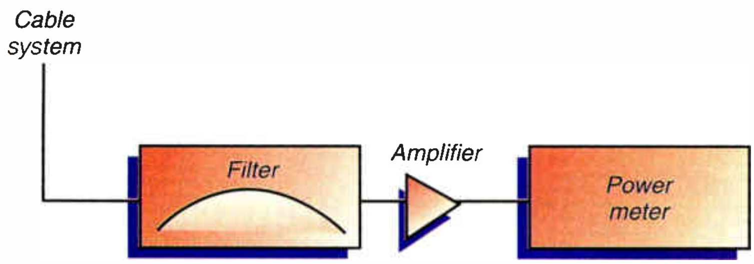

Figure 2: *Real world setup*

By Rex Bullinger, R&D Engineer, Hewlett-Packard Company

New FCC technical standards, the increasing use of fiber and higher quality expectations of subscribers have all created a demand for better carrier-to-noise measurements. Obtaining repeatable results when measuring noise requires a detailed knowledge of how the instrument being used measures noise, its limitations and necessary corrections. To help take the mystery out of this measurement, five correction factors are introduced to help describe a practical measurement method.

Section I.D. of the NCTA Recommended Practices covers the visual carrier-to-noise ratio (CNR) measurement in detail. This article will expand on two of the concepts described in that section: the noise correction factors and measuring noise in-service.

The carrier-to-noise test requires two measurements–carrier level and noise level. Much has been written on measuring carrier level, which is the signal power during synchronizing pulses. This article will concentrate on the more difficult measurement of noise.

FCC rules

Currently, the FCC requires that the ratio of the visual carrier level to system noise be at least 40 dB. As of June 30, 1995, this ratio increases to at least 43 dB. The rules define system noise as noise measured in the range from the visual carrier frequency to 4 MHz above it [CFR 47: Parts 76.5(w) & 76.605(a)(7)].

When measuring noise, a number of corrections to the initial instrument readout are usually necessary. To understand what they are and why they are used, let's look at five of the most important of these.

Noise-equivalent bandwidth

To measure CNR in an ideal world, we would use a perfectly rectangular, 4 MHz wide filter covering the desired frequency range with its output connected to a power meter (see Figure 1).

Unfortunately, our ideal world scenario is not possible for a number of reasons. These reasons give rise to the correction factors that are necessary in practice.

The first problem we encounter is that perfectly rectangular filters do not exist. So we must introduce the concept of "noise-equivalent bandwidth." This is the bandwidth that the filter would have if it were perfectly rectangular, while passing the same amount of noise as the imperfect filter. Since filters are often specified as their bandwidth 3 dB or 6 dB down on either side of center frequency, our first correction factor is to change the specified bandwidth to a noise-equivalent bandwidth. A typical value is -0.52 dB for filters specified at their 3 dB points. This means that, in this case, the noise equivalent bandwidth is slightly wider than a specified 3 dB bandwidth.

Correction to 4 MHz bandwidth

We now know that specifying a filter by its noise-equivalent bandwidth gives an effectively perfect rectangular filter. However, it still isn't likely to be what we want, i.e., exactly 4 MHz wide. So our second correction factor changes our real world filter bandwidth (whatever it is) to 4 MHz.

Noise figure

Now that we have dealt with the filter in Figure 1, let's consider the power meter. Again, the ideal world setup doesn't work. This is because power meters cannot directly measure the low levels of noise we need to measure; therefore, we have to add an amplifier to bring the noise level up to what the meter can measure. But the amplifier adds its own noise, which must be accounted for (see Figure 2).

Thus, noise figure is our third correction factor.

Why don't we normally measure CNR with the Figure 2 setup? There are several reasons:

1. Knowing the filter's noise-equivalent bandwidth is critical to the measurement, but the bandwidths of tunable filters vary as a percentage of center frequency. so their noise equivalent bandwidths will also change with tuning. Using calibrated filters is possible, but not very convenient, and they are not commonly available to the cable TV technician.

2. Measuring in an exactly 4 MHz wide bandwidth has the advantage that it incorporates any ripple or

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slope in the noise level and exactly meets the FCC rule for summing over the system noise range. However, it will also include any distortion products, extraneous signals or the unmodulated carrier, if present. This might lead to an erroneously high result. In practice, noise measurements are done in narrower bandwidths, typically 30 kHz to 300 kHz, with the results mathematically corrected to what the noise power would have been if actually measured in a 4 MHz bandwidth, as in Figure 1.

3. Power meters are not commonly available to cable TV technicians.

Using a spectrum analyzer

Spectrum analyzers are available to cable TV technicians and are very convenient to use for this purpose. When not sweeping (zero span), a spectrum analyzer is a fixed tuned, frequency selective voltmeter (see Figure 3.) When it is sweeping, it's simply displaying the results of a series of zero span measurements made over a range of frequencies. When an analyzer displays power, it is calculated from that measured voltage.

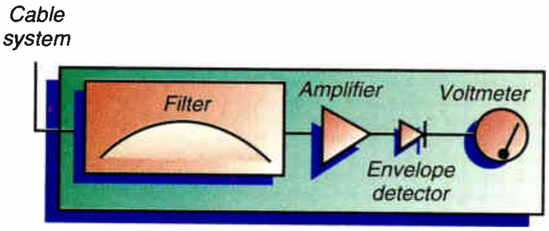


Figure 3: Spectrum analyzer

In Figure 3 we have transformed the ideal, but impractical setup of Figure 1 into a real world, practical measurement setup through the use of the three above-mentioned correction factors.

