CED

THE MAGAZINE OF BROADBAND TECHNOLOGY / SEPTEMBER 1990

Interactive TV: Will it catch on?

—page 42

Cablevision Systems' fiber plans revealed

—page 50

Customer service standards: How to relieve the pressure

—page 82

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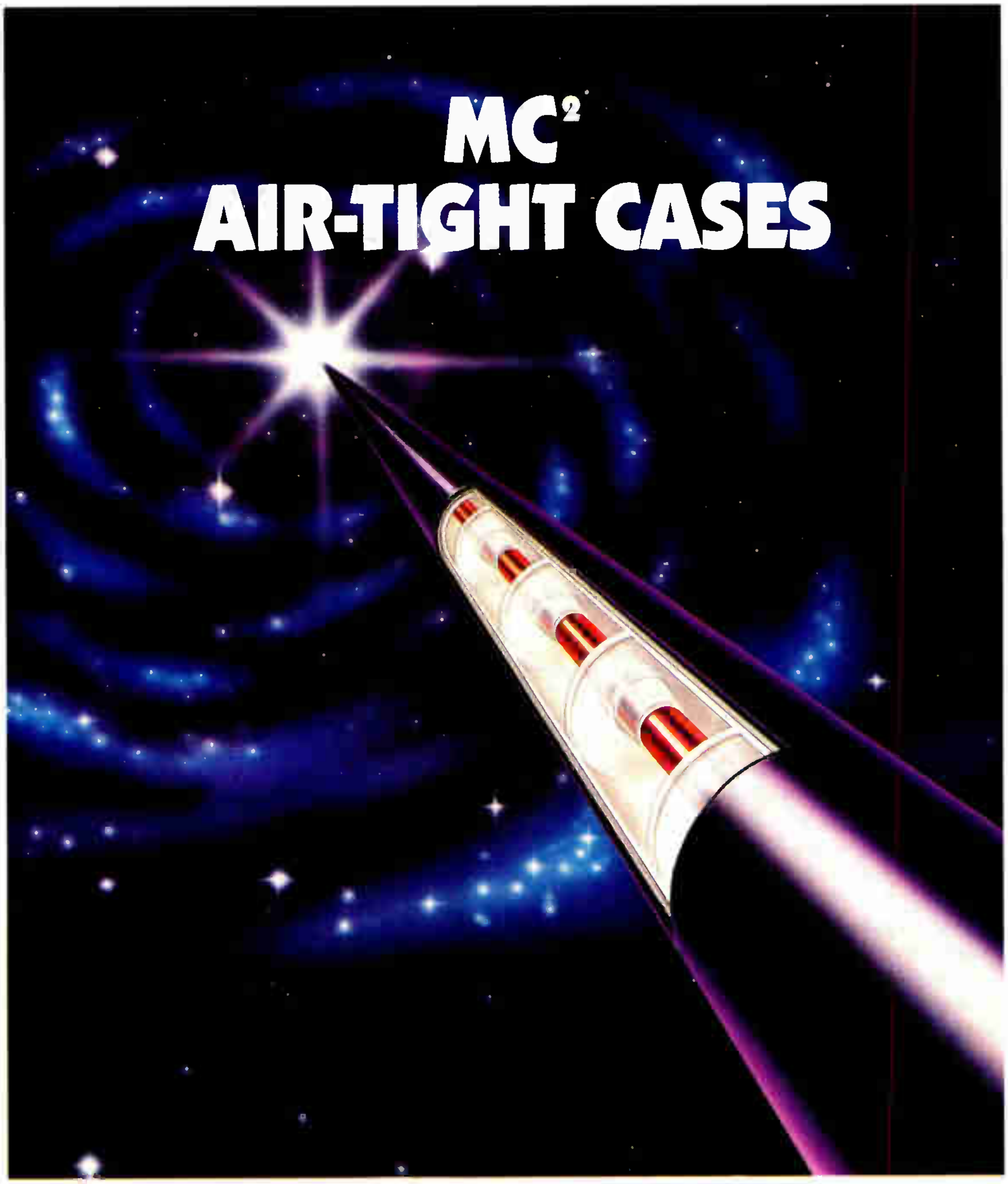

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CED

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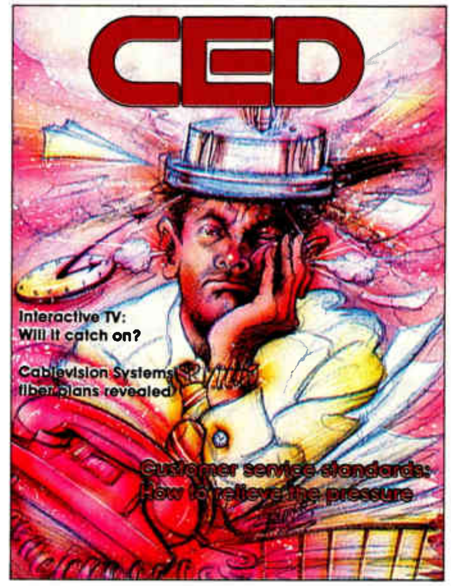

About the Cover:

Operators are feeling the pressure of the NCTA's customer service standards. Illustration by The Image Bank.

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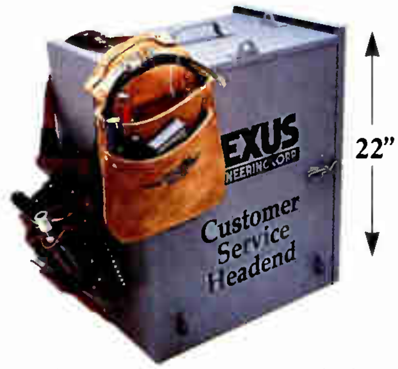

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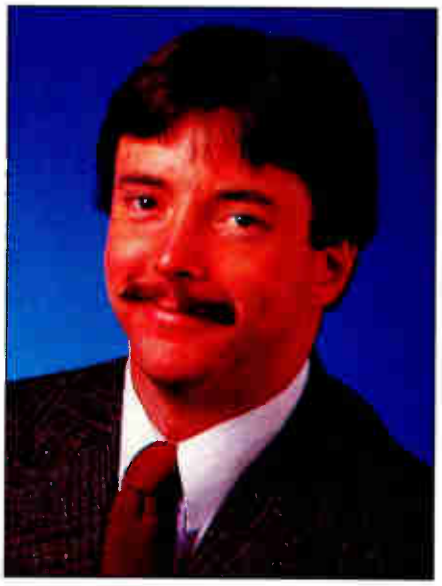
Inside the Capitol's dome

Any student of government wishing a lesson in national politics couldn't have found a better example of the compromises that take place on Capitol Hill than the recent haggling over a cable television re-regulation bill.

By the time Congress broke for its summer sabbatical last month, it seemed clear that yes, the cable industry would see—and willingly accept—some form of rate re-regulation while the telephone companies were apparently shut out of the information services marketplace.

While anything is still possible—remember, nothing has yet been cast in stone, and we're talking about the vagaries of Washington, D.C.—the powers at the top of the cable industry appear to be cooperatively participating in framing cable television legislation. In fact, according to insiders familiar with the proceedings, the powerful NCTA lobbying force actually had the option of calling in a few favors and killing any new attempt at regulation or helping shape it.



This apparently is not uncommon. Despite their public diatribes, members of Congress are keenly aware of the effects legislation can have on various industries and often seek to reduce damage while maintaining control. It doesn't always work, but then what does?

Needless to say, faced with the option of either taking an active role in determining its immediate future or taking a gamble with the next Congress, NCTA chose the former alternative. It may seem a little crazy to accept "defeat" especially when the same group fought so hard for de-regulation six years ago. But in Washington there are no absolutes. Actually, the industry should be delighted with the fact it was allowed to grow unfettered for so long.

Perhaps the biggest disappointment is having to face up to the "I-told-you-so's" who said cable would take advantage of its new-found freedom and gouge cable subscribers unmercifully. Those who years ago predicted the industry would be re-regulated sure seem like prophets today.

I certainly hope the new regulation has a calming effect on the industry. As ever more competitors are poised at the door, upping the technology ante, now would be a bad time not to invest in product R&D. It's time the industry licked its wounds, accepted its fate and got on with the process of designing, building and maintaining the best telecommunications networks it can.

Roger J. Brown

Roger Brown
Editor

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Wireless VCR programming device makes task a one-step process

An interesting new product has surfaced that eases the compatibility problems posed by VCRs either directly fed by cable or through set-top converters. Gemstar Development Corp. has introduced VCR Plus+, a wireless infrared unit roughly the size of a remote control that makes the VCR programming process a one-step technique.

The process is begun by entering into the unit a code number dedicated to the selecting the proper channel to tape on the set-top converter. Of course, a viewer will have to remember to leave the converter on.

The VCR Plus+ unit offers several features to accommodate various taping habits and hardware in the home. Viewers must enter a set of codes one time only for the brands of VCR and cable converters they own and can set the VCR to record the same program daily or weekly.

Gemstar's engineers have even con-

Gemstar Development's VCR Plus+ VCR Programmer

program a viewer wants to tape. These code numbers, which use a patent-pending coding scheme, will be printed in the TV listings of a variety of different publications located around the country. The short codes include information on the time, length and channel position of the program desired.

Complete remote operation

After the code(s) is entered, the unit is placed near the VCR. When the selected program begins, commands are sent via infrared to the VCR which tell it to turn on, select the proper channel, tape the program and then turn off.

VCR Plus+ will also work in a cable-television environment by tuning the VCR to channel 3 (or channel 4, depending upon the market) and sidered how to accommodate viewers in different systems that may have different channel lineups. The unit can be mapped on a channel-by-channel basis to coincide with the channel designations listed in local newspapers.

Gemstar plans to roll out VCR Plus+ by the end of October in California, Michigan, Texas, Florida, Chicago, New York City and portions of Colorado. It expects to be fully national within a year, according to Louise Wannier, vice president of marketing and business development. The units will be sold at retail outlets and through cable operators. They carry a suggested price of $60 each.

Gemstar has already reached agreement with several newspapers and *TV Guide* to publish the codes in the TV listings and Wannier said she expects more agreements to be reached in the very near future.

CableTrac closed by judge's ruling

A nasty court fight between Alpha Technologies President Fred Kaiser and Dovetail Systems President Robert Dickinson has resulted in the dissolution of CableTrac, a aerial signal leakage detection service jointly owned by Dickinson and Kaiser. Alpha has since acquired Flight Trac, a Chicago-based flyover service.

The court found Dovetail to be in breach of contract and Dickinson, as an officer of CableTrac, was personally found to be in breach of fiduciary duty. Dovetail has been ordered to repay Kaiser at least $200,000 for monitoring equipment that was never delivered and lost profits that occurred from CableTrac's failure to attain nationwide status.

The judgment officially ended a relationship that began in October 1988, when Kaiser agreed to fund CableTrac and join Dickinson in the CableTrac venture. According to court documents, Alpha provided $150,000 to start up the flyover business and agreed to pay Dovetail for three modified versions of its existing measurement equipment.

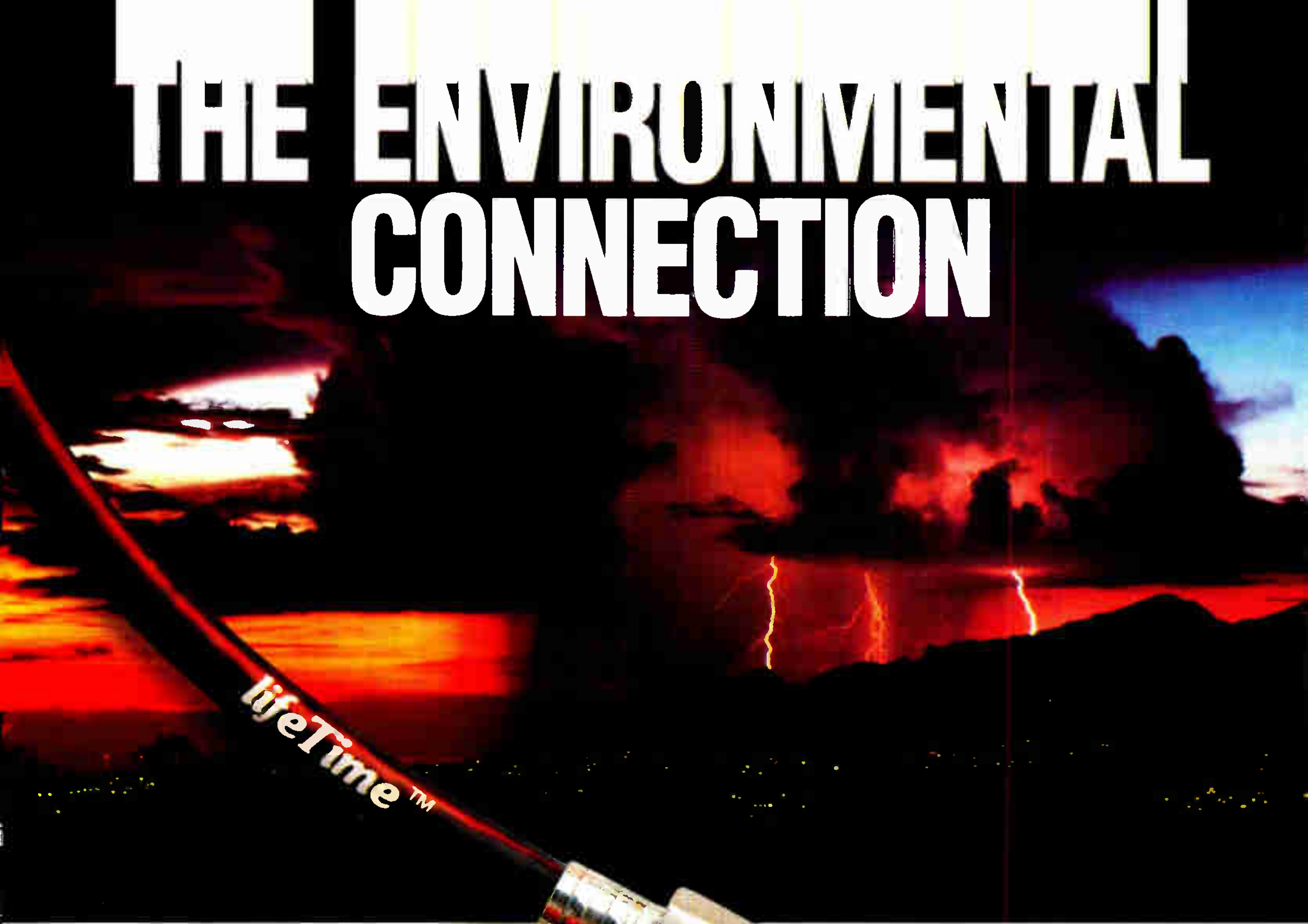
Specifically, Dovetail was found to have diverted CableTrac funds to alleviate its own cash flow problems and failed to deliver the monitoring equipment despite several deadline extensions. As a result, the court ordered that CableTrac shut its doors, a process which was to have been completed late last month.

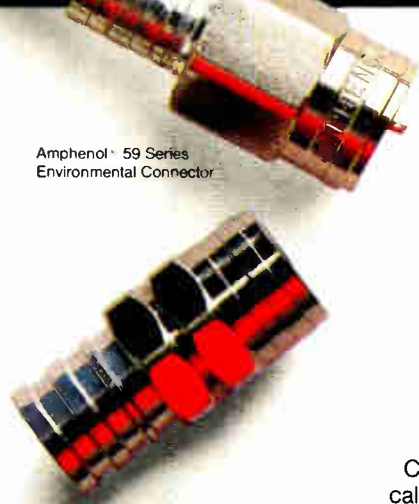
Alpha has since acquired Flight Trac, a flyover service headed by Dom Stasi which employs the leakage detection technology developed by Rogers Cable Systems.

According to Kaiser, Flight Trac will become a nationwide service, with at least five aircraft operating out of various hubs. They will be headquartered in the Pacific Northwest, the Southwest, Chicago, Philadelphia and either Dallas or Atlanta.

ATC buys Jerrold fiber products

Jerrold Communications' research





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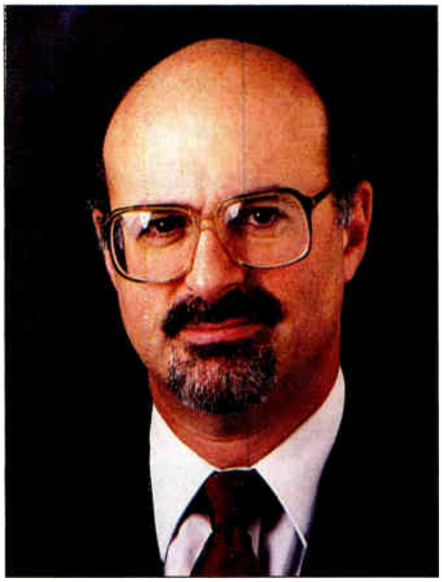

C-band satellite orbital spacing

In 1983, the FCC decided there were going to be more C-band satellite applications than could be accommodated with the 4-degree spacing policy then in effect. So the FCC said that future satellites would be spaced much closer, at only 2 degrees apart. There is an effort now underway in Washington to get that decision rolled back to 3-degree spacing. The result would be smaller (and less expensive) dishes for homes and cable headends.

By 1981, the satellite communications industry was booming as first generation satellites launched in the mid-1970s were becoming filled and a large number of additional companies sought to enter the industry and launch satellites. The FCC began an inquiry into the technical issues related to reducing the orbital spacing and, in 1983, decided to reduce the spacing from 4 degrees to 2 degrees. This was to be implemented over the 1983-1990 time period.

The FCC recognized that 2-degree spacing would require larger satellite dishes than 4 degrees or even 3 degrees. This is because a satellite dish serves two purposes. One is to amplify the incoming signal from the satellite it is pointed at. The other purpose is to narrow, or more sharply focus, the "beam" that can be received.

By Jeffrey Krauss, Independent Telecommunications Policy Consultant and President of Telecommunications and Technology Policy of Rockville, Md.

