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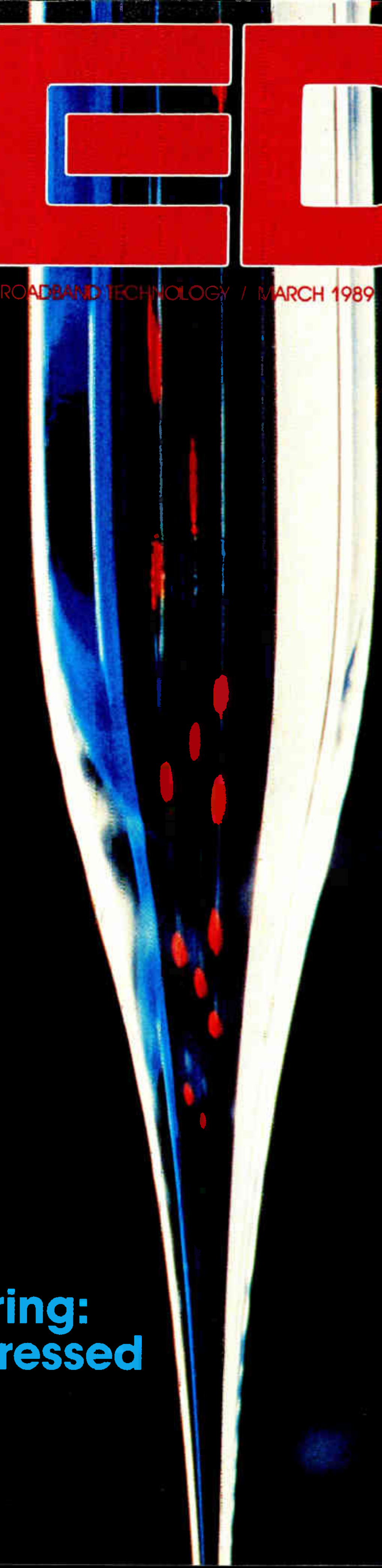
THE MAGAZINE OF BROADBAND TECHNOLOGY / MARCH 1989