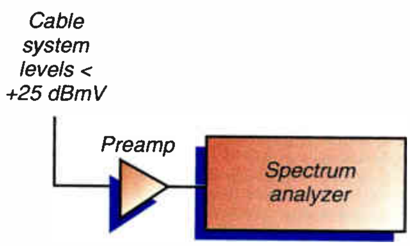


Figure 4: Spectrum analyzer with preamp

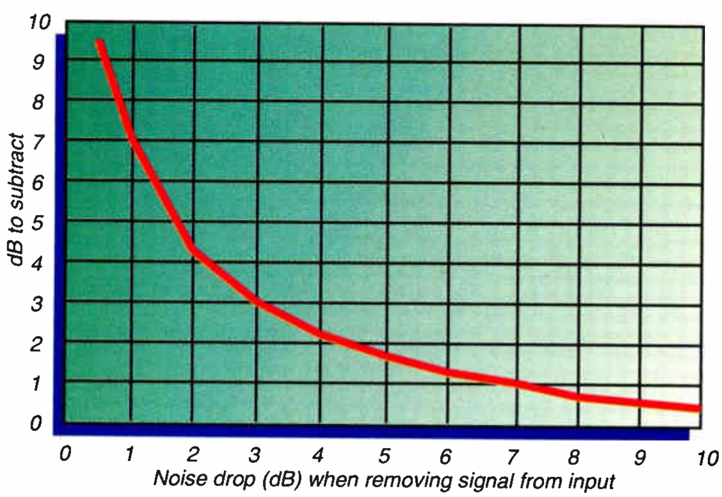
Logarithmic detection of noise

The fourth correction factor to be introduced is a result of using the measurement unit "dB."

A spectrum analyzer is a voltmeter which, when displaying results in units of dB(m, mV, etc.), is actually measuring a voltage that has been converted into a logarithmic value. This allows very widely differing levels, such as carrier and noise, to be viewed on the same display. Otherwise noise, for example, when on screen with a carrier, would be too small to see.

However, measuring noise in dB reports a value 2.5 dB too low. So our fourth correction factor is to add 2.5 dB to our measured noise level.

Figure 5: Noise-near-noise correction



Preamp noise contribution

The setup in Figure 3 performs well when measuring CNR in high level parts of the distribution system, such as at line extender outputs. However, when measuring CNR at lower levels such as at drops, the amplifier noise figure correction is not adequate. To boost the noise to be measured into the measuring range of the spectrum analyzer, a preamplifier is used.

We have now added yet another uncertainty to the measurement and must add another noise figure correction factor. Our list of corrections with typical values for a spectrum analyzer now looks like:

1. Noise-eq-BW: -0.52 dB
2. 30 kHz to 4 MHz: +21.25 dB
3. Analyzer noise figure: (use Figure 5)
4. Log detect noise: +2.5 dB
5. Preamp noise figure: (use Figure 6).

Now that we know the correction factors involved, let's do a sample measurement using the following conditions:

Carrier level at preamp output: +13 dBmV
Uncorrected CNR: 73 dB
Noise drop when disconnecting cable from analyzer input: 9 dB
(use Figure 5 to get 0.6 dB)
Preamp Gain: 10 dB
Preamp Noise Figure: 7 dB.

Using the above information, we calculate CNR at the output of the preamp:

73 - (-0.52 +21.25 +2.5 -0.6) =
50.37 dB CNR at preamp output

where:

73 = uncorrected CNR
0.52 = filter noise-equivalent bandwidth
21.25 = 30 kHz to 4 MHz
2.5 = log detect noise
0.6 = analyzer noise figure.

Now, to correct for the noise contribution of the preamp, we subtract the CNR just found above from the carrier level at the input of the preamp, which is the output carrier level minus the gain:

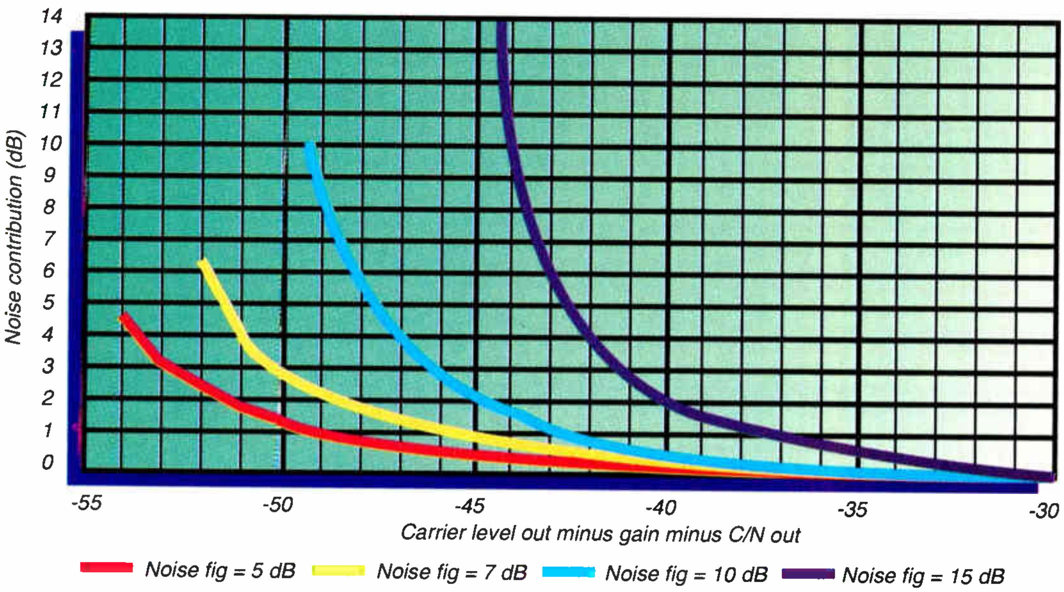
+13 - 10 - 50.37 = -47.37

Find -47.37 on the x-axis of Figure 6 to find the noise correction value of 1.3 dB on the curve for a noise figure of 7 dB. This means the preamp is adding 1.3 dB of noise at its output, so we should add thus:

50.37 + 1.3 = 51.67 dB CNR

This value, 51.67 dB CNR, is now the value we would have measured with the ideal Figure 1 setup, if it were possible.

Figure 6: Preamp noise contribution



This advantage, however, can also be a disadvantage to the cable operator. This occurs when the video feed to the cable operator is excessively noisy. Here, the in-service CNR test result may not meet FCC limits, but the operator may still be legal, because the cable TV system-contributed noise without the video feed noise may be within the FCC limit. One way to find out is to revert to removing the video modulation. Another option for satellite or local origination channels is to place a video line stripper at the headend, then measure the noise on the stripped line. An option for off-air channels is to measure the absolute noise level of the in-service signal at the input of the first active device after the antenna, and subtract that from the noise measured at the system test point.

In addition to the FCC rules mentioned above, the FCC says, "system noise . . . power indications . . . are taken in successive increments of frequency equal to the bandwidth . . . summing the power indications to obtain the total noise power present over a 4 MHz band . . . If it is established that the noise level is constant [flat] within this bandwidth, a single measurement may be taken which is corrected by an appropriate factor . . ." [CFR 47; Part 76.609(e)].

In the traditional noise measurement with video modulation off, the noise floor is assumed to be (and usually is) "constant" or flat, and the noise is measured at a single point, which is then corrected to 4 MHz. In-service noise measurement very often means that the noise floor is not constant, as mentioned in the rules above. This is because video channels often have various kinds of filtering and frequency dependent processing. Indeed, modulators, processors and convertors themselves can add much to the unflatness of the channel. The rules account for this by requiring that the noise be integrated or "summed" over the 4 MHz bandwidth when the noise floor is not flat.

What follows are a few measurement results using a spectrum analyzer capable of doing the test both with modulation off and in-service in order to compare the two methods. The spectrum analyzer measured in-service by summing the noise over 85 percent of the 4 MHz range in order to eliminate the effect of the carrier, which is always present. This 85 percent range is automatically corrected to 4 MHz. For the modulation off-test, a single point was measured.

In theory, the results with video modulation "on" should be the same or worse than with video modulation "off." Numerous measurements have confirmed this, and in this case, ranged from equal results to a worst case of 6.8 dB for the in-service measurement. A typical channel can be expected to measure approxi-

Smart instruments and set-tops

Newer instruments can automate many of the above tasks. Indeed, one spectrum analyzer measures carrier-to-noise, showing exactly how it calculated the result, and what correction factors it used.

Measuring CNR involving convertors is a subject that deserves more attention, but goes well beyond the scope of this article. This subject is covered in the NCTA Recommended Practices CNR Section I.D. in its "Discussion." Also, issues involving baseband convertors are reviewed in Appendix D.

Another subject worthy of more attention but beyond the scope of this article is that of measuring individual noise contributing components such as headend active devices, trunk and distribution amplifiers, and convertors, then summing their individual contributions for a net CNR result. As with convertors, this subject is addressed in the "Discussion" section of the NCTA Recommended Practices CNR Section I.D.

Measuring CNR in-service

Traditionally, CNR is tested by measuring the carrier level, then removing video modulation and measuring the underlying noise level. Disadvantages of this technique are that at least two people are required, which increases labor expense, and service interruptions are required, which cause customer dissatisfaction. For these reasons, cable operators have asked test equipment vendors for tests that can be done in-service.

In response, several companies have developed in-service carrier-to-noise tests which measure noise during a selected line or lines in the vertical interval. These tests are not only non-disruptive to service, but they also actually measure the carrier-to-noise of the picture as would be viewed by the subscriber (as long as the line being measured has not been disassociated from the picture lines by video path switching).

mately 2 dB to 4 dB worse.

Figure 7 shows essentially the same results between the video off and in-service measurements. This equivalency has also been seen when measuring a line which has been stripped at the headend, and on channels which are digitally delivered to the headend. This channel had local character generation with video leaking into the vertical interval which was excluded from the noise summation.

Figure 8 is typical, showing a 2.3 dB difference; however, even the worst in-service result at 47.2 dB CNR is clearly acceptable.

Figure 9 is an example of the worst noise contribution of video signal noise that is likely to be seen. This could be due to a noisy active device anywhere in the signal path before the modulator.

Test results confirm that in-service carrier-to-noise testing can be used to satisfy FCC proof tests, if the combination of video program noise and cable TV system noise is within FCC limits. In-service test results will be equal to, but no better than, the video off-test, and can be several dB worse. When the in-service CNR result is not within FCC limits, the alternatives are to test in the traditional way by turning modulation off, stripping the test line at the headend, or in the case of off-air signals, subtract the in-service noise from the incoming signal.