Signals from an adjacent satellite, which might cause interference, can be rejected. The bigger the dish, the closer that satellites can be spaced without causing interference to one another; the smaller the dish, the farther apart the satellites must be.

In 1981-83, there was virtually no home dish market, and the cable industry was the largest user of satellite dishes. The dishes then in use at cable headends would not be able to discriminate adequately between satellites spaced at 2 degrees.

The cable industry objected to the narrower spacing. But the FCC said that the seven years from the time of the decision until all the new satellites were launched would provide adequate time to install larger dishes at headends. To the limited extent that there were some receive-only home dish antennas at that time, the FCC said that home dishes are not licensed, and do not deserve any protection against interference. That policy remains in effect today.

Changed circumstances

The satellite industry has changed dramatically since 1983. Because of the successful deployment of long distance fiber optic networks, most of the voice and data traffic that was carried by satellite is now carried by fiber networks.

There has been consolidation in the industry. The satellite system once operated by the Southern Pacific Communications Company is now part of GTE. The Western Union satellite system is now part of Hughes. Contel ASC will soon become part of GTE. As a result, the extreme pressure that the FCC felt in 1981, because of a shortage of orbital slots, has disappeared.

Since then, the C-band satellite growth has come in the video distribution market. Along with some 10,000 dishes at cable headends, there are 2 million to 3 million C-band dishes at private homes. That market is strongly affected by dish size. The typical size needed for a home dish today, in order to receive an acceptably strong signal, is 8 feet to 10 feet in diameter. With that size, the market for C-band dishes could grow perhaps to 4 million over the next 5 to 8 years. But if the dish size could be as small as 3 feet to 4 feet, the market could grow to 10 million in that same time period.

The satellite transmitting and receiving technology has changed as well. The next generation of C-band satellites will use amplifiers of up to 16 watts, compared with the current range of 5 watts to 10 watts. And there have been tremendous improvements in low noise amplifiers. This means that dish sizes of 3 feet to 4 feet would provide a strong enough signal to give a good picture.

While a 3-foot to 4-foot dish will provide adequate signal strength, it will not provide a beam that is tightly focused enough to reject interference from a satellite spaced 2 degrees away. A 3-degree spacing is needed if 3-foot to 4-foot dishes are to be used.

Spacing in the near future

Today, the important satellites that distribute video to the cable and home dish subscribers are spaced at 3 degrees or more from their neighbors. This includes Satcom 3R, Galaxy 1 and Satcom 1R. Some video is also distributed on Westar 5, which is spaced at 2.5 degrees from its neighbors.

However, starting in the next year or two, the next generation of C-band satellites will be launched. These include Satcom C1, Galaxy 1R, Satcom C3 and Galaxy 5W. They will have higher power than current C-band satellites. But under current plans they will be spaced at 2 degrees from each other and from existing satellites.

A legislative effort is underway to force the FCC to look at the costs and benefits of wider satellite spacing. Earlier this year, Louisiana Representative Billy Tauzin wrote to FCC Chairman Al Sikes and asked the FCC to examine the issue. The FCC wrote back, saying, "No."

As a result, the cable bill that is now working its way through Congress has a section that forces the FCC to look at whether the orbital spacing policies act as barriers to the use of 4-foot (or smaller) dishes. If so, the FCC must change its policies to remove the barriers.

Because the demand for orbital slots has abated, several orbit assignment plans are feasible that provide additional spacing to the primary cable video satellites. The FCC will have to balance the benefits to home dish viewers and cable operators against possible harm to satellite operators. The details of choosing among these alternatives will be dealt with in the FCC rulemaking process that will be required by the law. ■

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Simulcast compatibility

Seven or eight years ago, with a considerable assist from Japanese press releases, the media—both print and electronic—discovered the exciting new world of "high definition television" (HDTV). Wide screen TV pictures would be as clear and bright as the movies. No more snow. No more ghosts. Surround sound would equal or exceed the excellence of compact discs.

Compatibility

TV broadcasters, fearing for their commercial lives, demanded that FCC adopt standards for HDTV before video cassettes and cable TV put them out of business. Soon the word "compatibility" was resurrected from the lexicon of the 1950s when color television was born. Direct compatibility is perhaps the most striking feature of the color TV standards adopted in 1952.

Transmissions in color could be viewed either in good quality black-and-white on the older TV sets, or in full, living color on new TV sets. Moreover, black-and-white transmissions could be viewed on the new color sets, so that neither the older TV sets nor the library of monochrome films would be made obsolete. This remarkable engineering achievement provided for a smooth transition over a period of more than 10 years while broadcasters installed color equipment and consumers adjusted to the idea of color TV and replaced their old TV sets.

By Archer S. Taylor, Senior Vice President Engineering, Malarkey-Taylor Associates

At first, it was universally expected, even demanded, that the same kind of direct compatibility must be provided by the new HDTV standards. Otherwise, it seemed, an orderly transition might be impossible, and millions of perfectly good NTSC TV sets could become obsolete overnight.

Unfortunately, the HDTV system developed by the Japanese over nearly two decades, and vigorously advocated by the United States for several years, was not compatible, and could not be made so without great compromises. In fact, the original Japanese system, called MUSE (MUltiple sub-Nyquist Sampling Encoding), would not fit the conventional 6 MHz channels.

Augmentation

What to do? North American Philips, the Sarnoff Laboratory (NBC/RCA), and others worked on the idea of using a second full channel (or half a channel) to carry the additional information needed to fill in the side panels on a wide-screen HDTV receiver and enhance the picture definition to true HDTV quality. Standard NTSC sound and picture signals would be transmitted on the main channel, to be received normally on conventional, non-HDTV receiving sets. The additional information would be transmitted on the second channel and combined in HDTV receiving sets so as to augment the conventional signals for true HDTV, wide-screen display.

> A special opportunity could open if cable TV were to provide HDTV programming without simulcasting in NTSC format.

The trouble with this idea was that the required augmentation channels could only be allotted by relaxing co-channel and adjacent channel separations, and disregarding the UHF "taboos." It was feared that this could result in shrinkage of service areas and undesirable interference. The hope that new VHF or UHF spectrum might be made available for HDTV broadcasting collided head-on with the demands of cellular telephone and other land mobile users.

Simulcast compatibility

In September 1988, the Commission decided that no new spectrum would be allotted to HDTV, and that service must be continued to the existing NTSC TV sets, at least during a transitional period. However, FCC did not mandate direct compatibility, as with color TV. Instead, it acknowledged as an option that NTSC service could be maintained by simultaneously broadcasting the NTSC signal on the normal channel and an incompatible HDTV signal carrying the same program on a supplementary 6 MHz channel.

This simulcast compatibility option seemed more theoretical than real, however, because the Commission's own studies showed little hope of assigning 20the extra channel to many important stations.

Then, within hours of the FCC Notice, Zenith Electronics Corp. announced its Spectrum Compatible HDTV proposal. Zenith's extraordinary announcement claimed that the Spectrum Compatible system could deliver high definition signals, with improved signal-to-noise ratios, throughout the normal service area of conventional NTSC TV stations *using no more than two percent as much peak radiated power*. At such low power levels, Zenith predicted that a second 6 MHz channel could be assigned to virtually every existing TV station without degrading the existing conventional service.

If tests confirmed Zenith's claims, simulcast compatibility would have a great future. Early in April 1990, FCC indicated opposition to augmentation, and significantly encouraged the simulcast compatibility concept.

Only two months later, in June, General Instrument announced its DigiCipher™ HDTV system. While Zenith's Spectrum Compatible System is a hybrid combination of digital transmission at low video frequencies and analog at higher frequencies, DigiCipher is completely digital. Both provide true HDTV, with twice the resolution of NTSC and 16:9 display aspect ratio. Both claim to be able to cover the same service areas as NTSC with 17 dB to 20 dB less power (1 to 2 percent normal). But DigiCipher also claims the ability to transmit more than one program in a single 6 MHz channel!

MY VIEW

Neither the Zenith nor the General Instrument system has yet been fully tested. Unless there are errors in the calculations and computer simulations as devastating as the incorrect curvature of the Hubble telescope reflector, it appears that the new television system may really have begun to take shape, at least for North America. Nevertheless, the remaining contenders approved for testing by ATTC (Advanced Television Test Center), after several dropouts along the way, should not yet be discounted. There are still many questions that can only be resolved in laboratory and field testing of real hardware, in real circumstances, to confirm the computer simulations.

The impact on cable

What consequences of simulcast compatibility are likely to be felt by cable TV? Most obvious is the need for an additional 6 MHz bandwidth to carry each off-air broadcast TV program in HDTV format simultaneously with NTSC transmission, on separate channels. I am not bold enough to predict how "must-carry" might be applied to this situation.

It is easy to predict, however, that the growth of HDTV transmitters will be spread out in time, probably over several years, maybe even a decade. FCC expects to issue standards in 1993. Some HDTV transmitters could be in operation within two years thereafter, but the off-air HDTV channel capacity crunch will not hit cable TV until several years later.

However, the cable satellite networks could also add HDTV simulcast transmissions, perhaps even before terrestrial broadcasters are ready. This is especially likely if the GI DigiCipher system proves to be an acceptable way to deliver more than one HDTV program per transponder. Moreover, it may be possible to deliver HDTV programs in video cassettes, and by DBS or MMDS, without the NTSC counterpart. The claimed ability of DigiCipher to transmit two, or even three or four HDTV programs in a single 6 MHz channel, if confirmed, could go a long way to ease the cable channel capacity crisis.

Getting from here to there

The adoption by FCC of standards for HDTV is only the beginning. Then comes the great "chicken and egg" game. Prices on HDTV sets are not likely to become affordable unless attractive HDTV programs are available. Producers, broadcasters and video stores will not make HDTV programs available without a reasonably assured audience. Considerable experience indicates that it may take 10 to 15 years to achieve solid public acceptance of the new kind of television.

If either Zenith's Spectrum Compatible or GI's DigiCipher system proves to be successful, it could have a decidedly favorable effect on cable TV transmission. Because they operate at power levels 17 dB to 20 dB below normal, with suppressed carrier, they would be unlikely to contribute intermodulation noise. However, the effect of NTSC composite triple beat products falling within the HDTV channel still needs to be investigated.

Multi-path transmission of digital HDTV signals over-the-air could be a problem for broadcasting. A similar effect due to return loss reflections could perhaps be a less severe problem for cable TV distribution. If ghost cancelling circuitry is required in the TV set for broadcasting, cable TV would also be a beneficiary. The extent of this problem is still to be determined, as is the technical feasibility of ghost cancellation.

Considering the many technological and commercial riddles that must be solved, the impact of simulcast HDTV compatibility is not likely to be felt by most cable TV operators for at least a half dozen years.

A special opportunity for cable

By 1995, wide-screen television sets with twice normal resolution capability will be available for anyone willing to pay the rather high introductory price. Movie product, most of which is already in wide-screen format on high resolution masters, will probably be made available to broadcasters for simulcast in both standards on a limited scale. But for the rest of the decade, conversion to HDTV of many bread-and-butter games and sitcoms, and real-time local news and special events is likely to be restricted and gradual.

A special opportunity could open if cable TV were to provide HDTV programming without simulcasting in NTSC format. The traditional role of cable TV has been to offer programming not otherwise available.

The sale of wide-screen, high resolution TV sets would be significantly stimulated by the presentation on cable of attractive movies or special events, in HDTV format only. ■

Coax is dead—long live coax!

I have recently been quoted as saying that coaxial cable is dead, at least for CATV trunking applications in newbuilds and major rebuilds. I believe that is in fact true today for 450 MHz (60 channel) systems, and will soon be true for systems designed at 550 MHz (80 channels) and beyond. This arises from the fact that in newly designed plant, we are approaching a point where there is a cost "push" between the purchase and installation of new coax trunking cables and electronics, and optical fiber trunking cables and their associated terminal equipment, used to feed the coaxial distribution plant directly.

This has led to speculation about the ongoing viability of the coaxial cable manufacturing business where, it is said, a significant portion of net income is derived from large-sized trunking cables. Indeed, if this translates into a direct loss of sales of trunk cable and the continuation of sales of small-sized distribution cables at present levels, it probably is not terribly good news for Comm/Scope, Times Fiber and Trilogy, the major manufacturers of rigid aluminum cables for our industry today.

Coax advantage and disadvantage

Things are not quite so simple, however. First of all, it is absolutely true that in the distribution plant, the vast majority of plant mileage which we will construct and rebuild will remain coaxial. Coaxial cable has one tremendous advantage and one major drawback. The advantage is that it carries television signals in a form which is directly receivable by our customers' TV sets. This point has been largely overlooked by potential competitors who talk about all-digital, all-fiber delivery systems, but the fact is that coaxial cable can deliver a large number of channels to very simple terminal equipment in the home (no terminal equipment at all when delivering signals to cable-ready sets and controlling services using traps or addressable interdiction).

This is in contrast to systems which will require an expensive, complex terminal for every television set and VCR. This is a fundamental strategic strength of cable, and in a more competitive future, it may turn into a trump card.

Coaxial cable is also easy to terminate, easy to install, and, most critically, already in place in 53 million homes. It has one fatal flaw, however, and that is its relatively high signal loss. In distribution plant, however, where the maximum reach of the plant is only a mile or so, that is not a significant drawback. It does not appear that for the foreseeable future, there will be an economic motivation to replace coaxial distribution plant with fiber.

> The door is now open for the cable industry to revisit the way it builds the distribution plant itself.

Even the telephone companies which have been vocal promoters of the "fiber-to-the-home" concept have begun to back off. A number of them are now talking about "fiber-to-the-curb," where twisted pair and coaxial cable would transport voice and video signals, respectively, the last few hundred feet to the home. This is an acknowledgement that a hybrid fiber/coaxial plant makes sense for video delivery; the only disgreement is exactly what proportion of fiber and coax such a system should have, and that is largely an economic question. Our industry is reaching the conclusion that economics will tell us to push our fiber plant out through the trunking system, but to retain coaxial cable for distribution.

Nevertheless, why is that not still bad news for coaxial cable manufacturers? The answer lies in the fact that the door is now open for the cable industry to revisit the way it builds the distribution plant itself. Most loss in distribution plant is "flat loss," and stems from the use of directional couplers to split the power on the cable onto branches and subscriber drops. There is another approach to distribution whose time may have come, however.

Amplified taps?

Throughout the history of the cable industry, engineers have periodically examined the idea of using low-loss taps with amplifiers built into them to achieve much greater reach within the distribution plant. Such an idea initially sounds terrifying. If active devices are the root cause of a fair amount of system unreliability, having thousands or tens of thousands of amplified taps scattered through a cable system sounds like a bad idea indeed. That is true, unless there can be a dramatic improvement in the reliability of the solid-state devices used in RF amplifiers.

There is hope on the front, however. The military has been designing electronics for years designed to operate reliably in the presence of EMP (ElectroMagnetic Pulse), the electrical phenomenon which accompanies a nuclear blast. Thus, there are transistors and integrated circuits which can operate reliably in an atmosphere far more hostile than that provided by the power surges and lightning which afflict our systems.

That is currently very expensive technology, but the expense is not inherent. It derives, rather, from the very low volumes of such devices which the military orders. If our industry was to use such devices in every tap, the volumes would be very high and costs would come down accordingly.

Dick Green of CableLabs points out that some of this technology has already found its way into the consumer marketplace. The semiconductors which are increasingly used in the automotive industry have been successfully designed to survive in an exceedingly hostile environment. The high current surges and inductive kicks which come

By Jim Chiddix, Sr. Vice President, Technology and Engineering, ATC

Clarifying Part 15 rules

Mr. Krauss stated in his article ("Part 15 of the FCC Rules," *CED*, August 1990, p.26) that refurbished converters purchased by cable operators after July 1, 1990 must all have an AGC circuit in them. Luckily for cable operators, this is simply not the case. In fact, even new converters that were in the United States in inventory prior to July 1, 1990 do not require an AGC circuit.

As far as the impact of Part 15 and Part 76 on the refurbished converter market, suffice it to say as long as the vendor does not make any unauthorized changes to the original manufacturer's product, then the converter is acceptable to the FCC under all applicable guidelines and does not require the addition of the AGC circuit. Of course, the definition of unauthorized changes must then be clarified. Unauthorized changes to converters would include the adaption of an addressable product into a pay/descrambling product. For example, taking a Jerrold DRZ-3A and converting it into a DRZ-3-DIC would constitute an unauthorized change that would require the addition of an AGC circuit as well as a new FCC authorization, provided the changes were made after July 1, 1990.

Hopefully this short explanation will serve to clarify the true impact the new FCC rules are having on the refurbished converter market.

Pete Morse Jr.
Cable Technologies International

In this article, there are several misinterpretations of the current FCC ruling. Since these comments are very damaging to the current industry, we do need clarification.

Converters marketed to cable systems may comply with the standards in Part 76. All cable TV converters manufactured or imported on or after July 1, 1990 must be authorized under Part 15 as CSTDs, regardless of whether they are marketed to consumers or cable systems.

Refurbished and repaired converters which are considered identical to the original converters remain covered by the original equipment authorization. The original grantee would remain the party responsible for compliance. Reference sections 2.904(b), 2.908 and 2.909 of the rules. No additional label would be required on these converters.

John Wright
CCS Corp.

Mr. Krauss replies:

There are two points in the letters from Mr. Morse and Mr. Wright and in my August 1990 "Capital Currents" article about FCC Part 15 Rules that deserve some clarification: The effective date of the new regulations and the obligations of converter refurbishers.

The effective date is July 1, 1990. Any converter manufactured or imported after July 1, 1990 must comply with the new regulations. In practice, this means they must contain an AGC circuit. If a cable operator can purchase new converters that are supplied from inventory rather than being newly manufactured, then they do not need to contain the AGC circuit if they were manufactured before July 1, 1990.