Switched-star architectures compared

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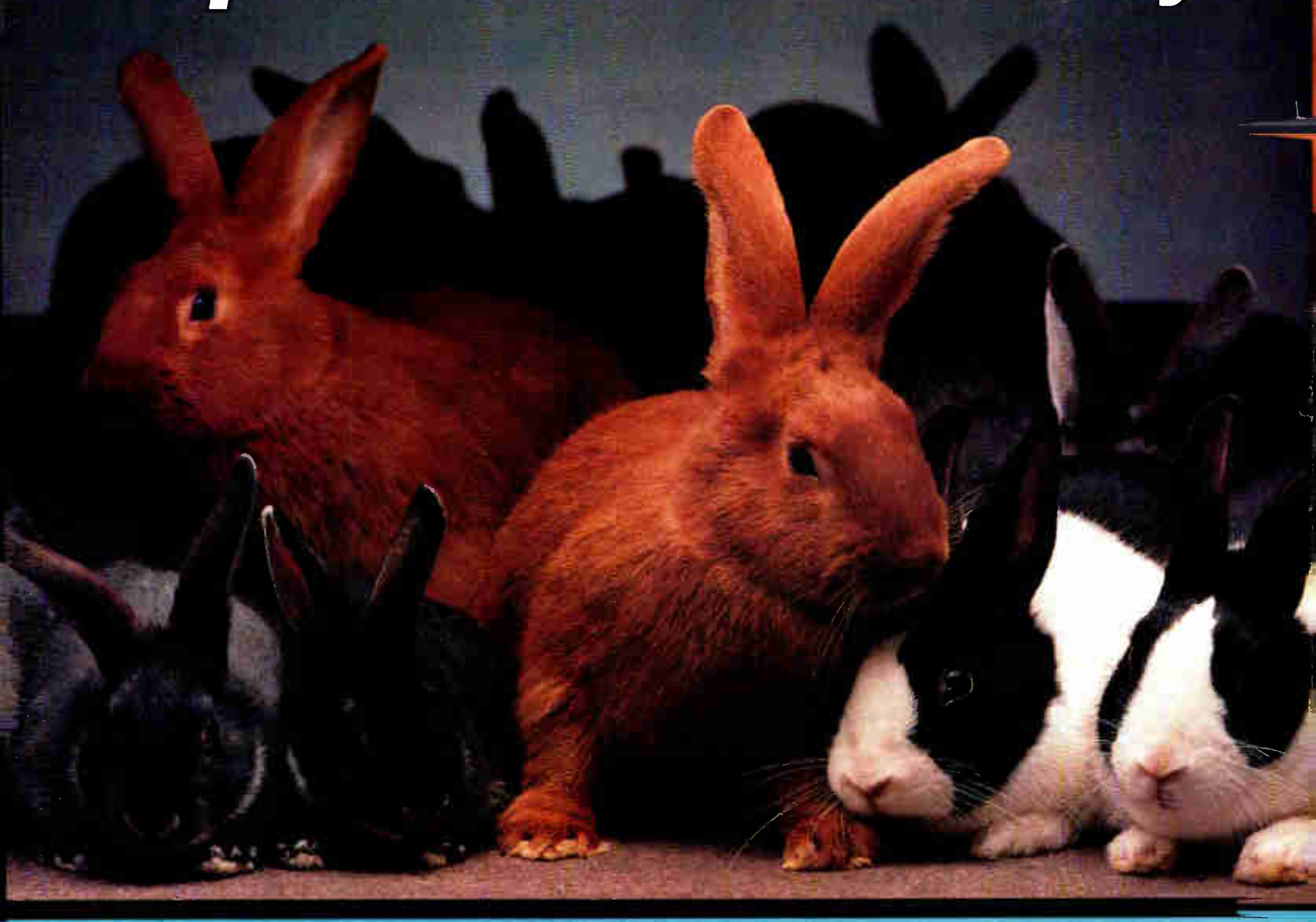

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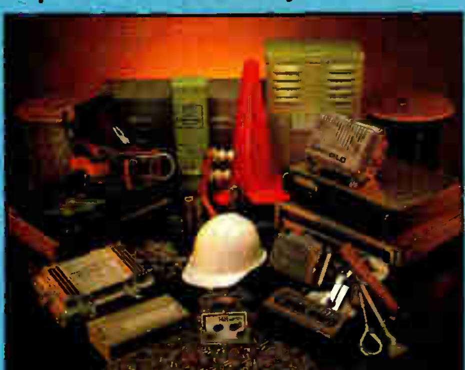