Another consideration for satellite channels is that the noise could be coming from the LNB and/or the satellite receiver/descrambler. Currently, I don't know of a convenient way to test these components for CNR, other than device substitution.

If the noise is truly on the programmer-supplied video, another option is to ask the video feed provider for a cleaner signal, since the poor in-service CNR signal is what the subscriber will ultimately see.

Conclusion

Getting repeatable results when measuring carrier-to-noise over a wide dynamic range requires attention to a number of details. Modern instrumentation can do much of the work while increasing measurement accuracy, reducing errors and measuring in-service. CED

Figure 7a(red)/7b(blue)

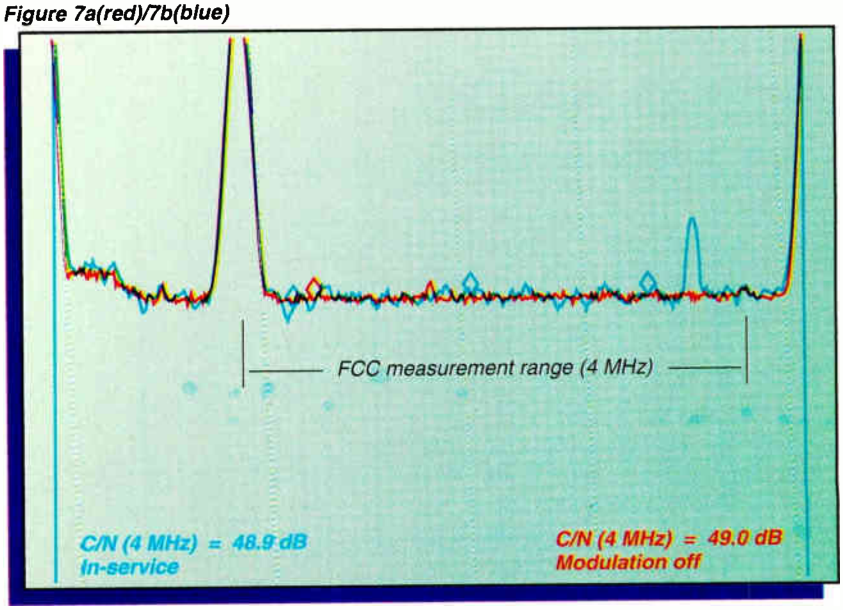


Figure 8a(red)/8b(blue)

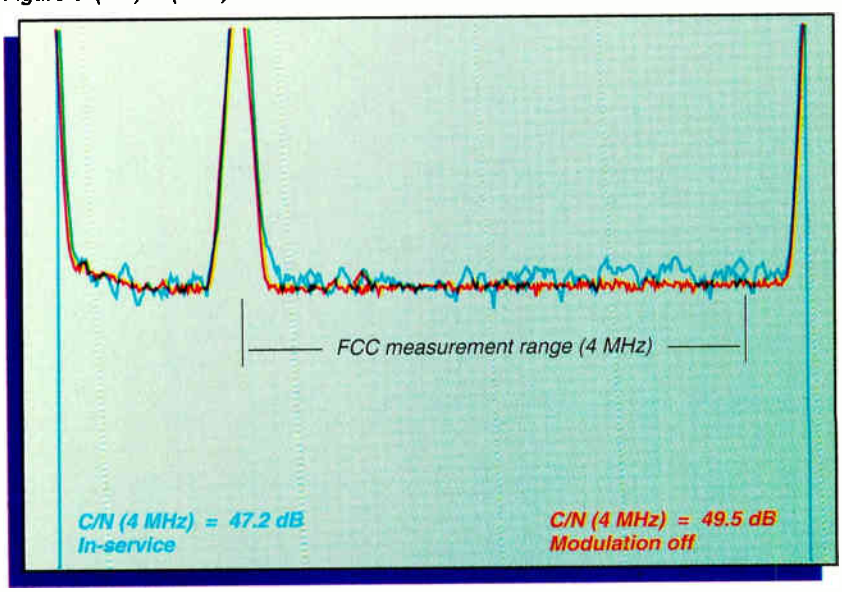
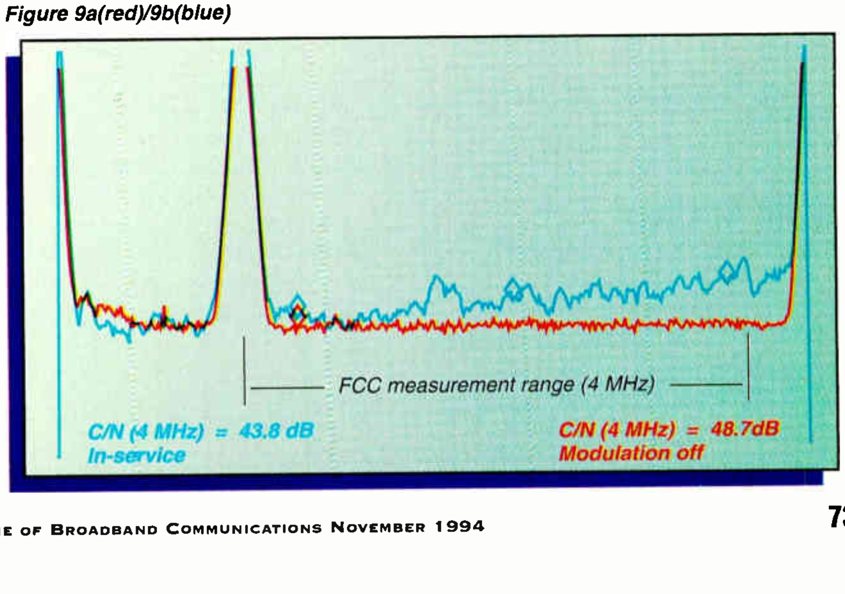


Figure 9a(red)/9b(blue)



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2. Lin, Wen Tsung and Tim Homiller, "Noise Measurements For A CATV System-C/N, S/N, Phase Noise," 1989 NCTA Technical Papers, p. 179.