With respect to refurbished converters, the FCC has traditionally allowed limited refurbishing of authorized converters by persons other than the original manufacturer. (The FCC calls the original manufacturer the "grantee" because the FCC "grants" an equipment authorization to the manufacturer.) This refurbishing can include cleaning, repainting and replacing components with identical ones. These refurbished units are considered to be identical to the original unit. But units with non-identical components are not considered by the FCC to be identical to the original product.

Limited changes can be made to the electrical components or the mechanical construction of the converter, but these changes can be made only by the grantee, or by a refurbisher that has received the grantee's approval to make the changes.

If a refurbisher makes any changes to the converter's components without the grantee's approval, it becomes a different product and the refurbisher must get its own grant from the FCC. This means that any converters that are refurbished after July 1, 1990, and contain any components that are not identical to the original components, are new products in the eyes of the FCC, and must contain an AGC circuit. The only exception to this is changes approved by the original grantee that the grantee itself is permitted by the FCC to make.

Mr. Morse's letter suggests that only the most drastic changes to converters by refurbishers would result in a new product. But that is not the case. Even the mere replacement of the power cord with a non-identical power cord could change the RF leakage properties of the converter, and could trigger these requirements for the refurbisher to get a new equipment authorization, and to add an AGC circuit.

In the end, it is the original manufacturer that has the right to decide whether the changes made by a refurbisher are acceptable. If they are not, then the refurbisher must get its own equipment authorization grant from the FCC. And because of the new Part 15 Rules, this will now mean adding the AGC circuit.

Results from 'Cable bashing'

I would like to thank you for printing my letter regarding "Cable bashing" in the June issue of *CED*. Since the letter appeared, I have personally received varying degrees of feedback. The most gratifying (yet somewhat disheartening) of the responses came from a plant maintenance supervisor of a 90,000 subscriber system located in a major Northwestern city.

He phoned me to say that my letter had "changed his life." He stated that the letter had not only encouraged him to leave his employer of the previous 10 years, but to leave the cable TV industry altogether. He went on to elaborate on his perception of the cable TV industry from his perspective as a local system manager. We found that we shared much of the same frustration that has ultimately driven us from an industry we love. We were commonly outraged that with obvious solutions so close at hand, the present structure of the cable industry seemingly continues to self-destruct.

We came to the sad conclusion that based on our experience and subsequent contact with other cable TV industry associates, moving on to another CATV company to find professional gratification would be an exercise in futility. The major problems with cable TV are generally industry-wide and not isolated to a specific company.

On the other end of the spectrum were responses I received from some of my former superiors. They felt my letter was more of a "sour grapes" reaction to being forced to leave the industry, rather than a true and accurate assessment of cable industry problems. Instead of addressing the points I made, or constructively disagreeing with them using counter examples as rebuttal, they saw fit to try to discredit the author. I have witnessed this approach before. The premise is quite simple: discredit the source, and the problems presented will not have to be addressed. They can be conveniently dismissed.

I don't see how they can feel this way when the facts are that out of a total of 11 engineering supervisors, only one has any education beyond high school, and there are no technical training programs for employees! I simply had to consider the source of this feedback to rationalize its validity.

In conclusion, I would like to say that I have always had a great deal of respect for the professional stature of *CED* magazine. The success of the magazine is a tribute to your leadership. Over the years I have found *CED* to be extremely useful and informative to technicians and managers alike. In the ever-changing technical climate of the cable TV world, reading *CED* is a must. Thanks again.

Michael J. Devolve, President
Protechnical Associates Consulting

We need switched video

I disagree with the argument of CableLabs ("Will the '90s signal 'boom' or 'bust' for CATV?" *CED*, July 1990, p. 42) that "because fiber optic/coaxial cable TV networks are proficient at delivering multiple signals in a low-cost, user friendly manner with high quality and reliability and telco fiber/copper plants can deliver information from any point to any other, there is no need to completely rewire the country again."

Neither present one-way tree design CATV fiber/coaxial networks nor two-way telco fiber/copper narrowband data and voice design address other important and potentially lucrative needs of our society. These include multipoint-to-multipoint high speed computer interaction, video two-way, HDTV and telecommuting.

There is surely a need for a fiber trunk with a coaxial last mile video interactive network of switched system feeders.

Vic Nicholson, President
BUSS Inc.

Thank you

The high-tech opportunities facing the CATV engineer today are more numerous than in most recent years. The conventions, associations, meetings and the media explore these month after month. All this hoopla may overshadow a real need to support the current business realities through these organizations and media avenues.

The above is just background to say that *CED*'s column "Back to Basics" is an outstanding feature. It may not be glamorous but it is a real service to the industry.

Larry Nelson, Exec. VP
Comm/Scope Inc.

CED *welcomes your comments: write us at 600 S. Cherry St., Ste. 400, Denver, CO 80222.*

Using technology to meet customer service needs

Twenty-some years ago, the comedian Bob Newhart had a routine where a "supervisor" computer's synthesized voice asked an "employee" computer to come into "its" office and then said, "Sit down machine. I'm sorry but your work has not been going so well and we are going to have to let you go. This is a recording." At the time it seemed funny because it was such an outrageous idea. Laughter was our response to future shock.

But fact has almost replaced fiction in the '90s. Old computer hardware and software systems that seemed futuristic when they were introduced are being replaced by new highly sophisticated systems. And the computer-based management tools that exist today for operating businesses as complex as major cable systems seem almost human. But, unlike humans, they work consistently and tirelessly around the clock without food, sleep or sick days.

Today's subscriber management and telephone response systems can handle much of the workload that human's have heretofore labored with. The subscriber management and automated audio response systems of the '90s deal with the more tedious tasks: routing calls, receiving customer complaints, calling them back, scheduling humans to go out and make installations or repairs, generating work orders, allowing workers to check-in, making appointments and confirming them, assisting in targeting customer groups for promotions, telemarketing your next promotion, and a host of other functions. There's even a computerized system for automatic real-time response to service outages including immediate dispatching of repair trucks.

And this is not the half of it. Within these task categories, the specificity of detail and micro-control of functions that are computerized is mind-boggling. And the amount of cybernetic assistance computer systems can give to those humans who work with them daily, such as customer service representatives (CSRs), is astounding. With the industrywide push for more meaningful customer service, computers can greatly assist in meeting standards and beyond.

By George Sell, Contributing Editor

NCTA seal of good service

One way to look at the capabilities of these computer systems for dealing with customer service would be to see if they match or exceed the voluntary standards issued by the National Cable Television Association.

> The NCTA has called for voluntary standards implementation by July 1991 and has begun issuing Seals of Good Service to systems that meet or exceed the standards.

The NCTA announced last February a set of national customer service, information and installation related requirements. Systems are asked to present records of compliance to their corporate offices which will then notify the NCTA. Independent systems will certify themselves to the NCTA.

While the standards are voluntary, the NCTA has called for implementation by July 1991 and has begun issuing Seals of Good Service to systems that meet or exceed the standards. Systems wishing to display the Seal will be obligated to annually release compliance information to their local franchising authorities. This way the industry hopes to counter unsubstantiated bad reputations with good impressions backed by hard facts.

In a nutshell, here are the NCTA standards:

- Answer telephone calls within 30 seconds.
- Subscribers should hear busy signals a maximum of 3 percent of the time.
- Installations will be done within seven days of request and scheduled for either morning or afternoon.
- Installers running late will reschedule appointments.
- Office hours should be extended or some method employed to provide after-hour response.
- Systems shall establish a system for response to service outages within 24 hours.
- Repair requests will be processed promptly.
- Customer service and bill paying locations will be open during normal business hours.
- Billing statements will be clear and concise.
- Refund checks will be issued within 45 days.
- Subscribers will get written information on products and services.
- Customers will be notified 30 days in advance of rate and channel changes.

"Essentially, I think they are a move in the right direction," says Susan Vicchio, marketing communications manager for CableData. "I think that most of the standards are doable probably by most operators today and are certainly doable with the subscriber management systems and technology that's available today, if used correctly. There are a significant number of things that operators can do. Frankly, they need to elevate their awareness of what's available to them today. There's probably more there than they realize."

Gil Jacobs, vice president for sales and marketing for Creative Management Systems, believes the NCTA standards could be stricter. "I think they could be tightened. I think it's a real good start considering the wide range of systems that are out there. It's a pretty generous set of rules."

Computer hardware and software exists from established cable industry suppliers to meet or exceed all the above standards. It's up to cable operators to put it in place and establish procedures that use it properly.

"We have been selling the concept

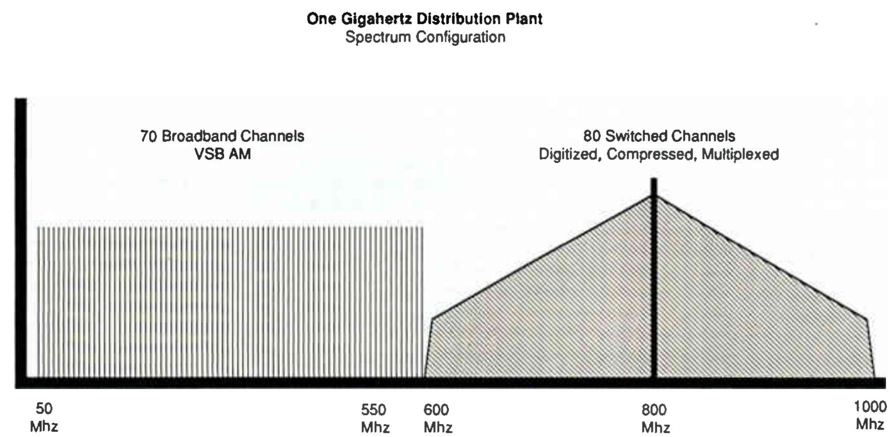

Figure 3

reducing electronic parts and increase channel capacity while treating fiber as if it was nothing more than very low loss coax.

Long term vision needed

While Chiddix believes this type of thinking is gaining acceptance in the cable community, he says the industry needs a broad, long-term vision of its future in order to head off the various competitors lurking on the horizon.

"Strategically, we need to be able to evolve to a network where people can watch anything they want to watch," he says. "How far we go down that road depends upon various business factors, but over the course of the next decade or two we're going to want to deliver switched video services, which means video-on-demand in some form."

How does the industry prepare for such an eventuality without starting from scratch? By adding fiber to the trunk today, channel capacity can easily be increased to 550 MHz. In a few years, with natural electronic and distribution hardware improvements, the same system will be able to offer up to 150 channels of video.

"At that point we face the question of what to do with all that bandwidth," Chiddix says. He recommends that the industry use the spectrum to begin offering lots of pay-per-view—perhaps offering 70 channels of broadband video and 80 channels of PPV. "That represents a way to use the bandwidth to generate additional revenue. It means giving customers lots of choice and is another step in the direction toward video-on-demand."

Don't obsolete the TV

A second—and very important—reason to limit the number of broadband channels and concentrate on the transactional services that generate revenue is to avoid obsoleting the millions of cable-ready televisions that have been sold to date. "Cable-ready sets sold today are capable of (tuning) 80 channels," Chiddix notes. "It seems counterproductive to deliver 150 channels to the home and require a new converter. If we do that we give up the advantage of delivering signals directly to the TV set. Maybe we should offer a very simple off- or on-premise device that, on a transactional basis, tunes these additional 80 channels."

Many channels; no in-home investment

As Chiddix envisions it, the approach offers a seamless method for viewers to have access to huge numbers of video offerings, without an investment in the home. "From the customer's point of view, he has a 71-channel cable system, except channel 71 can be any one of 80 different things, all of which are value-added, like movies at convenient times, special-interest programming—something people will pay a little more for and take some action to order."

The system is seamless because all the subscriber knows is that suddenly he has a larger number of "basic" channels to choose from and his pictures look better. Then he discovers he has access to scores of pay events through a menu-driven selector. All that's left is to increase his number of choices and offer them on demand. But how does that happen?

Again, once the amount of revenue justifies the expense, the cable operator adds a switch in the headend that allows him to select any 80 of the 200, 500 or 1,000 events and feed them down each fiber trunk, each of which divides the system into a collection of "neighborhoods" under the fiber

High performance couplers extend cable reach

The cable television industry is moving rapidly to take greater advantage of the transmission and operational benefits of architectures based on fiber. Although inconspicuous, fiber-optic couplers play an essential role in furthering this migration of passive optical components into cable television systems, replacing active electronic circuitry. As more and more couplers are deployed, it is important for designers to know what they are, how they work and how they can be applied.

Couplers are passive devices that split or recombine optical signals at various points in fiber-optic networks and systems. A divided signal allows sharing of hardware resources, resulting in less equipment requirements and lower system costs. The most basic type of coupler is a splitter (or tree coupler) that divides a single optical channel into multiple, equal output channels.

Figure 1

A directional coupler (or tap) is a tree coupler with an unequal splitting ratio (90 percent and 10 percent, for example). An unequal splitting ratio allows the power distribution to be controlled, compensating for uneven transmission distances between a single source and multiple remote receivers.

Star couplers typically have an equal number of inputs and outputs (2 x 2, for example), and input to a port on one side is split among output ports on the other side.

In cable television systems, most couplers used are 1 x 2 directional devices, with one input port and two output ports. A new multiple index coupler manufacturing technology developed by Corning yields 1 x 2 devices that specifically address the design requirements of cable television systems (see Figure 1).

By Curt Weinstein, sales engineer, components, Telecommunications Products Division, Corning Inc.

Fiber optic advantages

Optical fiber possesses a well-recognized technical superiority for cable television system reliability, transmission capacity and picture quality.

Because passive fiber optic systems have few active components, they are less subject to failure or interruption than coaxial systems. In addition, fiber overlays on conventional architectures provide redundancy and segmentation of plant, resulting in fewer outages. When outages do occur, they affect fewer subscribers.

Fiber's enormous bandwidth will accommodate the most ambitious channel upgrades including high definition television (HDTV) and other future services. In contrast, most coaxial systems are limited to a 330 MHz to 550 MHz capacity as a result of the diminished signal-to-noise (S/N) ratio typically caused by long amplifier cascades. For this reason, fiber is widely viewed as the only transmission medium with sufficient capacity to make available the anticipated variety of higher-bandwidth video services.

The lower signal attenuation of optical fiber eliminates the need for noise-producing amplifier cascades used in typical coaxial systems (see Figure 2), allowing fiber optic systems to deliver video that is remarkably free from interference and degradation.

The cost of high performance

But the feasibility of bringing fiber capabilities beyond the trunk backbone and into distribution systems is contingent on reducing the average cost-per-subscriber of installed fiber systems. The high performance and upgrade potential inherent in optical fiber has technical appeal, but the industry's prior investment in coaxial architecture—at approximately $400 per subscriber—sets an eminent standard for cost efficiency.

The lion's share of the cost of any fiber system is its investment in lasers and related optical equipment.

Fiber optic couplers enable expensive laser power to be split across several

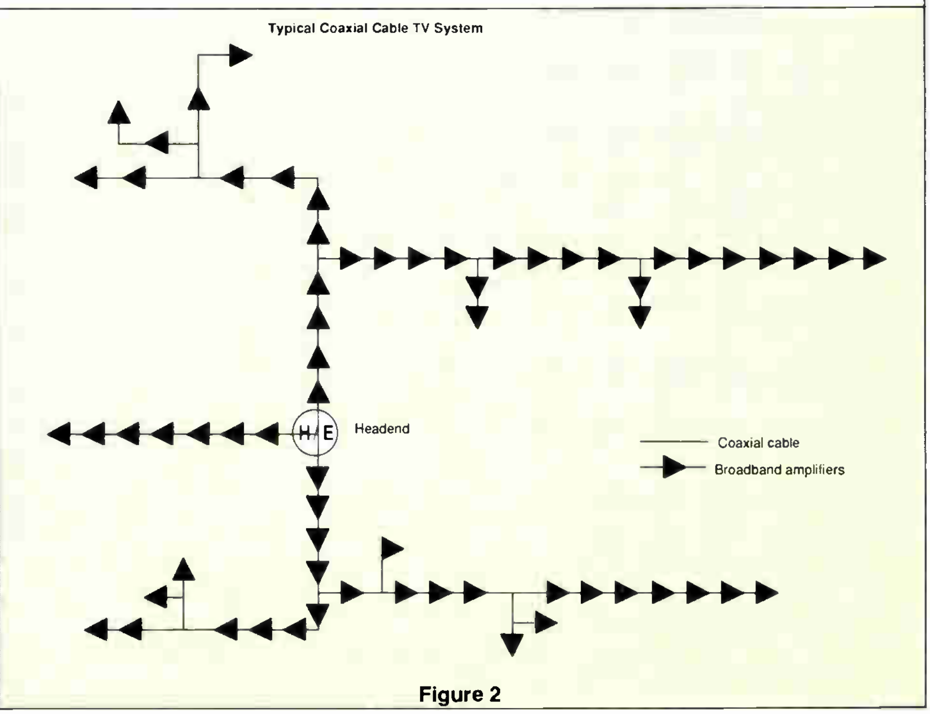

Figure 2

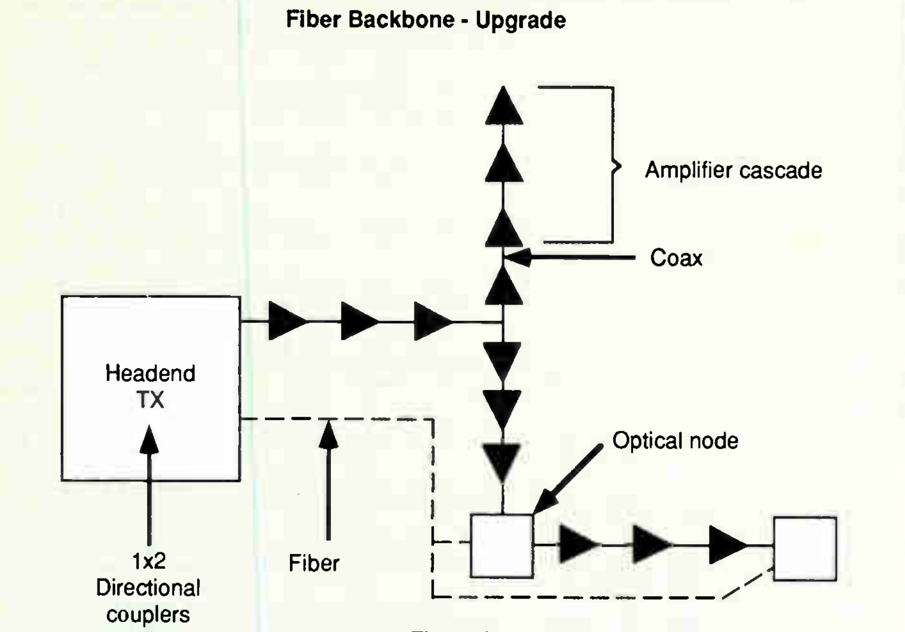

Figure 3

routes while imparting almost no optical losses of their own.