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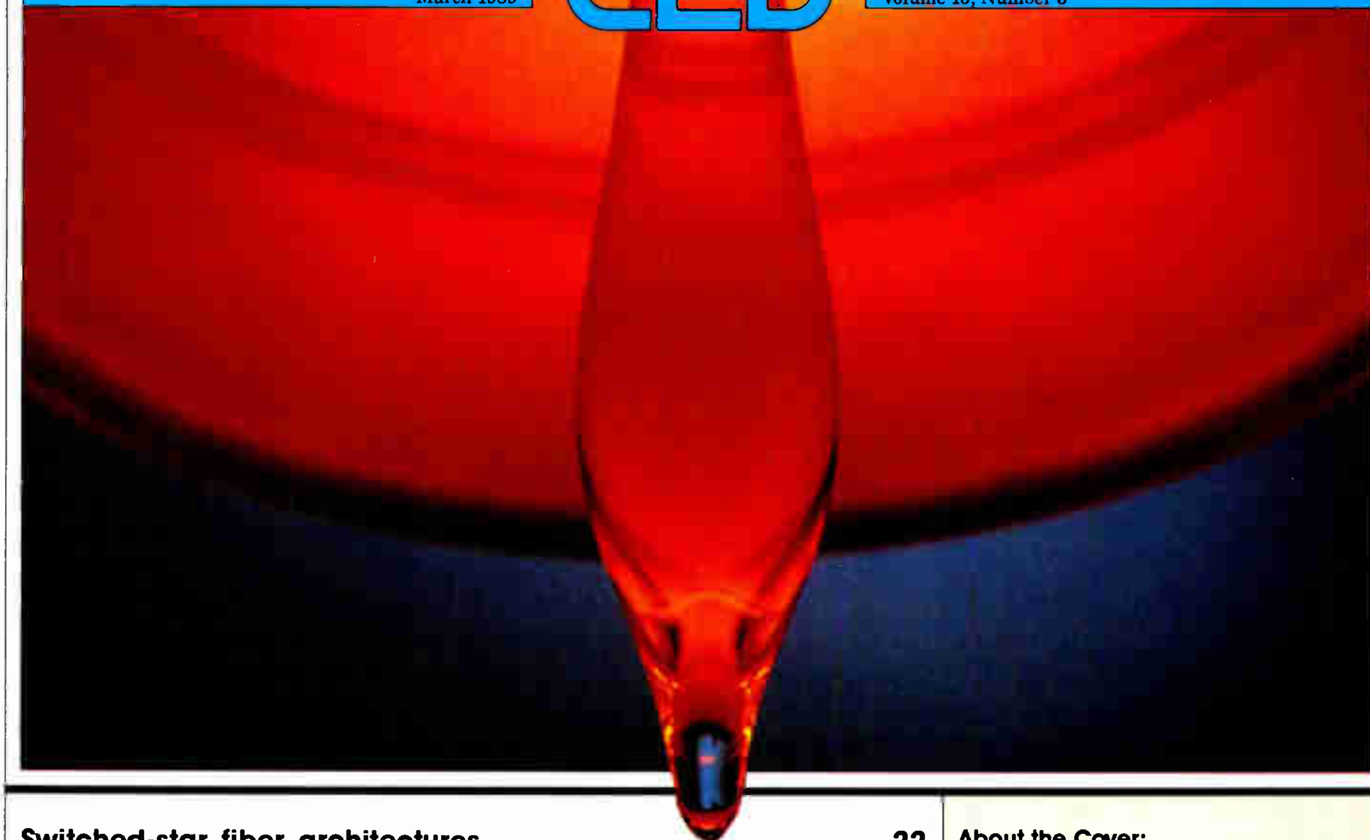

About the Cover:
A consolidated glass blank is drawn into optical fiber at Corning's Wilmington, N.C. manufacturing facility. It is one of the largest optical-fiber manufacturing facilities in the world. Photo courtesy of Corning Glass

DEPARTMENTS

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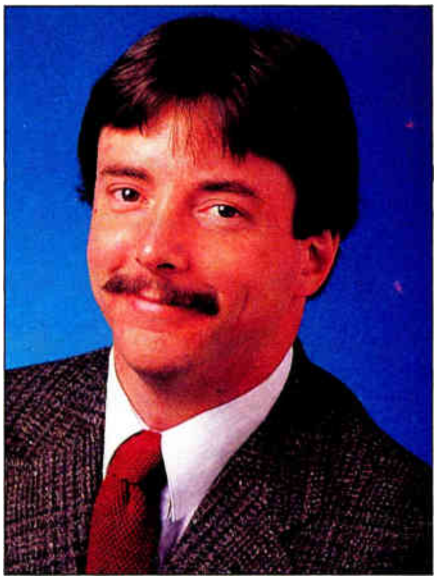
Reader Service Number 3

The economics of HDTV

High Definition Television promises a lot. It's lists of attributes includes pictures so sharp it's hard to tell the difference from 35 mm film, audio so clear and rich you might think you're in a concert hall, and, perhaps, a chance for the United States to renew its technological leadership.

While picture and sound quality will have the most immediate and direct affect on consumers, the most lasting affect HDTV will have on the world is economic. There's a lot at stake with HDTV, just ask component and tube manufacturers.