3. Schwartz, Mischa, "Information Transmission, Modulation and Noise," Second Edition, McGraw-Hill, 1970.

4. "Visual Carrier-To-Noise," Recommended Practices (National Cable Television Assn. 2nd ed. October 1993), sec. I.D.

5. Code of Federal Regulations, Title 47, Chapter I, Part 76, "Cable Television Service."

6. Bullinger, Rex, "Wide Dynamic Range Carrier-To-Noise Testing," 1993 NCTA Technical Papers, p. 330.

Lightweight spectrum analyzer

2715 cable TV spectrum analyzer

BEAVERTON, Ore.–Tektronix Inc. has announced the 2715 cable TV spectrum analyzer which delivers in-service measurement performance. The unit measures 5 x 14 x 17 inches and weighs 23 pounds, or about half the weight of other in-service cable TV analyzers. An in-service RF measurement capability enables engineers and technicians to take accurate measurements while minimizing the time test-channels must be removed from service. In-service tests include carrier-to-noise, composite second order (CSO) distortion and in-channel frequency response. Composite triple beat (CTB) distortion can also be made as an in-service measurement when an allocated channel space adjacent to the test channel is unoccupied.

The 2715 addresses all FCC-required proof-of-performance measurements. Building on the 2714 analyzer, the 2715 offers a full complement of additional cable system spectral measurements, such as depth of modulation, FM deviation and hum/low frequency disturbance. In addition, the 2715's measurements are pre-programmed, enabling cable TV engineers and technicians to perform extensive cable system analysis and data collection at the push of a button.

In addition, the company has announced new capabilities for its FiberMaster Optical Time Domain Reflectometer (OTDR). Control from a remote location, five language options and enhancements to FMTAP software all make the FiberMaster even easier to use.

The unit is well-suited for testing telecommunications, cable TV networks and local area networks where the trend toward wide deployment of fiber continues.

Circle Reader Service number 41

Line locator

MOUNTAIN VIEW, Calif.–Metrotech Corp. has introduced a new line of intelligent, time-saving utility pipe and cable locators.

The four versions of the 9800 Line Locator Series offer one (82 kHz or 9.82 kHz) two (82 kHz and 9.82 kHz), and three (82 kHz, 9.82 kHz and 982 Hz)

IRD for headend

MIAMISBURG, Ohio–The R.L. Drake Co. has introduced a new high performance commercial integrated receiver descrambler, the ESR1260 IRD. Designed and engineered for demanding CATV installations, the ESR1260 IRD has a compact design which saves the operator needed rack space while incorporating the VideoCipher RS commercial module. The removable front panel allows easy access to the VideoCipher RS descrambler module without removing the receiver from the rack. Frequency synthesized tuning of video IF and audio subcarrier frequencies provides maximum stability. The ESR1260 IRD features a 16-character, liquid-crystal display which indicates all receiver parameters, a dual input tuner for operation on C and Ku band, and two IF bandwidth filters of 27 and 22 MHz to maximize receiver performance.

ESR1260 IRD integrated commercial satellite receiver

The descrambler has a standard 950 to 1450 MHz block IF input and utilizes a low noise 140 MHz IF with threshold extension to provide the best possible picture. The video output is automatically switched between descrambled video from the descrambler module and normal clamped video if an unscrambled signal is being received.

Drake is also offering two new distribution amplifiers, the DDA-1218 and DDA-1236. The new amplifiers are designed for applications in SMATV, private cable and other television distribution systems. The DDA-1218 offers 18 dB of gain, while the DDA-1236 has a full 36 dB.

Circle Reader Service number 42

Fiber power meters

BEAVERTON, Ore.–Photon Kinetics has introduced its new 7100 Series Fiber Optic Power Meters, part of a new line of rugged handheld fiber optic test and measurement equipment. The meters are designed to measure the absolute power of light from a fiber optic cable. They feature simple two-button operation and a large LCD display. The 7100 is ideal for telecom and data operations and has a measure-

7100 Series fiber optic power meter

Intelligent, time-saving utility pipe and cable locators

active frequency options. All offer passive 60 Hz and RF locating capabilities.

The 9800 transmitter's built-in ohm meter automatically measures the line resistance and determines the quality of the ground at power up. The 9890 and 9860 models feature "auto select" which transmits each of the available frequencies onto the line, evaluates each one, and selects the best frequency for the job.

Patented Distance Sensitive Left/Right Guidance and digital signal strength provide guidance to the conductor. Current measurement provides confirmation. Real-time Continuous Gain Adjustment gives a smooth signal response. Depth is determined with the push of a button; receiver display backlighting is an option.

High (three watt) transmitter output is powered by replaceable D cells or rechargeable nickel-cadmium packs. A vehicle-mount battery charger provides "on site" quick recharge. Both the transmitter and receiver housing design are rugged, weight balanced and weathertight.