By preserving and stretching optical power in this manner, couplers reduce the hardware investment required to build a system, thereby making it possible for fiber to penetrate deeper into cable architectures.

Groundbreaking fiber architectures

Several different fiber optic cable system architectures have evolved showing an increasing implementation of couplers to achieve progressively deeper system levels of fiber penetration. In general, the closer fiber is brought to the drop, the more branching is required, and the greater the reliance on the splitting function of fiber optic couplers.

The *fiber supertrunk* was the first cable application for fiber, used to replace coax and microwave in connecting headend sites. But couplers were not relied on in fiber optic cable systems until the *fiber backbone* began utilizing directional 1 x 2 devices to split headend laser power between two remote optical nodes (see Figure 3). This backbone architecture was introduced as an upgrade option by American Television and Communications Corp. (ATC) in 1988.

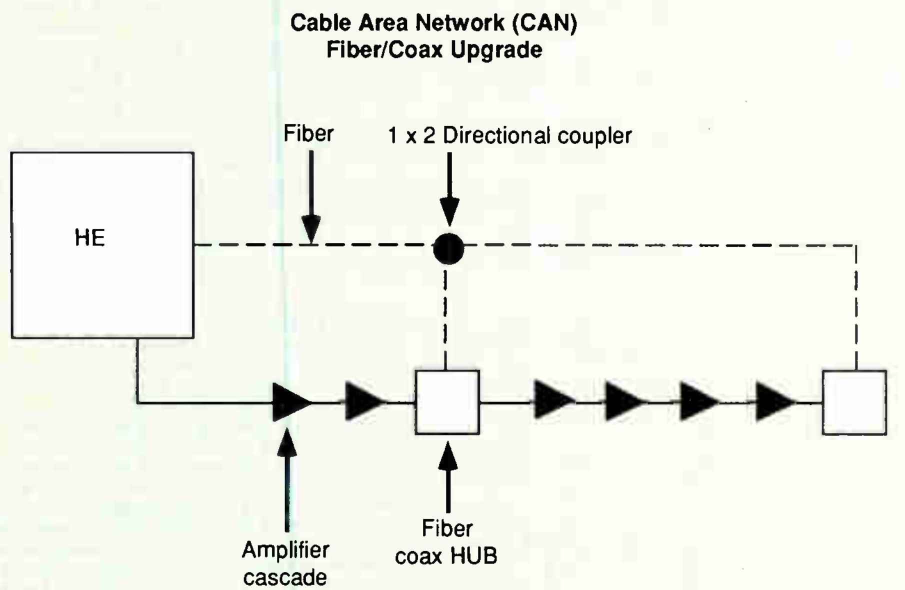

Figure 4

It uses fiber to carry video signals from the headend site to various nodes located within an existing coaxial distribution system. By bypassing long coax segments, this application eliminates the need for extended amplifier cascades. The in-place amplifiers are redirected and used to extend a higher quality signal further into the system with no additional expenditures for active equipment.

To divide the optical power between a closer and a more distant location, for instance, a 40 percent/60 percent splitter might be used. With the coupler's input connected to a transmit laser, the outputs are connected to two separate fibers in the backbone cable.

The fiber containing 40 percent of the power is peeled off at the closer node (called the "tap leg") with the fiber containing 60 percent of the power continuing in the cable to the farther node (called the "thru leg").

Alternatively, the splitter might be located at a power node in the field, where it would tap off a given share of the optical power delivered by fiber from the headend—and send the remaining signal to another node down in the system.

Cable area network

An alternate approach to the fiber backbone, the *cable area network* (CAN) also uses directional 1 x 2 couplers to split a headend power source between two hub sites (see Figure 4). Proposed by Jones Intercable in 1989, this upgrade architecture connects the headend site by fiber to a series of fiber/coax hubs.

These hubs are optoelectronic conversion points that allow the distributed signal to be carried primarily by fiber, while the in-place coax plant is left intact to provide network redundancy. Relative distances between the source and the hub sites determine the splitting ratio needed in the couplers, which can be located in the headend or in the field.

Another approach using fiber optic couplers currently being implemented by Rogers Cablesystems in Canada is the *redundant ring*. Because this system is designed to support both cable television and Roger's cellular telephone service, system back-up is essential.

The Rogers design provides this system redundancy by using two rings—a primary ring which can carry digital or FM signal over fiber, which in turn feeds secondary fiber hubs using AM over fiber. Within the secondary ring structure, couplers reduce the number of transmitters at a primary hub needed to serve secondary hub sites.

Fiber trunk and feeder

The new, more coupler-intensive *fiber trunk and feeder* (FTF) architecture brings fiber deeper into the system and closer to the subscriber than ever before. It utilizes a 1 x 2 directional coupler and 1 x 4 splitters at remote sites to provide up to four-way splitting of a laser signal (see Figure 5).

Introduced by ATC in 1990, FTF uses fiber to connect a headend site to optical splitting sites, where power is divided and sent to distribution nodes. In these nodes the signal is converted and sent via coax amplifier cascades throughout a neighborhood. By eliminating the need for trunk and bridger distribution amplifiers, the FTF system maximizes the advantages of video transmission through fiber.

System design requirements

By splitting an optical signal, fiber optic couplers in cable systems permit one source, either digital, FM or an AM laser, to service two or more distinct locations—as opposed to having a unique source dedicated to each optical node. At $10,000 to $15,000 per laser, this provides a substantial systemwide cost reduction. But only couplers that are virtually transparant to a fiber optic system are able to support this function.

The tight power budget typical of cable television systems demands that fiber optic couplers used in these applications impart very low optical losses. Because a 1 x 2 splitting function causes, by definition, a nominal 3 dB power loss (equivalent to a 50 percent reduction) in each output channel, any significant additional losses quickly could diminish the optical power in the system to an unacceptable level.

In order to provide a truly accurate measurement of component performance, cable system designers always specify the optical loss for couplers in terms of insertion loss, the true parameter of interest to any system designer. Treating the component as a "black box," insertion loss is the sum total optical power loss for any light path through the coupler over the entire operating wavelength window or windows. Insertion loss includes the splitting loss, as well as any excess loss contributed by the device, any non-uniformity of the splitting ratio and the wavelength-dependent effects.

Minimizing the light reflected back into a transmitting laser is another critical requirement for cable fiber optic systems. This undesirable factor can cause sensitive lasers to display non-linear distortion effects such as increased composite triple beat and composite second order (CTB and CSO). Backscatter, or optical return loss, is a measure of the light reflected in a

A glossary of fiber optic terms

Fiber optic technology has its own language. Here are some technical terms relevant to fiber optic television systems applications.

Coupler types

Splitter (tree coupler): Splits a single optical channel into multiple output channels, or combines signals from multiple channels into one. These couplers split the power equally to all output ports. Their port configuration is denoted by 1 x N, where 1 is the number of input ports, and N is the number of output ports when the device is used in the splitting direction.

The number of output ports of a tree coupler used for cable television applications is seldom higher than four because of system power budget limitations. Most tree couplers are completely bi-directional, and therefore can act as power splitters or combiners.

Directional coupler (tap): A coupler with an unequal splitting ratio, usually in a 1 x 2 configuration. Some portion less than 50 percent of the input power is coupled to one output port, with the remainder going to the other output port. The power split for a tap could be anywhere from 1 percent/99 percent to 50 percent/50 percent.

StarCoupler: A star coupler typically has an equivalent number of input and output ports (N x N). A signal input to any of the ports on one side is distributed equally to all ports on the opposite side. A star coupler also may have an unequal number of input and output ports. This configuration is designated as N x M.

Optical performance

Insertion loss: The key optical performance parameter of interest to a system designer. Insertion loss represents the total optical loss contribution that a component will make to a link of the system. It measures the total loss for any light path from a specific output port. It includes the splitting loss as well as any excess loss (excess loss is the total power lost in a coupler and never recovered at any output).

Insertion loss also includes the non-uniformity of the splitting ratio in a device, since a particular coupler may not achieve a perfect splitting ratio. And because the coupling ratio often changes with wavelength, the insertion loss should be specified for a given range of wavelengths.

Passband: The wavelength range around a center wavelength over which coupler performance is specified. A narrow passband indicates that the coupler insertion loss is wavelength dependant, and a wider passband indicates wavelength independance. A passband may exist around 1310 nm and/or 1550 nm.

Tap ratio: The percentage of power distributed to the output ports of a directional coupler (20 percent/80 percent, for example).

Backscatter or optical return loss (ORL): The measure of the return signal from an input leg of a coupler when all other ports are dormant.

Uniformity: Only relevant for an equal power splitting coupler. It is the measure of the maximum difference in insertion loss between output ports for a given input port over a specified wavelength range.

Directivity: A measure of how efficiently a coupler sends the input power to the output port(s) to which it is intended.

Manufacturing technologies

Fused biconic taper (FBT): Conventional process for manufacturing couplers that relies on the melting and pulling of fibers. This process tapers the cross-sections of the fibers and brings their cores into close proximity, allowing power coupling from one core to another.

Multiple-index taper: A new technology developed by Corning in which two fibers are inserted into a low-index glass tube for fabrication. The tube adds a third refractive index to the coupling region, which enhances optical performance, and also creates a robust, hermetic device resilient to environmental and mechanical stress. ■

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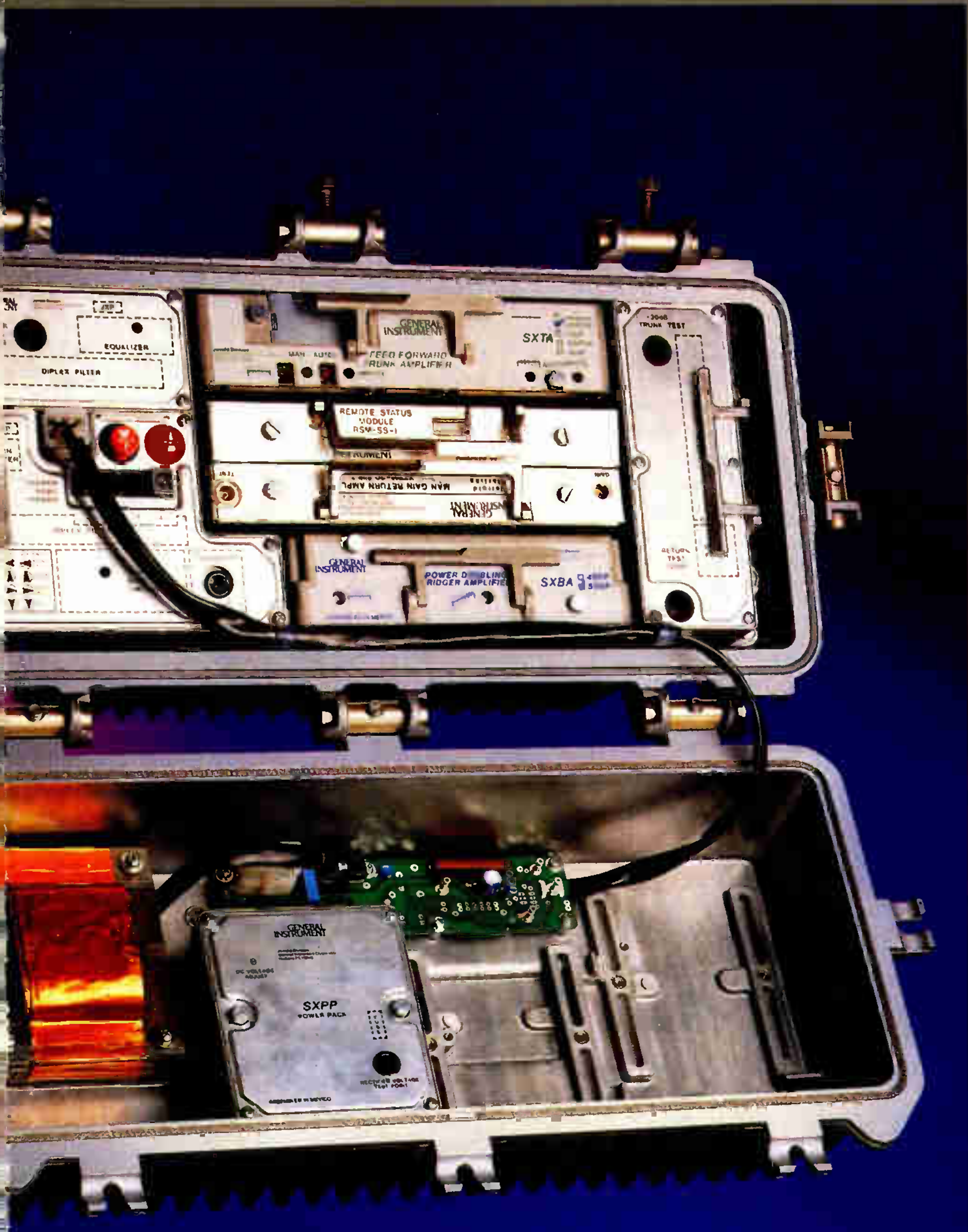

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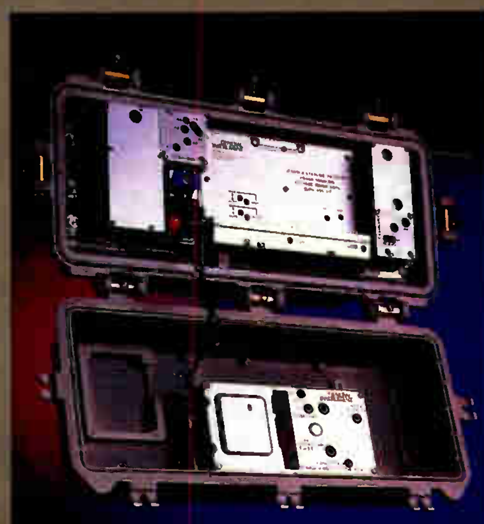

SX Housing with SJ Electronics

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GENERAL INSTRUMENT

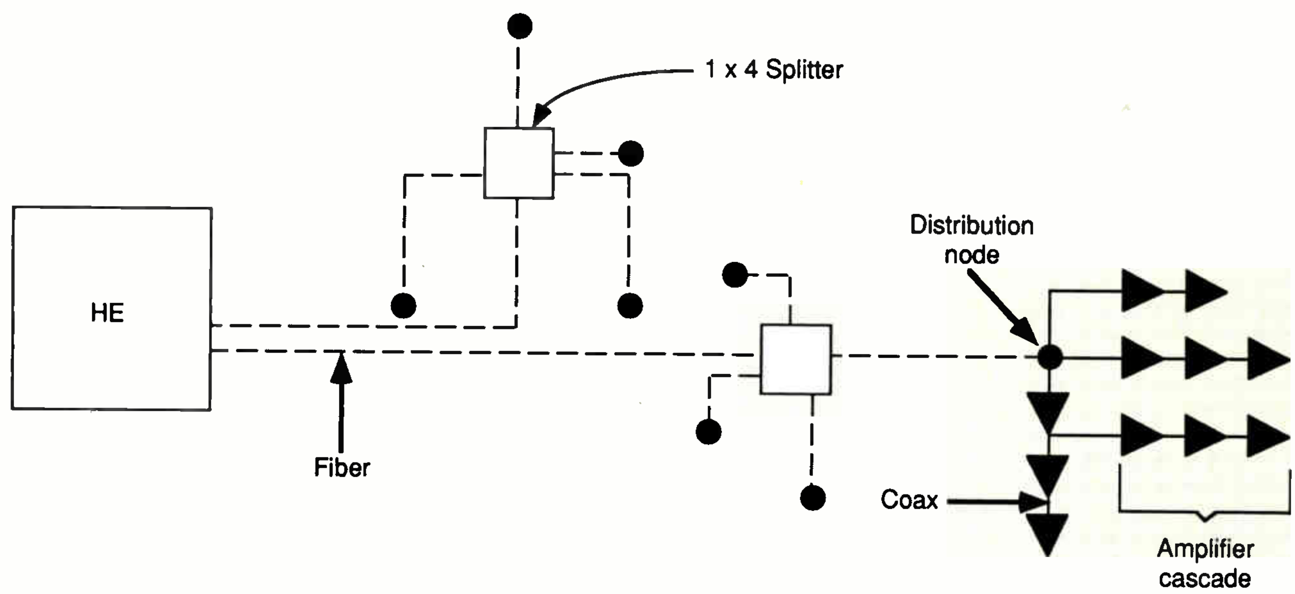

Figure 5

coupler input. Most cable television applications demand that coupler backscatter measure 50 dB or better.

Coupler manufacturing processes

Traditionally, fiber optic couplers have been manufactured by a process in which two standard optical fibers are axially aligned and heated, thereby melting them together. The fibers are then stretched to create a very thin cross-sectional region that enables light to couple from one fiber to another. The resulting fragile structure usually is epoxied onto a glass substrate to add mechanical strength, and then fixed into an external package for protection from moisture and contaminants.

This technology yields a product known as a fused biconic taper (FBT) coupler through a process well suited to producing devices with low optical loss over a narrow wavelength range. However, the fragility of the fused fiber coupling region tends to hinder automation, which makes the power splitting of a given FBT coupler highly dependant on the dynamics of its individual processing. In addition, insertion loss of these devices tends to vary greatly with changes in source operating wavelength and from component to component.