Of course, this premise rests on the assumption that HDTV will catch on with the public. With the first sets priced in the neighborhood of $4,000 each, some experts are skeptical. But consumers in this country are obsessed with high-tech "toys"—and that all important demographic category (25 to 40 year olds) probably won't wait long to rush out and buy a new set, just to be able to say they were the first on their block to get one. If you don't think so, just look at how quickly VCRs and CD players have been embraced by the American public.

Television manufacturers, especially those overseas (which includes everyone except Zenith), want nothing more than to sell 200 million new television sets in this country. HDTV will allow them to do that. Even though the FCC has ruled that any HDTV standard must be "compatible" with today's sets, full appreciation of HDTV will force consumers to buy new sets.

But this time, the U.S. has a chance to play the game, instead of spectating. Even though the TV manufacturers have fled the country or were brought up by firms headquartered on other continents, a unique opportunity exists to get back in the contest. It could mean millions, even billions of dollars not sent somewhere else.

The ripple effect it would have—beyond the sale of televisions—would also be enormous. With new TVs come new VCRs. Cable systems throughout the country will have to replace at least some of its headend equipment and certainly some line electronics as well. That bodes continued good times for the industry, as consumers pay cable operators for HDTV programming and those operators pay manufacturers to deliver HDTV-capable hardware. And the effect will be felt in the semiconductor industry as well.

But perhaps more importantly, imagine what it would do to the national mood. Defeats and embarassments in the high-tech arena have been commonplace lately. HDTV could change all that. Let's get moving and find out.

Roger J. Brown

Roger Brown
Editor

the

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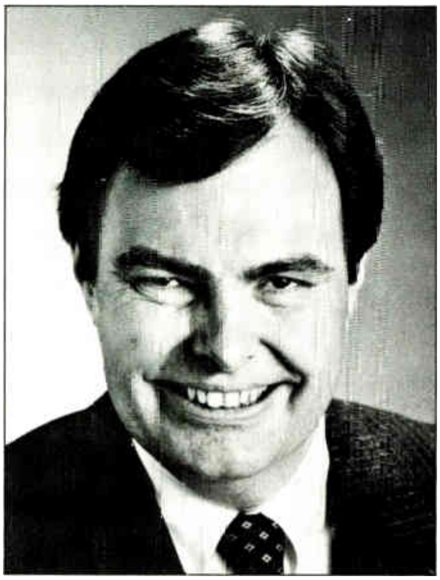

Richard Green

Green, Labs poised for future

HDTV is everywhere. Every time you pick up a consumer or cable trade publication, there is mention of high definition television. Which standard will be adopted? Will it be one channel or two? What kind of equipment will be needed? Perhaps the real question should center around, "Who's making sure the industry's needs are met?"

Fortunately, cable *is* an active part of the process, especially since the start up of Cable Television Laboratories Inc., informally dubbed "Cable Labs." Richard Green, president and CEO of the cable consortium, sees participation in the processes to define new technologies an important part of Cable Lab's role. "Our goal is to make sure that proposed systems will perform satisfactorily on cable systems," says Green.

Well-rounded

Green came to Cable Labs with a background that could be considered perfect for the role. With an engineering start in 1959, he has worked his way through the United States Army Electronic Research and Development (R&D) laboratories, past Boeing Aircraft Company, through KIRO-TV. by Hughes Aircraft Company and then on to ABC where he started his broadcasting career. Many of these earlier positions were actually R&D laboratory roles, with ABC being an operation/production position. From ABC, Green filled the role of director at CBS's Technology Center in another R&D endeavor. After a term as executive director of the Advanced Television Systems Committee, Green became the senior vice president of broadcasting operations and engineering at PBS. It was while at PBS that Green was offered the position at Cable Labs.

Such a multi-faceted background of broadcasting, operations and research and development is integral in Green's role as president of Cable Labs. According to Green, his job is not only to set up the organizational structure and get Cable Labs started, but to bring together two forces—the CEOs of the operating companies and key technical members of the industry.

"We have one group that is very knowledgeable and has the talent for determining the technical direction of the industry; and then we have CEOs who are concerned with policy and business aspects," says Green. "Working with both groups—pulling these two together—is what the industry needs to apply technology in a competitive environment."