Optional sheath fault locating capability is available for all models.

Circle Reader Service number 40

ment range of +5 dBm to -60 dBm. The 7100C has been specifically designed for CATV application, as well as applications where measurement of high-powered sources is needed. Its measurement range is +20 dBm to -35 dBm. The unit can operate either with rechargeable batteries, alkaline batteries, or with the AC charger/adapter.

Circle Reader Service number 43

Interference guard

EAST SYRACUSE, N.Y.–Communications & Energy Corp. has announced the Model DPI-100, which eliminates "direct pick up interference" (DPU or DPI) which enters cable television ready television sets and VCRs on the shield of coaxial cables. This is common in areas subjected to ambient interference sources of 100 dBu (100 mV/meter) or greater.

The DPI-100 is supplied with a short jumper cable for inserting it in the incoming drop cable to the television set. Connectors are 75 ohm Type F. The unit measures approximately 3.9 inches by 1.9 inches by 0.9 inches and weighs 3.8 ounces.

Circle Reader Service number 44

Fiber network hub

19-inch Linxs

LIBERTY LAKE, Wash.–Telect has announced several new product offerings. The 19-inch Linxs (Lightwave Integrated Network Cross-connect system) solves difficult cable management and network access problems. Designed as a modular, expandable network hub for fiber optic cable interconnection, termination and storage, the unit mounts into any standard 19-inch EIA or WECO relay rack and offers the same modular features as the 23-inch Linxs.

In addition, the company is offering the Digital Network Interface Panel (DNI), an interconnect and access point for all NE (network element) to DCS (digital cross-connect system) connections. It serves as a platform for cable changes, maintenance activities and troubleshooting procedures.

The DNI-1 panel has termination, test, monitor and patch ports for 168 four-wire DS1 circuits. The DNI-1B panel has termination, test, monitor and patch ports for 128 four-wire DS1 circuits.

Finally, the high-density DSX system houses 24 DS3, STS-1 or STS-3 circuits in four inches of vertical rack space.

Circle Reader Service number 45

Palm-sized optical meter

LACONIA, N.H.–Noyes Fiber Systems has announced the Model OPM 4 Series full-featured, low-cost palm-sized optical power meters.

Designed to measure optical signals at 660, 780, 850, 1310 and 1550 nm, the OPM 4 is suitable for both singlemode and multimode applications. SET REF feature enables users to Auto-Zero at each wavelength during testing.

Noyes optical power meter

OPM 4 features include: nine volt battery operation (battery included), auto-shutdown, soft carrying case, .01 dB resolution, power (dBm) and loss (dB) modes and auto-zero reference settings for each wavelength.

Circle Reader Service number 46

Addressable messaging

NEW YORK CITY–Successfully concluding work with the FCC and cable MSOs, Albrit Technologies Ltd. has announced the availability of its Addressable Messaging Systems, first in a family of new systems for installation at the headends of small and medium-sized cable television operations.

Service-enhancing functionality includes local or remote insertion of crawled and overlaid text messages into any desired program channel, with optional override of the audio signal, and continuous monitoring of all channels for loss of video. Messages can be created locally or received via modem for re-broadcasting. Channel selection and timing, and message content and format can all be remotely programmed and controlled via a PC. A headend activity log can be transmitted to any location.

New capabilities the system offers operators include local advertising and special-events messages and updates, emergency alerts, programming changes and community bulletins.

Circle Reader Service number 47

Photodetector module

WEST TRENTON, N.J.–EPITAXX Optoelectronic Devices Inc. is introducing the ETX 40FJ-S High Speed, 1300 nm Photodetector Module to the commercial market.

The ETX40FJ-S incorporates a 40 μm active diameter InGaAs PIN photodiode in a hermetically sealed TO-46 can and is pigtailed with a 9/125 μm singlemode, 900 μm jacketed fiber. Applications include central office receivers to 4 Gbps, 2.5 Gbps Sonet/SDH receivers, optical interconnects, digital CATV and test and measurement uses.

The company has also introduced the ETX 10LIN24-T5 and ETX 20LIN22-T5 to the commercial market. The ETX 10LIN24-T5 incorporates a 1 mm diameter InGaAs PIN photodiode mounted in a TO-5 package with a neutral density filter coating the glass window. The detector maintains linearity to a minimum input power of 24 dBm. The ETX 20LIN22-T5 is identical to the ETX 10LIN24-T5, except the product uses a 2 mm diameter photodiode which causes linearity to be maintained to 22 dBm.

Applications for both LIN packages include test equipment designed to measure power emitted by DFB laser modules, YAG lasers, Erbium Doped Fiber Amplifiers and other high power laser sources.

Circle Reader Service number 48

NOVEMBER

2-4 Fiber Optic 6: Working with Singlemode Fiber. A two-and-a-half day course emphasizing the specific techniques required for singlemode installations. Location: Kent, Wash. Call Valerie Johnsen (206) 251-1240.

3 Magnolia Chapter of SCTE Regular Meeting. Subject and speaker TBA. Location: Ramada Inn Coliseum, Jackson, Miss. Call Bob Marsh (601) 932-3172.

7-9 SCTE Technology for Technicians II Seminar. Hands-on technical training program for broadband industry technicians and system engineers. Location: Nashville, Tenn. Call SCTE National Headquarters (610) 363-6888.