Multiple index design

A multiple-index coupler design and manufacturing process yields a mechanically robust device with more stable optical performance. In the manufacturing process for this coupler, referred to by Corning as the multiple-index process, two single-mode fibers are inserted into a tube of specially fabricated glass prior to fusion.

The glass tube has a different refractive index than the core and the cladding of the fibers, hence the multiple-index designation. Using this tube yields a rugged, hermetically sealed component, more resilient to environmental conditions. The packaged multiple index coupler is a sturdy, reliable device with several performance characteristics significant to cable television applications (see Figure 6).

The multiple index couplers have very low insertion loss, typically less than 3.5 dB. Backscatter is typically better than 60 dB. Multiple index couplers can be precisely manufactured with a variety of coupling ratios from 50 percent/50 percent to 1 percent/99 percent.

Furthermore, the process is achromatic or wavelength-insensitive. This means the couplers will operate at the 1310 nm and 1550 nm operating windows.

System Implementation

One of the first coupler-intensive distribution systems in the United States is now being implemented by Jones Intercable in Turnersville, N.J. The cable area network (CAN) designed by Jones consists of 630 miles of fiber/coax cable. Jones is installing approximately 44 miles of fiber cable, with an actual fiber count of 929 miles.

The system's 630 miles of cable is served by 20 hub sites, 19 of which are fiber/coax, with the 20th being the former headend site. Of these hubs, four are served by dedicated transmitter and receiver (TX/RX) pairs, and the remaining 15 are served by only five lasers and 30 directional couplers.

Half of the fiber optic couplers are installed at the actual hubsites and the remaining are situated in line. Twenty of the couplers are being used to split the optical signal in the forward direction, and the remaining 10 are used in the return path of the system.

In designing and implementing the Turnersville system, exact power matching between the various hubs being supplied by a single source was achieved by installing Corning multiple index directional couplers with precise splitting ratios. These couplers counterbalanced the effects of different distances between lasers and hub-sites.

Corning's multiple index directional couplers were custom manufactured with the precise coupling (or tap) ratios specified by the Turnersville system

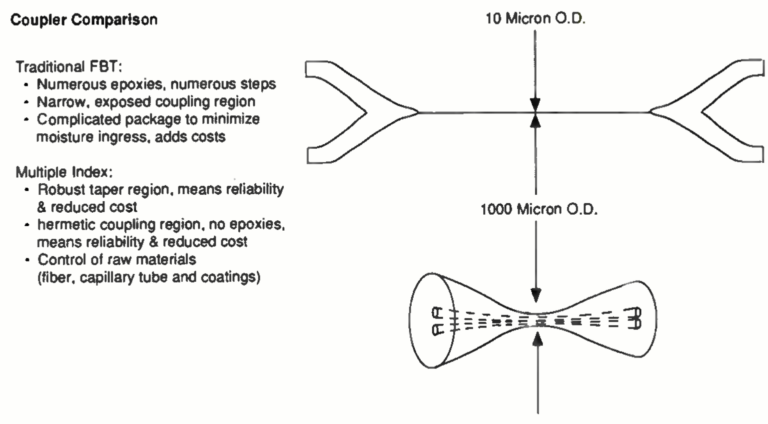

Figure 6

designer. This type of cost-effective, precision manufacturing-to-design is well served by the multiple index technology's ability to deliver high performance, robust couplers.

Summary

New coupler-intensive cable television architectures offer MSOs and local operators a realistic opportunity to take advantage of the proven reliability and performance of optical fiber. To a great extent, the cost feasibility of fiber rebuilds, upgrades or newbuilds depends on optimized shared resources, especially costly laser transmitters.

Fiber optic couplers split or combine optical power in a system, making these cost efficiencies possible. Multiple-index devices address the special design requirements of cable television systems—low insertion loss at 1310 and 1550 nm, low backscatter and precise coupling ratios—to facilitate these applications. ■

Fiber optic cable standards and testing

The question of "standards" and how they are established, tested and verified is often a muddled and misunderstood topic. Why establish standards in the first place? Should each customer set their own standards and testing requirements? Should it be left to the manufacturers? How is cost affected by standards? These and other questions often arise when new growth technologies are introduced to an industry. Such is the case with the growth of fiber optics in the CATV industry.

The purpose of this article is to provide one manufacturer's viewpoint and some valuable guidance that we hope could save system operators time and money in both the short and long-term. The article will address reasons for standards, describe examples of test procedures that illuminate the need for following procedure, and provide a list of fiber optic cable standards and test procedures from leaders in the deployment of fiber optics in other industries. Also, a generic fiber optic cable specification will be offered that will ensure a minimum quality standard and should be acceptable to any cable manufacturer capable of meeting the standards established in the fiber optic industry at large.

Primary reasons for standards

Why establish standards for fiber optic cable? For the purpose of the paper, I will limit the myriad of reasons to three.

First, standards ensure the satisfactory operation of the fiber cable network and permit economical planning and engineering of the system. Second, standards provide manufacturers with a minimum base requirement to eliminate the potential of introducing inferior grade product not designed for long-term reliability. Third, standards help ensure the CATV industry cable plant is at least of the quality as that of other industries deploying fiber optic cable. This may prove to be of major importance as the potential for competition heats up in the near future.

Fiber optic cable should be a highly

By Sanford D. Lyons, Siecor Corporation

CHART I

OPTICAL FIBER SPECIFICATIONS

Measurement Techniques

	Optical Parameter	Test Procedures	Typical Requirement	Comments
1.	Attenuation Coefficient	EIA-455-78 EIA-455-61	For conventional single-mode fiber, specify at 1310 nm and 1550 nm.	Provide attenuation grades which can be used in system design calculations. Typical low grade: 0.5 dB/km at 1310 and 1550. Typical high grade 0.35 dB/km at 1310, 0.25 dB/km at 1550. Individual fiber guarantee.
2.	Attenuation Variation with Wavelength	EIA-455-78	Change in attenuation coefficient from 1285 nm to 1330 nm of ≤ 0.1 dB/km from the the attenuation coefficient at 1310 nm.	Provide attenuation consistency with minor changes in source wavelengths and spectral widths.
3.	Water Peak Requirement	EIA-455-78	Minimize attenuation coefficient at the water peak to < 2.5 dB/km max. (1383 ± 3 nm).	Allow greater flexibility in source spectral widths used at the 1310 nm window. Typical value should be 0.4 dB/km.
4.	Attenuation Uniformity	EIA-455-59	Fiber attenuation uniformly distributed throughout the fiber length. No discontinuities > 0.1 dB.	Allows fiber/cable lengths to be subdivided with equal proportions of attenuation for each length.
5.	Chromatic Dispersion	EIA-455-168 EIA-455-169 EIA-455-175	1300 nm < λ_o < 1322 nm S_o max ≤ 0.095 ps/(nm²•km) where λ_o = zero dispersion wavelength and S_o = dispersion slope at λ_o.	Allows calculations of dispersion over user's wavelength window. Dispersion = = $D(\lambda) = S_o/4\ [\lambda - \lambda_o^4/\lambda^3]$ in ps/(nm•km) for 1200 nm ≤ λ ≤ 1600 nm.
6.	Cuttoff Wavelength	EIA-455-170 EIA-455-80	λ < 1250 nm (Cabled Fiber)	Controlled to prevent a single-mode system from operating in the fiber's multimode region.

Jerrold's New Commander 6 Frequency Agile 600 MHz Modulator Outperforms All Others On The Market Today.

You can now pack more power and performance into your headend than ever before. Jerrold's all new Commander 6 Modulator (C6M) gives you frequency coverage from 50 to 600 MHz and more standard features than any other unit on the market today. Microprocessor controlled tuning and automatically selected output band-pass filters allow you to combine 80 channels or more *without external filtering* and achieve better than 60dB S/N. Additionally, Jerrold continues to offer the cable industry's only phase-lockable agile unit with the C6MP.

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COMMUNICATIONS

Engineered for maximum flexibility, this vanguard for a new line of powerful headend products includes IF switching, scrambling and stereo compatibility with front panel video and audio metering as standard features. All adjustments are accessed from the front panel.

Jerrold packs all this power into an efficient 1.75" of headend rack space allowing you twice the number of full-featured units per rack than has been possible.

To find out how you can tap the power and performance of the Commander 6 line of headend equipment, contact your Jerrold Account Representative or contact Jerrold Communications, General Instrument Corporation, 2200 Byberry Road, Hatboro, PA 19040, (215) 674-4800.

COMMANDER® 6.

GENERAL INSTRUMENT

Reader Service Number 20

Let the Wavetek 1882A sweep you in

ONE of the most difficult aspects of making capital purchases for the cable industry is finding equipment that has an immediate as well as long-term payback. The Wavetek 1882A Sweep Analyzer offers the remarkable versatility and capacity to let you provide better subscriber service now and in the future — even if the conventional system technology changes.

A clear path home.

Today's complex systems contain many long amplifier cascades which can create signature build-up that distorts reception. In the eyes of your subscribers, that's not what they're paying for.

Storing and comparing successive amplifier response in the 1882A memory will allow you to detect the small changes that add up to major problems. Today, signature build-up can be a thing of the past.

No interference.

Why tolerate extraneous signals that simply load your system or interfere with revenue generating signals? That's precisely why you sweep, to make sure that your system properly passes each active channel.

The Wavetek 1882A utilizes the multitude of signals already on your system to test the frequency response. So you're not adding extra carriers that can interfere with picture quality, set top converter operation, or VCR usage.

1000 MHz to grow on.

The growth of cable very likely means increased frequency response requirements — 600, 800 even 1000 MHz. Why buy a sweep system that can't accommodate these increased frequency ranges?

See the light.

Fiber optic cable is already being used to shorten amplifier cascade lengths.

The 1882A lets you sweep the amplifier cascades from the fiber node by simply storing your reference at the fiber node and sweeping the rest of the system as you normally would, without an elaborate field transmitter.

You could also test parameters most affected by laser nonlinearity — cross-mod, and second and third order distortion.

Elegant but easy.

The Wavetek 1882A does so much, but so easily. Most modes of operation are entered by pressing one, two or three keys. If you make a mistake, it lets you back up, asks you a question, or lists your options.

It takes only a few minutes to store your HEADEND,

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Ad interconnects: Breaking into dollars

An advertising interconnect is like electricity: you know it's there, but don't always recognize its value. For years, local ad sales wore a low-priority label and gleaned little upper management support. In fact, local ad sales was at best a drop in the bucket as compared to the monies streaming in from subscribers. As recently as five years ago, commercial insertion vendors struggled to convince operators of the benefits of automated advertising insertion equipment.

But times are changing: a recent a Cabletelevision Advertising Bureau study forecasts the advertising sales market at $4 billion by the year 1994. "Ad sales is walking into that limelight and is strongly supported by the corporate, divisional, and system level offices," says Ron Loose, manager of advertising and sales, Tele-Communications Inc. "Ad sales is definitely a larger part of TCI's big picture, and capital expenditures in this area are justifiable."

New interconnects

There's no question that interconnect activity is also on the rise. Many urban markets including New York, Philadelphia, Miami, and Portland are currently in the throes of interconnect development. And, as the market grows, needs for advanced reporting and communications software are sprouting up too, with new industry-specific software packages emerging nationwide.

An interconnect, by definition, is 'when two or more cable operators link together for the common cause of running commercials to serve an entire community," says Bill Crowell, general manager, Cable Advertising Network of Greater St. Louis. The financial compensation for participation in the interconnect is either a guaranteed monthly payment on a per-subscriber basis, or a percentage of the monthly sales revenues.

Largely, interconnects exist because advertisers want cable in their marketing mix, but shudder at the multiplicity of operators involved in the deal. For example, the New York city market is comprised of more than 11 operators with over 44 headends. Without an interconnect, it would take an agency 11 separate phone calls (not including telephone tag) to place a market-wide buy. An interconnect provides the advertiser with the "one-stop-shopping" they desire.

Hard, medium and soft interconnects

Two types of interconnects, "hard" and "soft"—and possibly a third, "medium"—exist in today's cable advertising community. The designations refer to video and data distribution methods.

> 'Ad sales is definitely a larger part of TCI's big picture, and capital expenditures in this area are justifiable.'

Interestingly, interconnect size plays little role in daily operations: small, medium, and large sized interconnects operate similarly within designated architectures. "The difference between hard and soft is that if you're hard, you're sending a signal simultaneously by either microwave or LAN line to all headends on any particular network on which you're inserting commercials," interprets Crowell.

So-called "medium" interconnects are tied via telephone modem to a central office to provide a data backbone for transfer of playback schedules and verification data, but are still faced with bicycling videotapes to participating headends. Totally soft interconnects, on the other hand, have no insertion equipment whatsoever, and are more of a sales/administrative backbone that coordinates the efforts of the local ad sales forces.

Hard interconnects

Los Angeles is home to the largest and most visible hard interconnect, AdLink, which services 1.2 million subscribers via satellite uplink—an unprecedented approach that eliminates shuttling videotapes to so many headends. "In traffic, to get from one end of the city to the other it can take over four hours," says Alan McGland, president of Adlink. "The uplink was a necessity."

After a buy is placed with Adlink, the spot is incorporated on a master reel which is uplinked to the remote locations in the early morning hours. "We're connected by modem to all the remote sites," McGland explains. "Our computer calls up each site, checks the tapes to make sure they've received the reels that were uplinked to them, and shuttles through them to make sure the quality is good."

Adlink's Channelmatic equipment resides downstream of the local system's automated insertion equipment. Regularly, Adlink provides the interconnected systems with an inventory reservation report that requests avails from the local franchise area. "If we schedule a spot at 7:20 on MTV, it runs at 7:20 all over L.A.—which is exactly what the big advertisers want. They want to know they're buying spots for the market. So essentially, for them, it's like buying one TV station. But what they're really doing is buying a universe of subscribers," McGlade comments.

Oklahoma City took a quantum leap in interconnect architectures in August, moving from a sequential insertion system to a custom LaKart system, giving it hard interconnect status. A Compulink traffic and billing front-end feeds information to a dual LaKart CPU, which in turn controls 32 VCRs and two routing switchers. One router sends video via AML to the participating Cox headend, with the second router sending like video to MultiMedia's headend. All of the equipment is housed in the central interconnect office.

When asked why this transmission format was chosen, general manager Mark Kanter explains, "Both of the participating cable systems had a dilemma in that they wanted to be able to do their own system specific cross-

If your head is not tuned to the future, you're probably facing the past.

Local advertising interconnects too often spin their wheels to get new spots out to their headends. They're doing it the old way, and that's wasteful and inefficient. The delays can translate into missed opportunities.

Now Texscan MSI offers a better way to get your reels — and profits — into focus. Tap into the future by upgrading your commercial insertion system with Texscan's Video Download Controller, the new CSR-294D.

Use it to automatically record satellite-delivered video for commercial spot reels right at the headend. Use it to record local news updates microwaved across town.

Point your heads in the right direction. You may just see your profits soar to the heavens.

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Reader Service Number 34

UHF wideband networks alternative design architecture

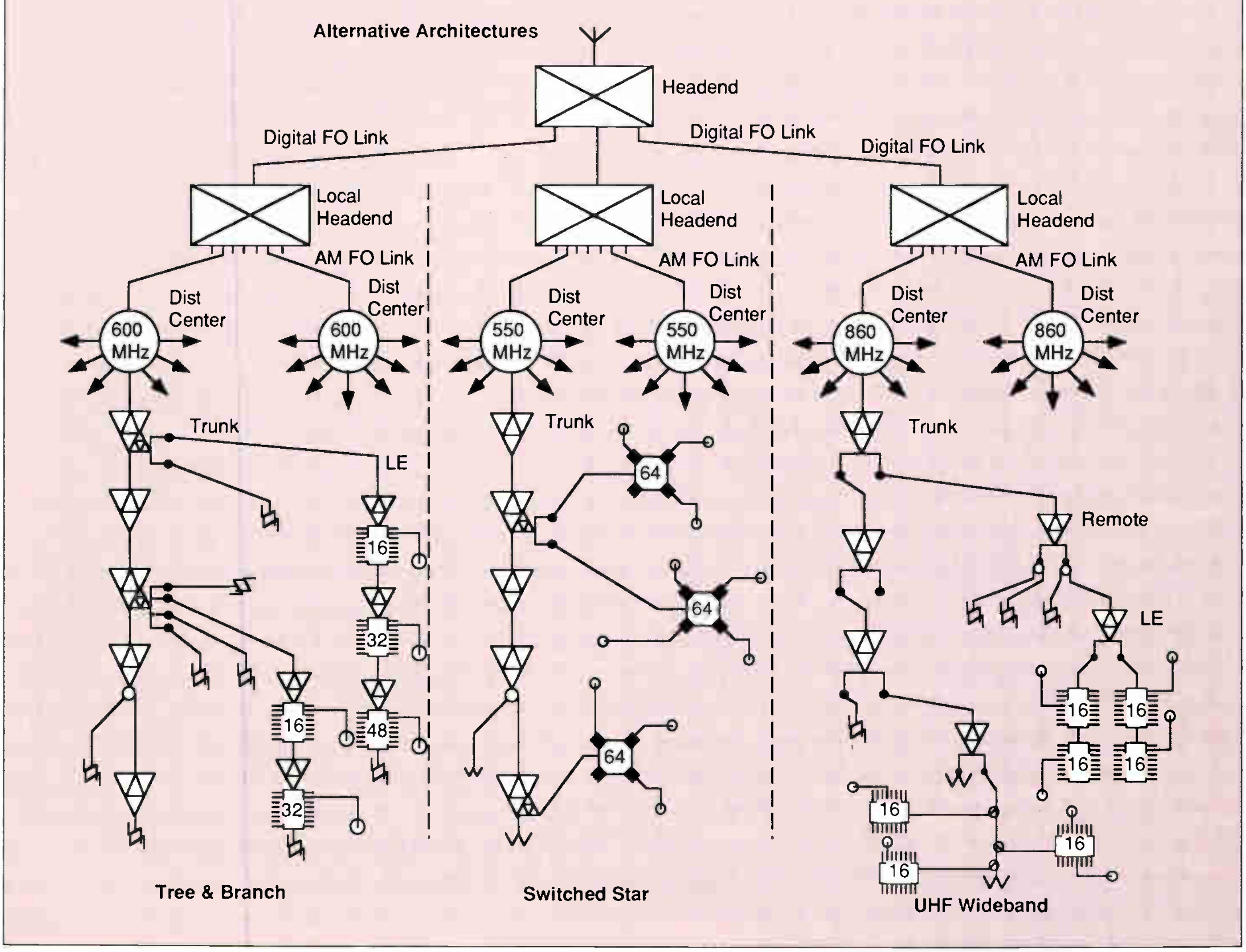
One of the most significant events in our industry's history is the emergence of a global market for cable television services and equipment. The current focus is on the European marketplace, and with good reason. In the United Kingdom cable penetration of TV homes is less than two percent and cable system construction is planned for 15 to 20 million homes over the next five to seven years. This level of activity will require capital expenditures approaching $10 billion.