Impressive goals

Cable Lab's goals are three-fold: to act as a clearinghouse for technical information; to identify and sponsor R&D; and to facilitate the technological transfer of data to member companies and suppliers. At this time, the consortium is developing what they term a "portfolio" of R&D projects. As might be expected, the two leaders now are HDTV and fiber optics.

Green sees the work on HDTV as being an immediate activity, whereas the work on fiber is more a long term endeavor. According to Green, fiber demands developing and working on the technology to make it practical to cable operators. HDTV, on the other hand, "is very important at the moment because of all the activity and energy that's going into it," says Green.

Background offers insight

Green's flexible background with broadcasting allows him to look at cable and its role in a different light. "I enjoyed my work on the broadcasting side but I'm looking forward to my work in cable also," says Green. "I think the kind of talent that's represented in cable is what is needed for the future, especially with respect to applying new technologies." Green's enthusiasm for the industry is fueled by the unamimous support for an organization such as Cable Labs. According to Green, the insight and commitment to new technology is a stimulating factor. "It's clear that the cable industry has a vision of the future which is something I think few industries do," says Green.

His interest in new technologies can be traced back to 1980, when Green was responsible for some international standards work. Recommendation 601 is a standard that was published for the development of a worldwide standard for digital television. The work was through an international committee, which is a United Nations signatory committee based in Geneva called the CCIR (Consultive Committee for International Radio).

Green's role in the published recommendation was "a very satisfying endeavor," he says. "I think that it's important as the world gets smaller and telecommunications, especially international telecommunications, becomes so significant, that we need the ability to break down electronic barriers that have kept us apart."

A changing world

As president and CEO, Green himself is finding his world will be changing, as Cable Labs relocates to the Denver/Boulder area in June. A Colorado Springs native, Green looks forward to moving to the Denver area, located just 50 miles north of his hometown. But why the move west? The move is positioned from the standpoint of research and development as well as from the perspective of contact with cable operators in the area.

Although the number of cable operators based in the area is appealing, Green states that it is also necessary to work with suppliers in a positive way. "I look at Cable Labs as a resource to the vendors—of information," says Green. "We are kind of a central thought process which can be of benefit to them," he adds.

The whole process is an exciting endeavor to Green. "Cable Labs has all the elements of success about it," he says. "Its been carefully thought out, carefully planned, and well financed.

—Kathy Berlin

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March 1989

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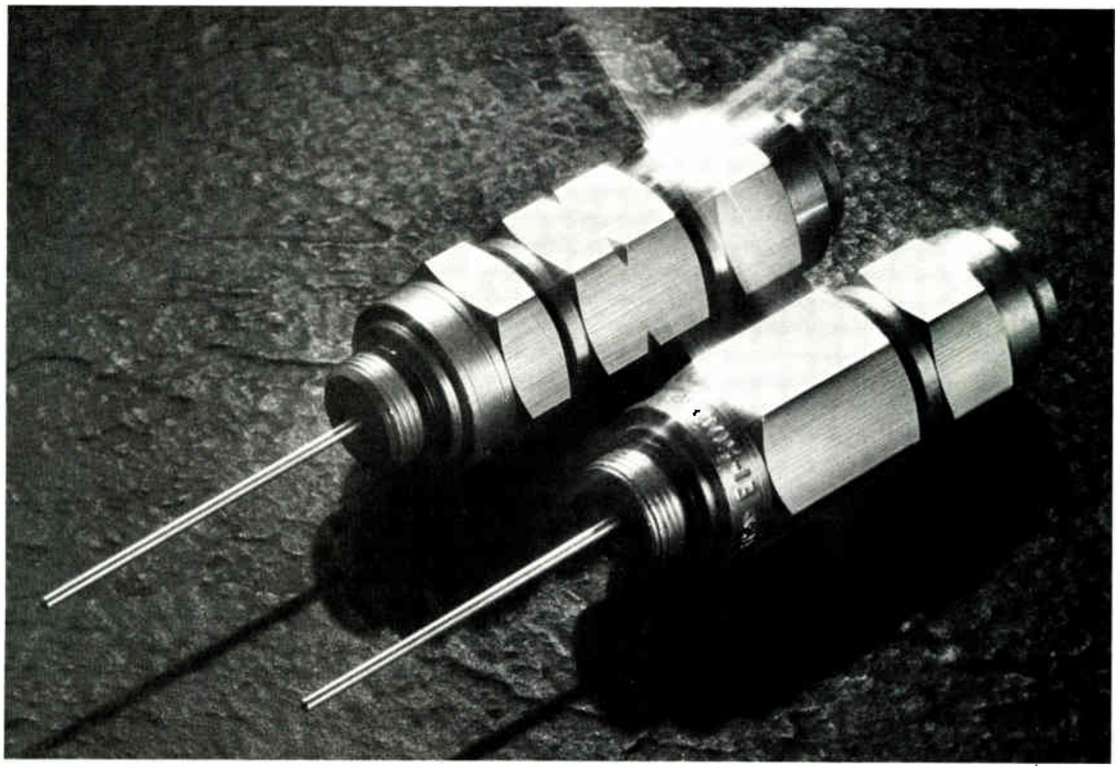