9-11 Fiber Optic Installation and System Design. Seminar sponsored by The Light Brigade, tailored for those seeking a full understanding of fiber optics, from engineering to implementation. Location: Santa Ana, Calif. Call Valerie Johnsen (206) 251-1240.

9-11 Network Management with SNMP. Produced by the American Research Group. A three-day course for understanding and using MIBs, Agents and Network Management Systems. Location: Atlanta. Call (919) 380-0097 to register.

10 SCTE OSHA/Safety Seminar. Location: Nashville, Tenn. Training seminar for system managers and safety coordinators on maintaining records and developing safety training programs. Call SCTE National Headquarters (610) 363-6888.

10 SCTE Satellite Tele-Seminar Program. "Customer Service: Doing the Job Right the First Time, Part 1." To be transmitted on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. EST. Call SCTE National Headquarters (610) 363-6888.

14-16 Fiber Optics Installation and System Design. Three-day seminar sponsored by The Light Brigade, tailored for those seeking a full understanding of fiber optics, from engineering to implementation. Location: Sunnyvale, Calif. Call Valerie Johnsen (206) 251-1240.

15-16 Fiber in the Loop Comforum. Sponsored by the International Engineering Consortium. Location: Phoenix, Ariz. Call (312) 938-3500.

16 Denver S(B+CT+MPT)E Meeting. "Compression: Theory and Practice of the State of the Art," sponsored by the Denver joint meeting task force of the SMPTE, SCTE, SBE. Location: Denver. Time: 5:00-8:30 p.m. Call Steve Johnson, Society of Cable Television Engineers, Time Warner Cable, (303) 799-5621.

16-18 Qualcomm CDMA Seminar. A three-day seminar which will compare FDMA, TDMA, GSM and CDMA, describing how CDMA works and providing field trial results. Location: Sheraton Grande Torrey Pines, San Diego, Calif. Call (619) 434-3431; or register by fax with credit card only: (619) 434-3737.

28-30 Fiber Optics Installation and System Design. Three-day seminar sponsored by The Light Brigade, tailored for those seeking a full understanding of fiber optics, from engineering to implementation. Location: Sacramento, Calif. Call Valerie Johnsen (206) 251-1240.

30 Summary Submissions due for 1995 National Fiber Optic Engineers Conference, sponsored by Nynex and Bellcore. The conference will be held June 18-22, 1995, in Boston, Mass. A major forum of information exchange concerning the planning, deployment and administration of fiber optic technologies for telecommunications networks. For additional information, call Marie Lee Marchesseault (Nynex) at (508) 624-1593.

30-December 2 The 1994 Asia-Pacific Cable & Satellite TV Summit. Organized by Pan-Asian Telecommunications Information Task Force (a division of The Institute for International Research). Location: Hong Kong Convention & Exhibition Center. To receive the program booklet, fax to: Belinda Strudwick, 61 2 959 4835.

Trade Shows

November

October 31-November 4 CAPER/Jornadas '94. Location: Buenos Aires, Argentina. Call (011) 54-1-383-5399 for more information.

14-15 Convergence IV–Information Superhighway. Produced by CommPerspectives. Location: Washington, D.C. Call Sarah Harvey (303) 393-7449.

15-17 RF Expo East. Sponsored by *RF Design* magazine. Location: Disney's Contemporary Resort, Orlando, Fla. Call Argus Trade Shows (800) 828-0420.

30-December 2 Western Show. Location: Anaheim, Calif. Call (301) 468-3210.

DECEMBER

7-9 Fiber Optic Installation and System Design. Sponsored by The Light Brigade. Location: Kent, Wash. Call Valerie Johnsén (206) 251-1240.

The issue: Interconnects

If cable operators are serious about entering the telephony or datacom market, they're going to have to be able to send and retrieve signals across traditional cable system franchise boundaries. This is a major break with tradition. Some say it can't be done easily. What do you think?

he questions:

. Has your system consolidated headends by adding iber to your system?

❑ Yes ❑ No ❑ Don't know

2. Has your system considered constructing one regional "superheadend" to serve the community?

❑ Yes ❑ No ❑ Don't know

3. Has your system considered interconnecting or completed an interconnect project with adjacent cable systems owned by other MSOs to fully "cover" the metro area you serve?

❑ Yes ❑ No ❑ Don't know

4. Do you think such an interconnect could save your system money over the long term?

❑ Yes ❑ No ❑ Don't know

5. Do you think your neighboring MSO would welcome the opportunity to interconnect with your system?

❑ Yes ❑ No ❑ Don't know

6. Do you believe an interconnect could bring you more revenue through data delivery to businesses, advertising or other services?

❑ Yes ❑ No ❑ Don't know

7. How important will interconnects be in the future?

❑ Very ❑ Somewhat ❑ Not at all

8. Today, would you be inclined to deploy Sonet equipment or go with a less costly analog or proprietary uncompressed digital fiber system?

❑ Sonet ❑ Proprietary ❑ Don't know

9. Do you think cable operators can overcome individual preferences (i.e. signal security) and interconnect their systems effectively?

❑ Yes ❑ No ❑ Don't know

10. Do you think a new set of standards should be created to allow for neighboring cable systems to interconnect seamlessly?

❑ Yes ❑ No ❑ Don't know

11. Do you think the cable TV industry should do more, less or about the same amount of work to determine the feasibility of interconnecting?

❑ More ❑ Less ❑ About same

Your comments:

FAX US

303-393-6654

Make a copy of this page and fax it back to us at the number above or mail it to *CED*, 600 South Cherry Street, Suite 400, Denver, Colo. 80222.