By Bob Beaury, Director of Marketing, C-COR Electronics and Rien Baan, Marketing Manager for C-COR Electronics, Europe

Although most of the industry's attention has been on the U.K., Scandanavia has been busy building cable systems and substantial growth is expected for many years to come. The political constraints in France, Germany and amazingly, in Eastern Europe have lifted, enabling cable television to grow and prosper in the '90s. Industry observers talk about a "generation of growth" for cable television in Europe.

North American cable operators were quick to realize the business potential in Europe. United, Jones, Videotron, MacLean-Hunter and many other MSOs have been extremely successful in partnering with local interests to win large franchises in the U.K. Their influence has led in many cases to the adoption of the traditional VHF tree-and-branch system architecture that has been used in North America since the inception of cable television.

The adoption of the North American design philosophy has led some equipment manufacturers to the simple conclusion that current product offerings will not have to be modified to meet the specific needs of European customers. This conclusion ignores the fact that cable television has a 20-year history in Europe and that history



QUALITY IN. QUALITY OUT.

"Nobody but Magnavox would have given us the technical support and quality products we demanded."

"Two years ago, we decided to upgrade our system. It served our subscribers well for 20 years but we needed to update it to meet the changing technology and to serve us into the next two decades.

"We wanted nothing less than the most advanced system possible. 550MHz. FeedForward. RF bypass. Two-way addressability. Elimination of semi-annual system balancing. Remote status monitoring. And a system that's ready for HDTV, fiber optics and other future technologies.

"In short, it was a pretty tall order for any supplier to fill.

"But, not for Magnavox. The Magnavox design team came up with a system that fit perfectly with our goals and their support throughout the project was complete. From design concept through system rebuild, their concern was for our total satisfaction with products, application and whole system performance.

"Since our new system has been in place, subscriber satisfaction is at an all-time high. With Magnavox's Digital System Sentry we're detecting problems and making repairs before our subscribers even know there is a problem.

"Our subscribers are happy because of the stunning picture quality and consistent service. I'm happy because we have one of the most technologically-advanced systems in the country. And we're ready for whatever the future may bring.

"Magnavox provided us with the quality, reliability and service we expected from a world leader. Using Magnavox was one of the best investments our company ever made."

To see how Magnavox can help you get the most out of your system, give your Magnavox representative a call.

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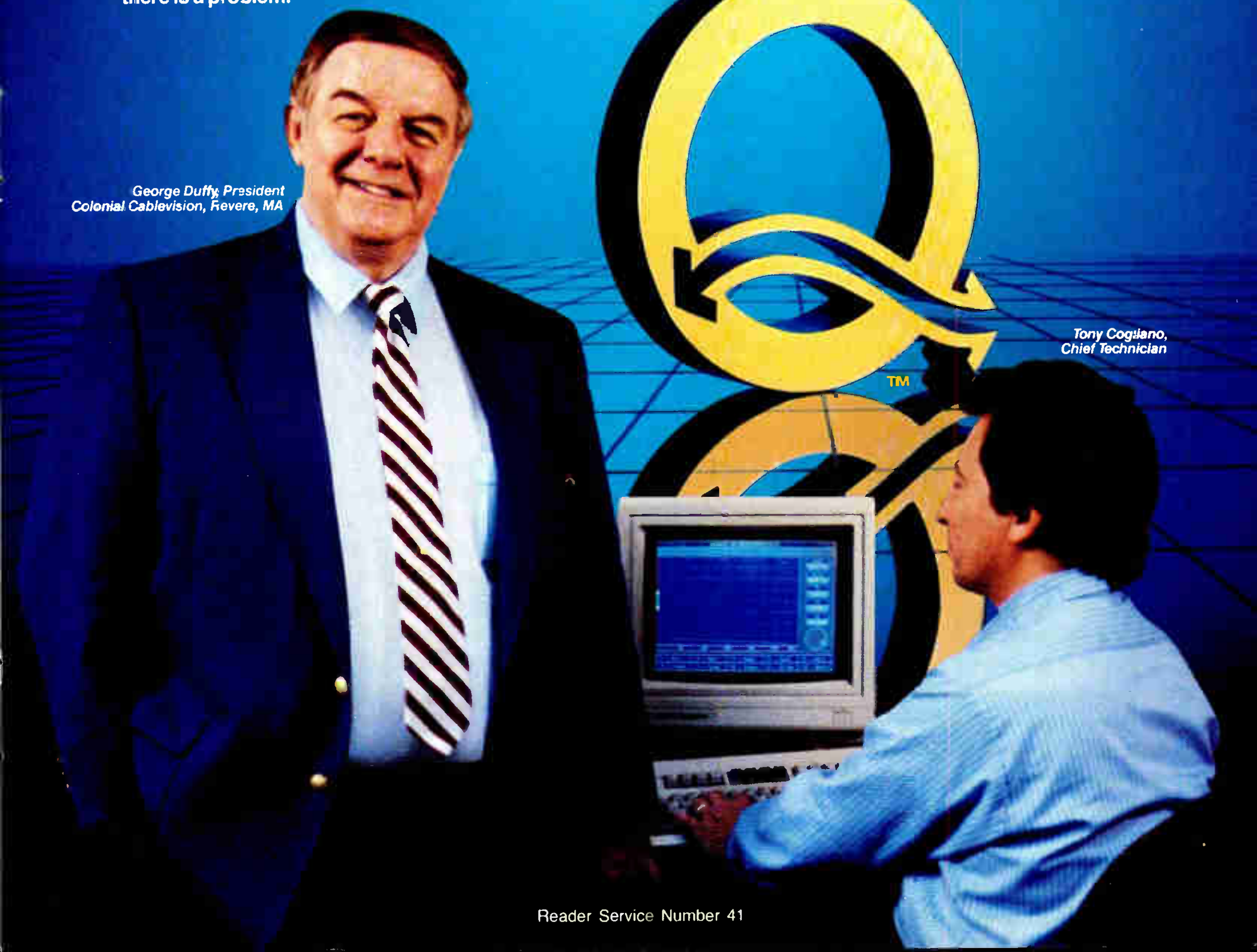


includes the use of system design approaches that modify the traditional tree-and-branch architecture that delivers 550 MHz of bandwidth (see Figure 1). UHF wideband is one of those alternative architectures, and this article briefly examines the history and practical implementation of a UHF wideband network.

Cable TV in Europe

Belgium and Switzerland were the cable television pioneers of Europe, having established successful systems more than 20 years ago. The factors that led to the development of CATV in Europe are similar to those that influenced the startup of business in North America. In Switzerland it was the mountainous terrain, while in Belgium numerous off-air signals prevented the reception of a clear TV picture with a simple antenna.

The systems built in Switzerland and Belgium were VHF tree-and-branch designed, with most of the active equipment mounted on poles. These initial systems offered subscribers 10 to 15 channels. Approximately five years later, in the mid 1970s, the Netherlands began building systems based on a VHF/UHF architecture. This architecture utilized VHF frequencies through the trunk portion of the system while the distribution system carried signals at UHF frequencies.

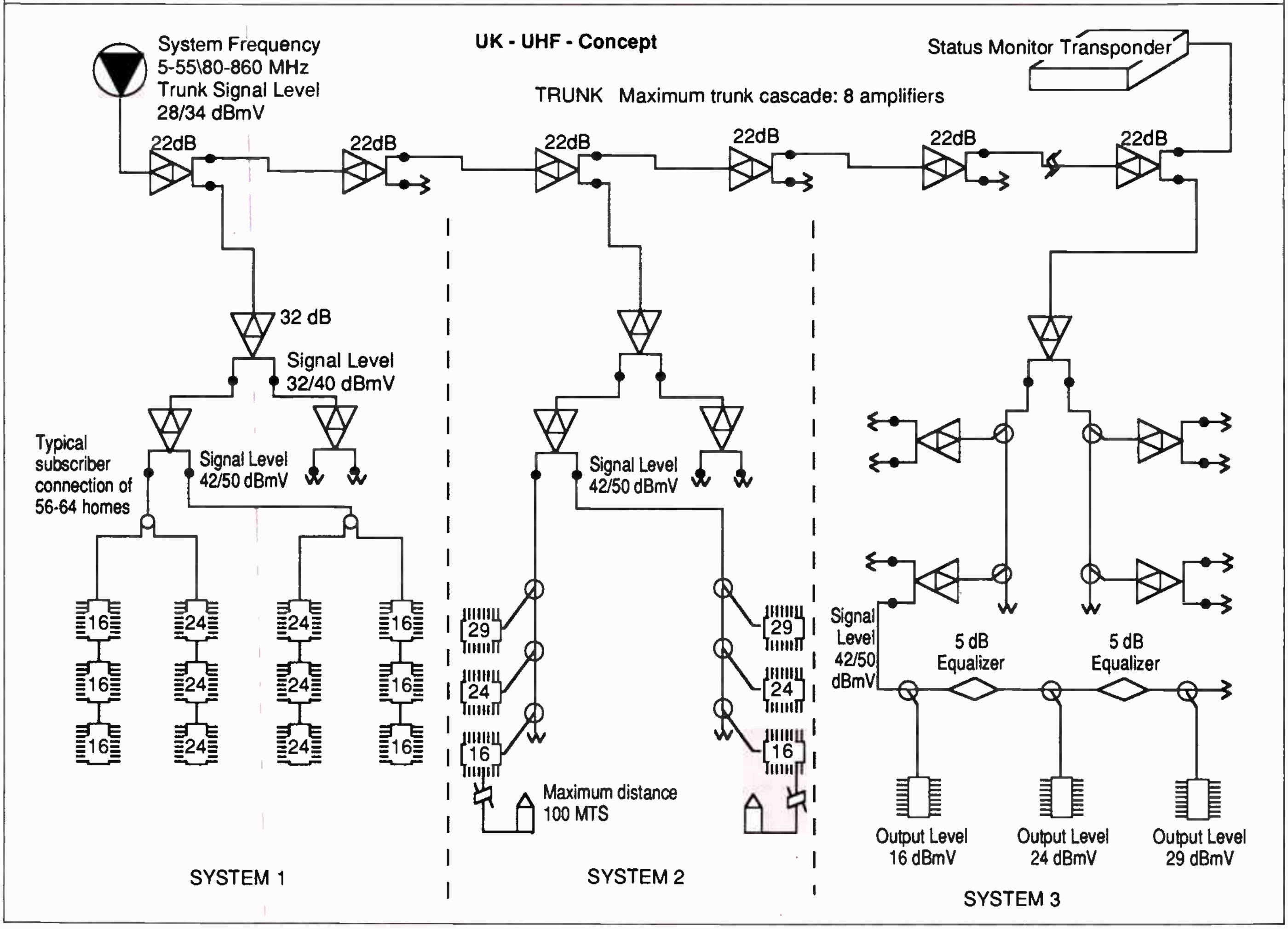
VHF/UHF feasibility issues

The VHF/UHF architecture used in the Netherlands is extremely cumbersone by North American standards in terms of initial installation and the future expansion to more channels. This is because VHF signals are down-converted to IF and then up-converted to UHF on a per-channel basis to achieve optimum selectivity and level control. The equipment required to complete this process can involve up the three separate electronic module cards. Again, this is on a per-channel basis requiring numerous sets of conversion cards at each distribution point for even the most basic system. The number of conversion cards and the associated powering requirement generate a significant amount of heat, dictating that fans be included in the basic enclosure.

All of this equipment makes the typical 20 channel conversion enclosure approximately three feet in length, five feet in width, and one foot in depth. The architecture requires conversion at every distribution point; therefore an enclosure must be located at almost each individual VHF trunk station location. The basic architecture calls for each trunk station to serve approximately 1,000 homes, so in a large system such as the one in Amsterdam (300,000 homes), 300 individual enclosures would be required.

Cost prohibitive

Additionally, the per set cost of conversion cards is approximately $1,250. In a 20-channel, 300,000-home cable system, the cost of conversion electronics could well reach $7.5 mil-



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The new Saturn 3.1 meter antenna.
Exclusively from Midwest Communications.
The premier antenna for C- or Ku-Band reception.

Dish and mount pedestal are precision-formed of high-grade steel. For durability. And years of consistent, low-maintenance performance.

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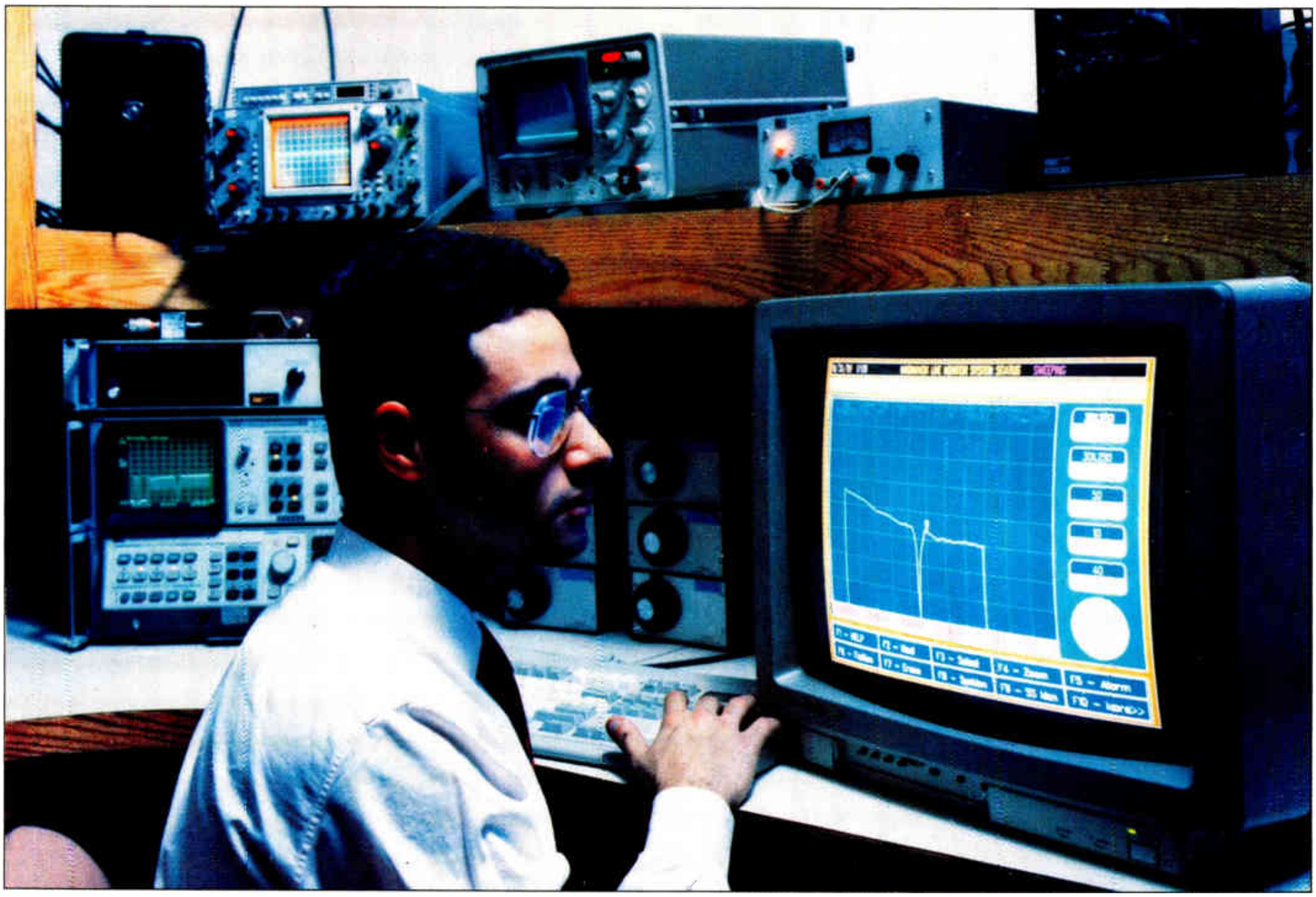
Reader Service Number 42

Status monitoring 101



Magnavox's line monitor (MLM)

Imagine gliding along the interstate in your sleek new automobile. Let's make it a convertible. A red convertible. Lotsa horsepower, lotsa chrome and lotsa money. Wind whips past your face as you speed toward your destination in a machine fueled only by your excitement and the controlled explosions of petroleum vapors. "This was money well spent..." you think, as you silently congratulate yourself on your new purchase.

Suddenly, from somewhere beneath the hood ornament, a sickening jolt rouses you to attention. What was that? A sudden deceleration quickly followed by an increased in speed followed by yet another drop in acceleration. How could this be? Yet again and again, choking spasms begin to grip your car as you reluctantly resign yourself to the realization that these spasms signal the impending failure of your new machine. Standing on the road's shoulder with gas can in hand and thumb pointing hopefully into space, you wonder why the designers of this wonderful automobile never bothered to implement status monitoring functions for this vehicle.