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The changing role of European cable

This month, as I sit and write this column, it is my pleasure to be working in a hotel room in Montreux, Switzerland, a small, beautiful village directly on Lake Geneva about an hour from the city of Geneva. Needless to say, I am here for work, not play (not bad duty if you can get it). I am here as part of a 26-person planning group representing more than a dozen countries who get together to plan one of the television industry's major international events.

We meet for two days to finalize the 1989 program for the oldest and most prestigious international television technical event in the world, the 16th Montreux International Television Symposium and Technical Exhibition, which is scheduled to take place between June 17 and June 22 1989. The ITS is only held in odd years, but the planning effort for an event of this type spans two years. When the exhibition is in full swing, more than 30,000 people will visit the exhibitors and more than 2,000 will attend the technical sessions.

Cable's role has grown

When I first became involved in the symposium in 1981, the cable side was highly professional and very well done. But, by anybody's reckoning, it was small and clearly played second fiddle at this prestigious event.

This is understandable, since cable was just getting started in Europe and had not had time to mature. But over the last eight years, I have seen the cable television side of Montreux become increasingly important. At the last event (in 1987), the proceedings, which are broken down into two books (broadcast in one and cable in the other), the cable book was slightly heftier and, in my mind, contained eminently readable and quotable reference papers.

Through the work of the Montreux Symposium management, with Professor Kaiser of the University of Stuttgart as the CATV chairman and Walt Ciciora and myself representing the United States CATV industry, I believe we have once again put together a nice program for the 16th ITS. My initial reaction to the program is that the proceedings will be first class.

Gaining momentum

One of the things I find most interesting about the entire event is the slow but very steady growth of U.S. and Canadian cable interests in this part of the world. When I say this part of the world I don't just mean Europe, because this being the prestigious event it is, there are delegates from the U.S.S.R., China, several African nations, the Middle East, South America, Australia, India and more. In fact, at the last symposium I was struck by the number of representatives from emerging African nations. But there is a reason for this.

Television is a very powerful medium. That power is one of the things that is recognized early on in any country. Up until now, television has only been available by broadcast entities. There is a growing realization in many countries that cable television is not only a possible alternative medium, but in fact, may be a better alternative.

Quite a few of the exhibitors will be American companies that do business with the emerging cable industry in this part of the world. Going from booth to booth at the exhibit hall, a number of engineering executives that you would immediately recognize on the floor of the National Cable Show, are looking at equipment displayed in this symposium.

The European market

If you've followed the trade press lately you also know that they are not just looking at equipment in Europe. In fact, they're looking at systems in Europe. Quite a few American MSOs have recently engaged in joint ventures or outright purchases in several European countries. From close scrutiny of the American cable industry you get an interesting perspective of the potential for cable in other countries. In this country, at least, the citizenry would not long tolerate any government ownership of the media, yet in most of the rest of the world this is the norm.