We will tally the results and print them in a future issue. Your suggestions for future questions are always welcome.

We also want some written comments from you on this subject. Names won't be published if you request your name to be withheld, but please fill out the name and job information to ensure that only one response per person is tabulated.

Your name and title

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System name:

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Your MSO:

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Location:

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Your job function:

____

MY VIEW

Broadcast quality technical standards

By Archer S. Taylor, Director and Senior Engineering Consultant, Malarkey-Taylor Associates

Many years ago, the expression "broadcast quality" was a synonym for excellence, the epitome of perfection in sound reproduction. In those days, the FCC was a respected part of the technological leadership in broadcasting. Its Standards of Good Engineering Practice were perceived as being the touchstone defining quality.

Technological change and deregulatory zeal have long since eclipsed FCC ingress into defining signal quality. In the heyday of radio, it did adopt rules, long since repealed, specifying frequency response, harmonic distortion and signal-to-noise ratio at the transmitters. In order to encourage utilization of the UHF band for television, it specified receiver noise figures for TV receivers. In response to political pressures, it recently revisited and restored the cable TV signal quality standards deleted a few years earlier. But these were minimal performance specifications. Broadcast quality sound and picture were established in practice primarily by the exceptionally qualified engineering staffs at ABC, CBS and NBC.

In 1941, television standards were proposed by the National Television Systems Committee (NTSC) and promptly adopted by the FCC virtually intact. The NTSC standard, and its offspring PAL and SECAM, were created to ensure that television receivers produced by diverse manufacturers could operate with any signals transmitted in accordance with the standard. The NTSC did not specifically define picture quality; however, the transmission standards were expertly crafted to enable excellent picture quality, allowing manufacturers to strike a balance between cost and picture quality. The outstanding success achieved by the NTSC is attested by the remarkable improvements in picture quality at steadily decreasing costs observed over its half century of existence.

Time for a change

We now realize that picture quality improvement is bumping the ceiling of NTSC capability. The development and availability of solid state memory and microprocessors, virtually unimaginable 50 years ago, have opened new opportunities with digital technology. It's time for a change. Advanced TV (ATV) standards soon to be adopted by the FCC will prescribe the signal architecture, as they did in 1941, leaving the definition of end product picture quality to the marketplace.

Receivers for ATV are predicted to cost some $2,500. But the market will extend well beyond the classical broadcasting consumer to include cable TV subscribers and computer networks. Moreover, the market is likely to demand $500 receivers, even if they are not capable of full ATV performance.

Thus, the dealer's shelves will include large screen, up-market models with exquisitely high definition; mass market models with somewhat improved picture quality; and PC cards to fill the 13-inch PC CRT screens with the highest possible definition when viewed at three feet. Perhaps there will also be models designed especially for use with cable or wireless TV distribution systems. If the ATV standards fulfill their mission as effectively as those of the NTSC, they will support increasingly diverse applications.

The transition

The problem of the moment is the transition period between NTSC and ATV. Experience suggests that it could be well into the 21st century before half or more than half of all TV households are equipped with ATV compatible equipment. Moreover, cable TV, DBS and MMDS will soon be distributing digital video signals to home users, possibly using MPEG-2 compression and a variety of transmission systems. The situation is chaotic. Proprietary standards are popping up everywhere, looking for de facto status.

The major players in the cable TV, consumer electronics, computer and telephone industries are economically and politically powerful to varying degrees. The goal of each is to provide video and interactive services, hardware and software, primarily to residential households. All eyes are focused on the adapter box between the commonplace but perhaps outmoded home TV display device and the high-tech digital information streams soon to be launched on an ill-prepared public.

Interface standards

More than 100 standards committees are reported to be at work on defining signal characteristics and the interface "box," whether it be set-top or set-back. The consumer electronics industry wants to build it all into its new models. The computer industry wants an interface to take advantage of the superior capabilities of the PC as an interactive display device. Cable TV intends to retain flexible control of security for its premium box office, as well as the navigational tools for 500 channels and interactivity.

The EIA/NCTA Joint Engineering Committee is striving to reach a voluntary agreement on the interface standards. If not, the FCC promises to do it for us. It is certainly hoped that the issues will have been resolved by the time this column is published. Standards destined to affect non-broadcast video distribution and reception for many years to come are too critical to default to the FCC.

Whatever the situation may be when this is published, we must commend Decker Anstrom, Wendell Bailey and especially Walt Ciciora of the NCTA, as well as Joe Van Loan as chairman of the NCTA Engineering Committee, and a host of others for their competence and dedication throughout these difficult and critical negotiations. CED

The System That's Certain...For a Future That Isn't.

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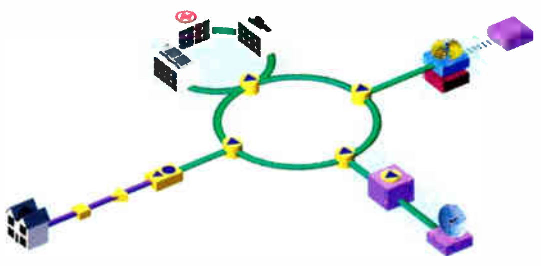

Our Cable Integrated Services Network (CISN) provides a "blueprint" for building a broadband network that accommodates interactive services in a 1 GHz spectrum. IDS provides the solution to the final, critical link of the broadband network, the subscriber drop.

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