By Uwe Trode, Marketing Product Specialist, Magnavox CATV Systems Inc.

But of course they did. Gauges and lights make up an instrument cluster designed to monitor the car's vital signs and warn of possible trouble before it happens. Automakers have fitted cars with these devices because drivers like you and I would not buy a vehicle who's operating condition cannot be assessed during normal usage. After all, we rely heavily on our cars and will not tolerate breakdowns which we could prevent. This reasoning applies to cable systems as well. To prevent costly breakdowns of equipment and service, status monitoring becomes a vital tool.

Status monitoring overview

Status monitoring (SM) has been with us for over a decade. Originally implemented as a blinking red light at the headend whenever a single system fault was detected, SM has evolved into a marketable technical and management tool. Beyond the blinking red light, complete SM systems must now provide measurements such as AGC/ASC voltage, forward and return carrier levels, operating voltage and internal housing temperature. These parameters collectively provide the status information necessary for determining a cable system's state of well being.

The task of analyzing this information is assigned to a computer. SM software should allow for setting "windows" of operation which, when exceeded, alarm the operator through various visual and audio clues. In addition, the well designed status monitor allows for certain corrective actions to be made remotely—such as disconnecting return feeder and trunk paths.

Because status monitoring is by definition an exchange of information, communication paths must exist from both the headend to the measuring devices and back again. A two-way operational cable system is usually a prerequisite although other data channels are available for one-way systems. If monitoring is confined to the trunk path only, trunk return amplifiers are all that is required. End-of-line monitoring usually requires additional return amplifiers for line extenders.

Present day status monitoring is comprised of a mixed bag of software and hardware products. Let's try to categorize and take a look at a few of these systems.

Automatic slope and gain

Though not traditionally thought of as a status monitor, AGC/ASC performs such a function—albeit invisibly to the system operator. Trunk amplifiers equipped with this circuitry continually monitor the levels of gain and slope pilot carriers on the system and adjust their gain and slope in proportion to changes in these pilots.

For example, if an incoming gain pilot drops below a threshold determined by the unit's circuitry, this very circuitry forces an increase in the amplifier's output—effectively restoring nominal operating levels. This same approach is used for the slope circuitry.

As a monitor of pilots, these circuits function admirably but leave no clue as to what is going on inside the amp. They are "closed circuits." My car turns on a fan whenever the engine reaches a critical temperature. This is the self-regulating mechanism which keeps the car from boiling over. But I also have a temperature gauge which I can monitor when I'm driving. It shows me the temperature trends. If I see the temperature significantly rise, and the cooling fan kicking in more often than usual, I have reason to suspect a problem with the cooling system—perhaps a faulty thermostat. I could keep on driving, but it is in my best interest to have the car checked. Similarly, it is desirable to monitor the movements of the slope and gain circuitry. A significant change in gain pilot, for example, could signal a failing amplifier, connector or cable faults causing attenuation or perhaps failure of the AGC circuitry itself.

> A significant change in gain pilot could signal a failing amplifier, connector or cable faults causing attenuation.

Trunk monitoring

In a trunk monitoring scheme, "transponder" modules are placed directly into existing trunk amplifiers and sample such things as gain pilots and transmit this and other data back. These modules have unique addresses encoded into them through dip switches or firmware programming and can be interrogated on an individual basis by computer to reveal whatever measurements the modules have performed. This is called "trunk monitoring" since the transponders are installed in the trunk path only. The headend or ever, the return path need not be the system's coax plant. Some models have built-in modems which make it possible to use the phone system for the data link.

Once the data has been collected from each line monitor, it is analyzed and presented by the headend computer. Since each monitor received its command at nearly the same time, the data we have about the system corresponds to a "system snapshot."

Imagine a supertech travelling at the speed of light. At warp speed he moves from pole to pole and completes system sweep after system sweep until he has covered the entire service area. He then returns to the headend with the stored information and dumps it into the computer. The computer now churns through the data and gives us a clear picture of the entire cable system at one instant in time. Imagine that! Was the suckout at the east end of town a transient occurrence at that location only? Or did we measure it at the same instant 20 miles away at the west end—a systemwide fault? This is what a line monitor can provide: otherwise unattainable system views.

Variations exist in line monitors as in trunk monitors. Models may measure AC voltage and internal module temperature. Additional inputs and outputs may be used to control external switches and devices and make measurements from auxiliary products. Carrier-to-noise and distortion measurements are possible with some versions

> Status monitors are inherently software-based products, which provide design, form and function.

of line monitors. Some are vendor independent. Others require additional hardware modules to perform ancillary functions.

Fiber monitors

This new kid on the block helps track processes within a fiber hub. Similar in concept to the trunk monitor, fiber monitors use an addressable transponder module that is polled for optical power, laser temperature, laser bias current, laser power control and the like. Control from the headend allows for remote coax/fiber switching both for forward and return paths.

The software connection

Status monitors are inherently software-based products. Sure, the modules do the dirty work of making the actual measurements, but the really neat stuff is being done by the controlling software program. Here the manufacturer has an opportunity to spotlight his creativity and inventiveness by producing software which is effective in design, form and function.

The economy of design which has characterized engineering-type software for decades has been given a new face. Colorful graphics, taking advantage of EGA and VGA resolution, paint vivid screens depicting spectrum analyzer displays. Multicolor plots can recreate a year's worth of system operation. Imagine being able to see the effect of the seasons on your system in graphic detail as daily system responses are automatically superimposed upon one another.

Though some status monitoring software requires EGA or VGA graphics compatibilities of a computer, other programs will take advantage of the more common CGA or mono graphics adapters—although at a significant loss in visual detail.

Of course, Spartan representations are still available. If you prefer to look at raw data, status monitoring software will generate "reports" of the acquired data. These reports should contain the acquired data in a format which allows it to be imported into popular word processor and spreadsheet programs for further analysis.

Before you buy software

Software provides the man-to-machine interface for the status monitor. It should be easy to use and provide practical immediate benefits for the system operator. Look for at least these features when comparing products of differing manufacture:

- Application to your system—i.e. sub-split, mid-split or high-split.
- High quality presentation—graphics should vividly assess the situation without being vague and confusing.
- Password protection—allows managers access to otherwise restricted routines and services.
- Centralized and remote capabilities—can the software be accessed from a remote location?
- IBM-PC compatible—PCs will be around for a long time. They are easily obtained, serviced and you may already have one.
- Alarm limits—uniquely definable for each module.
- System history—data should be saved regularly for archival purposes and later retrieval.
- Ingress/fault location—routines which permit the automatic locating of faults such as noise ingress.
- Trend analysis—can the software display history data in such a way as to make trends easy to spot?
- Training/upgrade policies—what will it take to get up and running and what will it take to keep me there?

Before you buy hardware

You may want one, two or three hefty 25-pound units with oodles of capabilities in a few key locations to constitue your entire status monitoring system. You may elect trunk monitoring transponder modules in every other amplifier. You may prefer to pepper your system with line monitors at every conceivable potential trouble spot.

Whatever your method and madness, you must weigh the cost/benefit ratios for your particular application. A piece of gear installed on the pole is far more costly to upgrade than the software running on your computer—that upgrade comes in the mail. Whatever your preferences, some measurement capabilities remain as basic requirements:

- Signal level measurements—should cover your entire system from 40 MHz to 550 MHz, for example.
- Measurement accuracy—expect ±1 dB for amplitude accuracy.
- Amplitude resolution—should be 0.5 dB or better.
- Temperature range—can it operate in Arizona at noon? In Alaska at midnight? (Look for -40 to +60 degree C).
- Powering options—is powering other than 60 volt cable available?
- Dynamic range—expect 40 dB minimum.
- Disconnects—Does the equipment have control over feeder/trunk disconnect switches?
- Input/Output—are there provisions for additional I/O to connect to external devices such as switches?

Pleading the case

Would you plunk down thousands of dollars for a car and then have the dashboard removed in order to save a few hundred dollars? Hardly. So it is with status monitoring. It is seen as luxury by some and as a vital necessity by others. If you are still unsure, consider that every major CATV manufacturer has invested heavily in designing effective SM products.

There are other compelling reasons to use status monitoring. As cable subscribers become more demanding for quality signals into their homes, operators must try to meet this demand—a basic marketing tenet.

Potential system problems can be prevented through a properly managed status monitoring system which offers prognosis rather than diagnosis and ensures maximum system efficiency and profitability. The cost of monitoring is invariably less than the cost of truck rolls, technician salaries, repair parts/labor and subscriber disconnects. ■

Continued from page 75

F = Coefficient of friction
A = Angle

A complicated route

In order to prevent breaks of fiber and to maintain long-term reliability, a maximum allowable tension is set. In this case, using Siecor fiber, the maximum tension is 600 lbs. and this installation would work. If, for example, however, we are using a cable with a max tension of 350 lbs., we can see that T6, T7 and T8 will exceed the limit. It would therefore be necessary to pull the cable to T5 and coil it in a figure-eight before we continue the run to the reel's end. Another method would have been to set up the reel at T5 and pull one direction, then the other.

There are many variables to consider in calculating pulling tension of fiber cable in a totally aerial plant. One of the most important is the quality, quantity and proper placement of cable rollers. This will improve drag coefficient and help the overall weight dispersion of pulling fiber. The construction practice of placing rollers every 30 to 40 feet will allow the tension per length to be safely optimized.

Typically what has been found in calculating pulling tension of aerial fiber installation with proper roller placement is:

$$T2 = (W \times LL)/2 + T1$$

T2 = Tension of cable at pulling length
W = Weight of cable
LL = Length of cable being pulled
T1 = Starting tension or back tension of pulling cable off reel

Conclusion

The installation of long haul applications in telecommunications have shown that fiber is not fragile. While excessive pulling or bending of cable may not break fiber on the spot, excessive rough treatment may cause fiber fatigue. This fatigue could eventually turn into a break, especially if the fiber is left under stress.

In cable television, applications push the limits of fiber transmission equipment; thus a high quality system is essential for the required performances. With these applications comes a concern for practical implementation using well thought-out prior planning and sound engineering practices. ■

Cable system upgrades and rebuilds

Today's rebuilds and upgrades are often more challenging because of the constantly changing technical environment. To add more fuel to this fire, Motorola Inc. (among other semiconductor manufacturers) has announced a desire to produce a new hybrid package to achieve an upper bandwidth from 750 MHz to 1 GHz operation. Although the old hybrid package will not be discontinued, the old and new package *will not* be interchangeable.

Hybrid technology and advancement determines amplifier distortion and bandwidth capabilities. For a series of 1 GHz amplifiers to be readily useful in today's CATV plants, new hybrids must be designed.

Assuming the bandwidth and distortion products are improved over the next few years, how can today's upgrade or rebuild take advantage of tomorrow's technology? Selecting passive devices with bandwidths suitable for tomorrow's needs is always a wise choice. Often the most satisfactory solution to a present problem can be best made by analyzing the past.

Obsolete before completion

In the late 1970s, many new systems were built to 300 MHz only to be lagging advancing technology as soon as construction was complete. The problem involved the evolution of hybrid technology advancing from 300

By Fred Rogers, President, Quality RF Services Inc.

New Package Advantages

1 ghz Amplifier Project

- Push Pull circuit layout symmetry can be much better with the pins along one edge eliminated. Better push pull balance should result in better CSO & IMOD.
- Usable circuit substrate area will increase allowing the development of alternative circuit topologies which will not physically fit in the existing package.
- Test fixture and application board design can use co-planar waveguide techniques for RF transitions into and out of the amplifier for better RF interfaces than current package allows.
- Cost of package will be lower allowing less increase in the total cost for 1ghz amplifier.
- Improved input/output RF isolation will result in more predictable performance in customer applications.

Why a New Package?

1 ghz Amplifier Project

- *FACTS:*
- Old package was designed in the 270/300mhz era and has been pushed to 400, 450, 550 and 600mhz. (Over 12 yrs. and 70 engineering man years in pushing bandwidth in this package from 3 octaves to 4 octaves.)
- Over four engineering man years and 8 different layouts and all the associated costs have been invested in extending the hybrid bandwidth in the existing package with only some marginal 750 Mhz samples resulting.
- Pins along one edge degrade push pull amplifier symmetry with resultant reduction in high frequency balance (Imod and CSO degradation).
- Structure does not lend itself to low reflection input/output transitions in either circuit board application or test fixturing.
- Present heatsink cost continues to rise.
- Over a year of potential 1ghz amplifier circuit modeling has shown that the most likely circuit topologies will not physically fit in the existing package.

MHz to 450 MHz in a short period of time. The 450 MHz hybrids that resulted from this evolution, with minor changes, are still being produced today.

"Stretched" hybrids

Between the design of the 300 MHz and 450 MHz hybrid was a 400 MHz unit that in reality was a 300 Mhz hybrid "stretched" in bandwidth to 400 MHz. This stretched 400 MHz hybrid has inferior noise and output distortions when compared to modern 450 MHz hybrids.

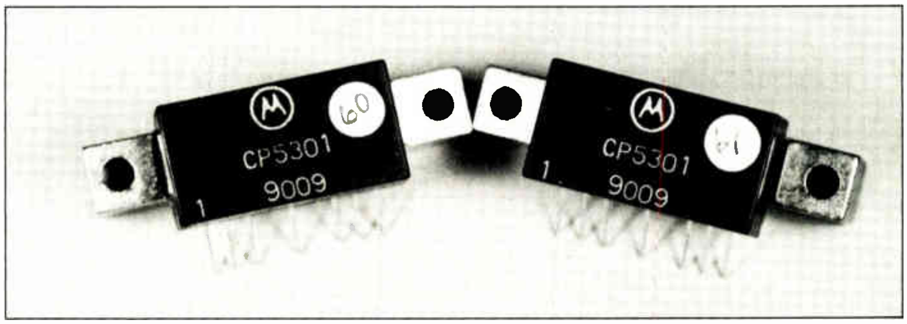
Many of the 400 MHz amplifiers produced in the middle 1980s contained this stretched 400 MHz hybrid and can be substantially improved by replacing these hybrids with today's hybrids.

One major manufacturer, Motorola, has two distinct manufacturing divisions. One division (the old TRW) produces original 300 MHz, "stretched" 400 MHz, 450 MHz and now, 550/600 MHz parts. The reason for producing an original 300 MHz hybrid is because of the original amplifier's design of the 1970s.

Higher frequency hybrids will not operate without modification because of high frequency signal "launching" and loss of response flatness. In addition, there are compounding oscillation problems.

The manufacturing of the original 300 MHz and "stretched" 400 MHz hybrids will be available. The "CP version" contains additional circuitry protection from RF overload as compared to the original "CA" part. The CP version represents a rugged hybrid using 450 MHz die. The CP version is only important for hybrids using the 450 MHz die and not the original 300 MHz part.

> Selecting passive devices with bandwidths suitable for tomorrows needs is always a wise choice.



Motorola's CP5301-9009

Blue hybrid

The second division of Motorola, the origin of the blue hybrids, manufactures hybrids using 450 MHz as the lowest frequency die.

For example:

- MHW 3172: 17 dB gain, 330 MHz part using 450 MHz die with positive voltage.
- MHW 3382A: 38 dB gain, 330 MHz output part using 550 MHz die with positive voltage (the "A" designation in the part number indicates the higher frequency die).
- MHW 5182: 18 dB gain, 450 MHz output part using 450 MHz die with positive voltage.
- MHW 5181A: 18 dB gain, 450 MHz input part using 550 MHz die with positive voltage.
- MHW 6182: 18 dB gain, 550 MHz output part using 550 MHz die (The "A" is not needed here).

Compatability concerns

Most manufacturers of hybrids today use 450 MHz or higher die for manufacture of 300 MHz parts. Soon this will be true for all major manufacturers. Consult your hybrid supplier's engineering staff for solutions when using higher frequency parts in original 330 MHz amplifiers. Often, when all is said and done, the simplest of solutions can be suggested.

Plan for the future

The system's political situation often determines its course of action. A franchise renewal may dictate a total rebuild, but if a choice exists that would allow an economical upgrade, take it.

It is very difficult for any competitor to get his foot in the door with your customer if your customer is pleased with his current service.

Hybrid technology will be progressing at a rapid pace in the next few years. Tomorrow's CATV system will be determined with rapidly advancing hybrid and fiber optic developments.

Remember, the customer does not care how we deliver his pictures; only the quantity and quality of what we deliver counts. An inexpensive hybrid upgrade coupled with high reliability power packs, plus improved overvoltage protection may buy another three to five years or even better, immediately improve the product a CATV system delivers. Today is the day to determine if your system's amplifiers can be improved with a hybrid changeout to avoid a rebuild for a few more years.