When governments own the broadcast stations they seem reluctant to allow cable operations, or at least it seemed so just 10 years ago. But in those 10 years there have been dramatic and what will turn out to be historic changes in this pattern. Where there was only government-owned television there is now private commercial television. Where cable systems were not even contemplated there are now city-wide franchised, joint ventures with American companies and outright ownership by American companies of cable systems.

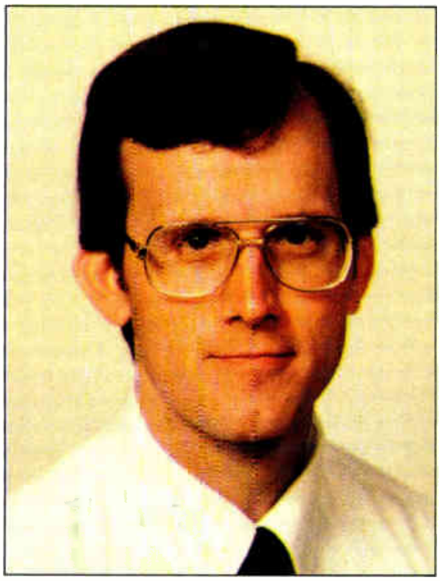
Important questions

It's almost as if cable is an idea whose time has come, that it is a persuasive force for change in the media. And while Americans may have become used to this plethora of television options, in the rest of the world, one or two channels for only part of a day was normal fare. The questions that we should ask is, "How will the introduction of American or Canadian style cable television impact the media structures in these countries? Will the people in these countries pay for television like people in America have or will they reject these types of services?"

While cable is working on these issues in Europe, the governments are putting money and efforts behind DBS services. Indeed, several countries are banding together to put up one or more satellites to provide DBS channels to citizens on the continent and in the U.K. How will this competition affect the new European CATV industry?

This may be a useful glimpse of how this type of competition will affect our industry. Pay attention to how CATV is developing worldwide. It could provide a look at the future. ■

By Wendell Bailey, Vice President Science and Technology, NCTA



Preemphasis and deemphasis

Twenty columns ago (yes, believe it or don't, this is "From the Headend" No. 21), back when CED's editors and I were discussing the content and format of this column, we stated as one of our goals that we would try to provide a service to CATV engineers and technicians—some of whom had no formal training in electrical engineering—to help them advance their careers through improving their knowledge of the basics (i.e. SCTE certification). To that end, we have tried to maintain a delicate balance between the practical, more glamorous topics and the more mundane theoretical ones, while always concentrating on topics that are easily digestible.

The subject of emphasis in FM systems is another of those topics that may not seem glamorous or important, but, in fact, is a key contributor to the success of CATV systems. After all, emphasis is used in FM video and audio transmission over-the-satellite, TV broadcast audio, as well as in FM radio broadcasting.

Why it's needed

The need for preemphasis and deemphasis in an FM system results from the inherent noise characteristics of FM demodulators which produce an output noise voltage spectrum that is triangular in nature. In other words, if white noise (equal amounts of noise at all spectral frequencies) was applied to an FM system and then demodulated, the output noise voltage from the FM discriminator (demodulator) would rise linearly with frequency. At low output frequencies, there would be very little noise contribution at the output of the demodulator, but at increasingly higher output frequencies, an increasingly larger noise contribution would be expected. The *amplitude* of the noise voltage from the discriminator output is therefore proportional to the input *frequency* of the noise.

One problem with such a triangular noise characteristic is that the higher frequency components of any message signal (audio for example) that we are trying to transmit through the FM system become unnecessarily contaminated with excessive amounts of noise at the output of the discriminator. And unfortunately, with audio as well as video, since the higher frequency components of the information tend to be the most delicate, such additive high frequency noise shows up quite readily.