It is very difficult for any competitor to get his foot in the door with your customer if your customer is pleased with his current service. ■

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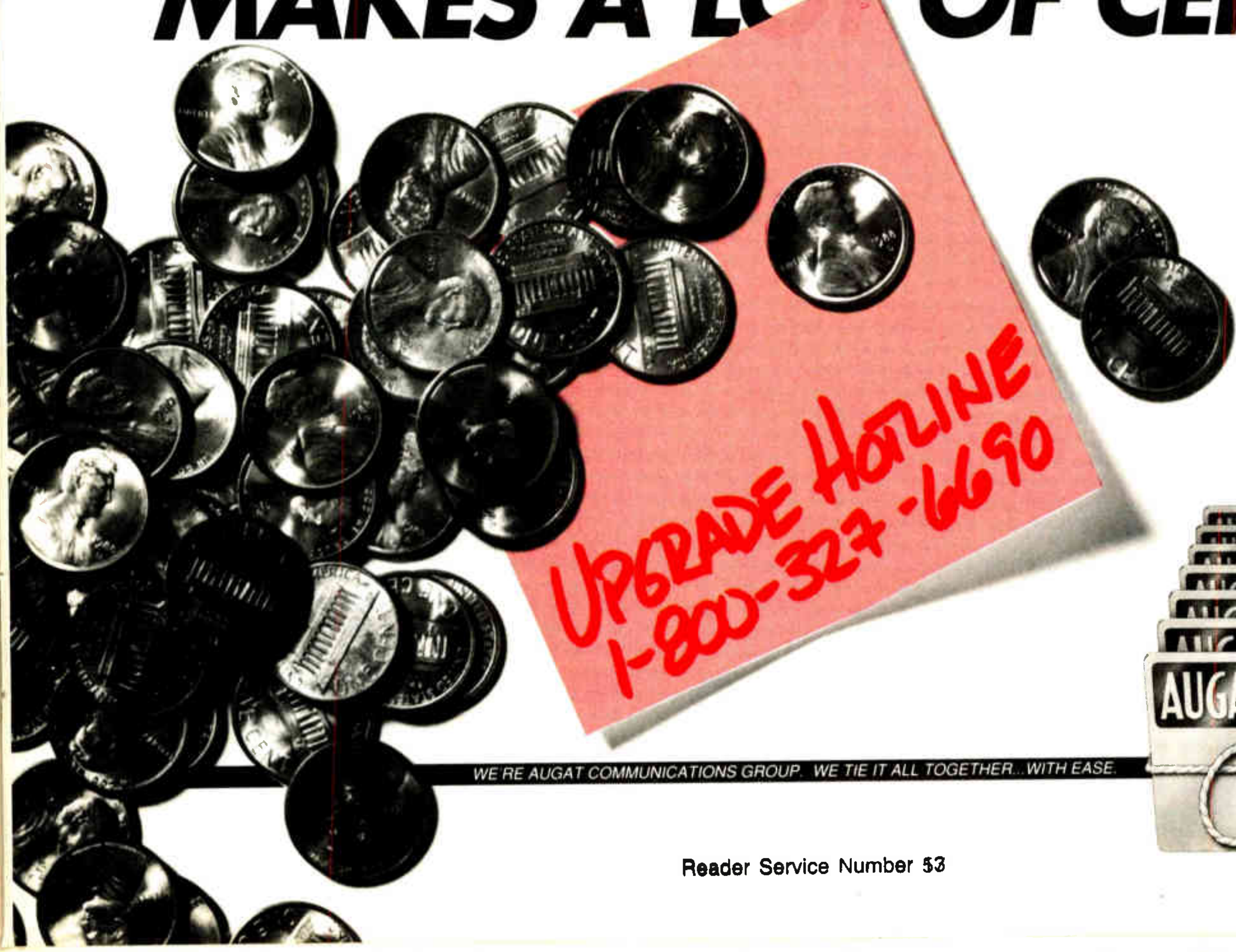

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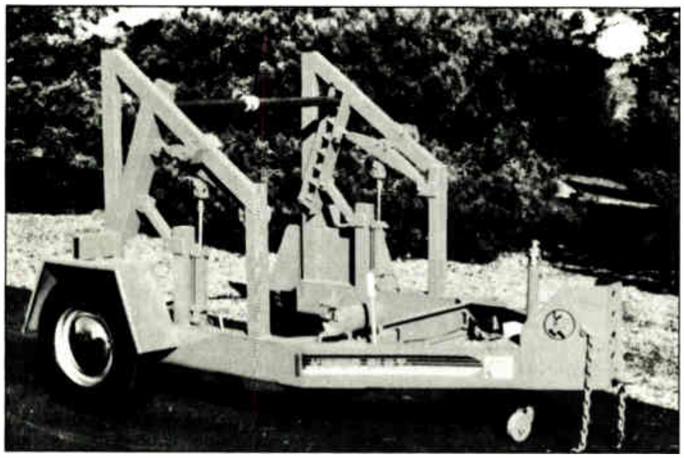
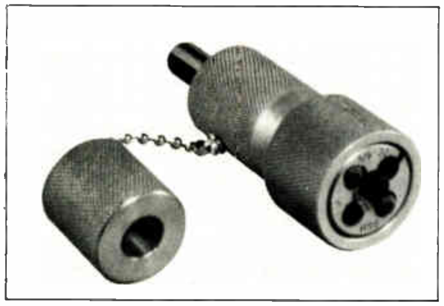


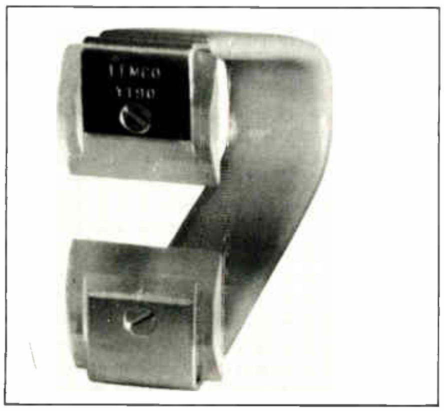
Keifer Built's hydraulic cable trailer

ile, offer performance that equals or betters a fixed channel product. Automatically selected output bandpass filters allow 80 channels or more to be combined without external filtering and still achieve a 60 dB or greater combined headend signal-to-noise ratio," says Geoff Roman, VP of marketing in Jerrold's Distribution Systems Division. For more information, contact Jerrold at (215) 674-4800.

Keifer Built Inc. has announced a new hydraulic cable trailer which features a spring suspension system for smoother action and reduced wear on stub axles. According to Keifer officials, once the hand hydraulic pump has lifted the cable reel into position, leaf springs suspend the reel and absorb most of the shock. The 3,500 pound model accomodates reel sizes of up to 54 inches by 72 inches, and the 6,000 and 10,000 pound models accomodate reels up to 54 inches wide and 108 inches high. All models feature electric brakes, a safety breakaway switch an a height adjustable Lunette eye on the hitch. For more information call (515) 762-3201.



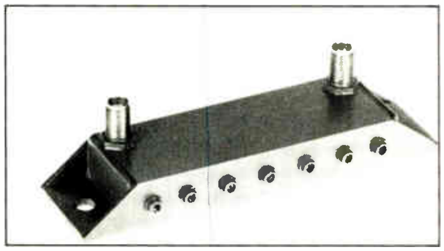
Lemco's thread cleaning tool



Lemco's center conductor cleaner

Three new products have been announced by **Lemco Tool Corporation.** The new Thread Cleaning Tool is designed to clean oxidation salts from internal and external 3/8'-32 UNEF threads, commonly found on passive devices and F-fittings. The Thread Cleaning Tool consists of an anodized, knurled tool holder, a die, a tap and a threaded cover to protect the tap when not in use. Lemco's Center Conductor Cleaner is designed to remove dielectric and adhesive from the center conductors of coaxial cables from 0.412 to super trunk. The tool is 3 inches wide by 4 1/2 feet long, with reversible scrapers. In a final announcement, a new Trap Tool is available to install and remove traps and filters. The tool's inner stem threads onto the male thread of the trap and holds the trap for positive alignment. Spanner pins are fully engaged during use for easy trap removal. For more information on these products, contact Lemco at (717) 494-0620.

Lemco's trap tool



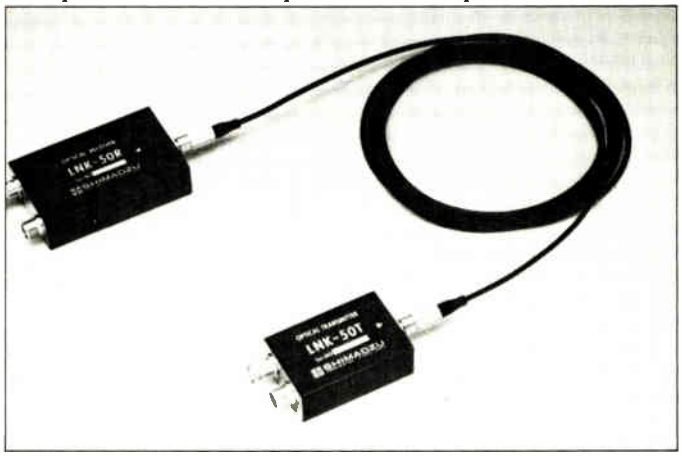
Microwave Filter's MMDS downconverter preselector

Field strength meter software has been announced by **Magnavox CATV Systems, Inc.** The software is designed for use with the MLM status monitoring device, and allows remote signal strength measurements through coax, RS-232 connection or telephone modem. The program features pull-down windows, a user-definable frequency editor, and on-line help. A pop-up frequency allocation chart is also available. The PC-based software package operates with monochrome, CGA, EGA or VGA monitors on machines having a minimum of 512K of memory. For more information, call (315) 682-9105.

Norland's NSK-4 splice kit

Two new MMDS downconverter preselectors, Models 6913 and 7578, are available from the **Microwave Filter Company Inc.** The Model 6913 covers the passband of 2500 MHz to 2686 MHz. It has a maximum passband loss of 3 dB and a minimum rejection of 50 dB at 2332 MHz, and costs $325. The Model 7578 has a maximum passband loss of 1 dB and a 30 dB rejection at 2100 MHz, and costs $350. Impedence for both units is 50 ohms. For further details call (315) 437-3953.

Norland Products Inc. has announced the availability of the NSK-4 Splice Kit, which contains the UVC Mini-Lamp, 10 UVC Optical Splices, two syringes of Norland Optical Adhesive, and a UVC Splice Holder. The kit allows an installer to repair broken splices, make pigtail connections, or make temporary laboratory splices. The Mini-Lamp is an ultraviolet light source that is constructed to permanently bond ultraviolet curing splices. It operates on four AA-sized batteries,a 9 volt AC adapter or cigarette lighter adapter. The kit is priced at $565 and is available directly from Norland Products. Call (201) 545-7828 for details.



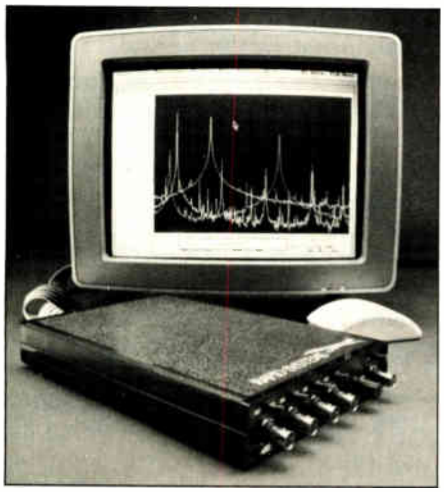
Soltec's optical video link, LNK-50

American Television and Communications Inc., Vision Cable, and Newchannels are using the **Orbital Technologies, Inc.**'s Comtor (Computerized Telephone Overflow Register) service, according to Orbital VP Vera Lynn. The incoming-call management system is designed to assist cable operators in their quest to comply with the NCTA's Rule 1c, which states that "a customer should receive a busy signal less than three percent of the time." The Comtor system provides 24-hour, 365 days per year busy signal surveys in which incoming calls are scanned 3,500 times per minute. Comtor's microprocessor counts, records, and prints the busy signal information to inform cable management how many calls were lost. For more information, call (804) 463-0312.

Soltec Corporation has introduced an optical video link transmitter and receiver, the LNK-50. According to Soltec officials, both transmit and receive modules are immune to EMI/RFI, which eliminates interference from noisy environments. The unit features a built-in automatic gain control to keep electrical output levels constant. The LNK-50 transmits color video signals up to 3 km, requires a +12 VDC power supply, and features 75-ohm impedance. For more info, call (818) 365-0800.

A new plug-in optical module has been announced by **Photon Kinetics Inc.**, designed to enhance OTDR measurements on multimode fiber. The Model 413M6 module operates in conjunction with the Model 4000 HiRes OTDR to offer short dead zone measurements of multimode fiber. The modlule features an event dead zone of 5 meters and an attenuation dead zone of 17 meters at 1310 nm. Electronic masking technology in the module provides 16 masks and seven pulse widths, which lessens measurement discrepancies caused by highly reflective features. Call (503) 644-1960 for more information.

Rapid Systems Inc. has introduced the R310 two channel real-time FFT spectrum analyzer. The instrument is PC-based and offers two simultaneous channels of 250 KHz analysis, with a real-time split screen displaying frequency and time waveforms. According to Rapid Systems officials, users can average from two to 1,024 different acquired spectrums on two channels. The unit features 32K per channel data buffers, digital/analog triggering and programmable gains. Other features include 10 mV to 50 V per division gain ranges, sample rates from 1 Hz to 500 KHz, log or linear frequency and amplitude scaling, and hard disk storage. For more information, call (206) 547-8311.



Rapid System's R310 spectrum analyzer

Fiber deal penned

Sumitomo Electric and **Cablevision Industries** have jointly announced a fiber optic system for Alert Cable TV, a Cablevision system based in Wilson, N.C. Joe Van Loan, senior vice president of Cablevision Industries, explained the Alert Cable TV will employ the fiber optic transmit technology in a system upgrade, saying "The optical transmission system will provide cost efficient, higher quality signals to subscribers at better reliability than conventional electronics could provide.

According to Larry Corsello, vp of Sumitomo Electric Fiber Optics Corp., the comany will be providing Alert Cable TV with a turnkey fiber optic system, including transmission equipment, optical fiber cable and fusion splicing equipment. Sumitomo will also provide construction, training and support. The Wilson system will utilize fiber optics to transmit optical signals from the headend to six remote receivers.

—Leslie Miller and Roger Brown

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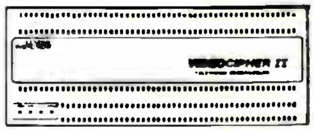

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Hybridization in cable TV

Anyone who has dabbled in home gardening knows that the best results come from hybridized plants. Hybrid fruit trees have branches grafted onto their trunks from other kinds. Farmers have used hybridized crops for decades to obtain best results.

In the cable industry, the "bricks" which form the active devices in our amplifiers are called "hybrids" by the semiconductor manufacturers because they contain integrated circuits and thin film devices in an encapsulated combination. The cable industry has begun applying the concept of hybridization to the overall design of cable systems. This kind of thinking has already brought significant benefits. There are more benefits to be realized from extending this approach to our thinking.

Cable hybrids

There are a number of hybrids I wish to consider: coaxial/fiber hybrids, NTSC/HDTV hybrids, compressed video/non-compressed video hybrids, analog/digital hybrids, video/audio hybrids and broadband/switched hybrids.

The coaxial/fiber hybrid has been described at great length over the last few years. I won't repeat that description here except to emphasize that the two major approaches ATC has been advocating, the fiber backbone and the fiber trunk and feeder, have two different purposes. The fiber backbone is a cost effective rebuild strategy utilizing the existing coaxial trunk. Fiber is overlashed to a point near the distribution plant. Four to six trunk amplifiers remain. Some of these amplifiers are turned around. The net result is a multiplicity of small cable systems.

The fiber trunk and feeder concept applies to new construction or to rebuilds where the existing coaxial plant needs replacement. No trunk amplifiers are employed at all. The distribution plant is fed directly with fiber. Two, perhaps three, line extenders are used. This technique is less expensive than conventional coaxial trunk.

The use of fiber in the cable plant is an important enabler. Fiber enables us to consider 1 GHz bandwidths. One GHz of bandwidth gives us 160 channels of 6 MHz each. There are some who believe we will be able to have more than just 1 GHz when the final results are in. This opens up the opportunity to consider other hybridizations in cable.

The NTSC/HDTV hybrid

There are approximately 200 million NTSC television receivers in the United States. A little over 20 million are added each year. There are over 70 million NTSC-based VCRs in American homes. Their numbers are growing at a rate near 10 million. Even the most optimistic projections for HDTV penetration claim it will be at least five years before there will be commercially significant numbers in U.S. homes.

I further believe that NTSC will be with us for essentially forever. For our purposes, a good engineering approximation to "forever" is the lifetime of all who are reading this column and the lifetimes of their children. Cable must service that population of NTSC equipment—and serve it well.

The FCC's decision to emphasize a simulcast solution for terrestrial broadcast fits nicely with the need to not damage NTSC in the process of introducing HDTV. The FCC is seeking a totally separate HDTV signal which fits completely in a 6 MHz slot. Assuming cable adopts the terrestrial standard for its purposes, this will automatically make our cable systems an NTSC/HDTV hybrid.

A reasonable strategy may be to have 60 or so of the 160 channels occupied by good old NTSC. This would serve all the NTSC equipment which forms most of the customer electronics hardware in the home. Keep in mind that the never-ending trend in consumer electronics is for improved quality at ever lower prices. NTSC devices will likely be in nearly every room of the house. They will all need to be connected to cable.

Compressed video hybrid

The last several months have brought lots of talk about compressed video. Most of this talk has centered around the application of video compression to satellite transmission to overcome the limitation in available bandwidth. For example, 4-to-1 compression would allow a 27-channel transponder set of three satellites to carry 108 channels.

There are a few points to make to put this into perspective. The multiplier in a transponder application is double what it is in a cable 6 MHz slot because of the wide bandwidth of the transponder. Thus, 4-to-1 compression for satellites is equivalent to 2-to-1 compression in cable. We have had 2-to-1 compression available to cable for over a decade! The General Electric Comband system offered us that years ago. In its later versions, Comband was quite good. Why was it not embraced by the cable industry? I think there are two reasons.

First, cable found it less expensive to upgrade the plant to obtain increased bandwidth. Upgrades can bring improved signal performance and increased reliability as well. Just adding compression hardware will likely reduce signal performance margins and reliability. A second reason is the reluctance to add the cost and other headaches of more in-home hardware. This is especially troublesome when that hardware has to go on top of every TV and VCR in the home. We've learned that our subscribers hate boxes on top of the TV.

Does this mean that video compression technology has no place in cable? Quite the contrary. While doubling the capacity of a 20- or 30-channel system may be cheaper than compression, doubling the capacity of near 1-GHz systems is another matter. A major change is that now we have the opportunity to consider higher compression ratios. Five-to-one compression for cable has been publicly demonstrated. This compression is worth another look.

Next month, we'll consider how we might use aggressive compression, as well as some additional places this move to hybridization can take us. ■

By Walter Ciciora, Vice President of Technology, American Television and Communications