Counteracting the noise

Long ago, after evaluating the problem, someone came up with the idea of reducing the noise at the output of the discriminator by following it with a simple single-pole low-pass filter that would counteract the discriminator's rising output noise characteristic. The net result being a noise spectrum that is very nearly flat with increasing frequency. There is a slight problem with this approach however, because placement of a low pass filter following the discriminator also filters the message signal (audio or video), rolling off its higher frequency information. This is an obviously undesirable situation.

The solution to this dilemma is to "preemphasize" the audio or video information by passing it through a preemphasis filter prior to transmission on the FM system. The preemphasis filter must have the reciprocal characteristic to that of the deemphasis filter.

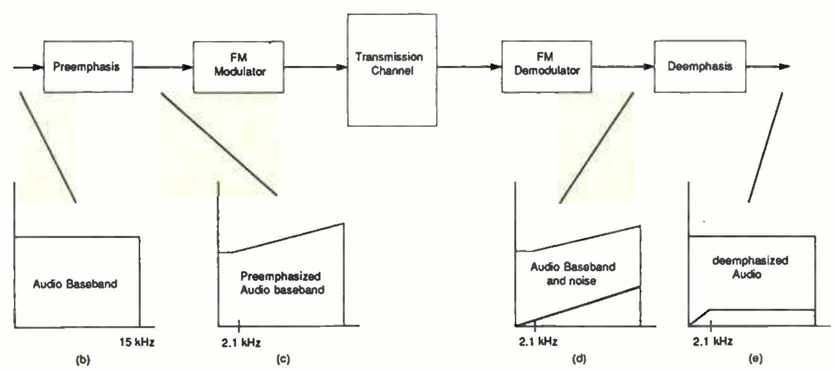
A schematic representation of the functions of preemphasis and deemphasis for TV audio (non BTSC) are shown in the figure below.

The "noiseless" 15 kHz audio baseband signal (b) is first applied to a 75 µsec preemphasis network. This network emphasizes (boosts) those frequency components above about 2.1 kHz (c) before being applied to the FM modulator. (More specifically, 2.1 kHz is the point at which the input signal is boosted 3 dB above its nominal input level.) As the FM signal makes its way through the transmission channel it is contaminated with white noise before arriving at the FM demodulator.

Faithful reproduction

With any luck, the output of the FM demodulator is then a faithful representation of the *originally preemphasized* audio, but contaminated with the FM demodulator's triangular noise contribution (d) resulting from the white noise present on its input. As a result of deemphasis (e) however, the audio signal is returned to its original condition, and the triangular noise contribution of the FM demodulator has been reduced considerably.

Note that while the use of emphasis networks is considerably more complex for FM *video* over-the-satellite, the concept is similar to the above. ■



By Chris Bowick, Engineering Dept. Manager; Scientific-Atlanta

Must-carry politics

Textbooks on civics and American Government don't always make clear just how complicated the legislative process can be. Consider, for example, the issue of "must-carry" requirements for cable operators. Broadcasters want a rule that requires cable operators to carry local broadcast stations on their systems. Congress seems to think that's a good idea, too. And the cable industry has made clear that it's willing to accept a reasonably crafted must-carry rule. But there's no must-carry rule today and no must-carry legislation was even introduced in the last Congress.

Never been codified

There's never been a must-carry *statute*, but until 1985 there was a must-carry *rule* imposed by the Federal Communications Commission. That rule required cable operators to carry virtually all local and nearby broadcast signals, including, in some cases, multiple affiliates of the same network and marginal stations that almost nobody watched. A federal court held, however, that the must-carry rule violated the First Amendment rights of cable operators to exercise editorial discretion in selecting the services and programming to be carried on their systems.

By Michael Schooler, Deputy General Counsel, NCTA

According to the court, the all-inclusive rule was far broader than necessary to achieve the FCC's objective of preserving local broadcasting.

Soon thereafter, the cable and broadcast industries reached agreement on a new, less restrictive must-carry rule, which they jointly proposed that the FCC adopt. The compromise proposal imposed a ceiling on the number of local stations that had to be carried. And it provided that, to qualify for must-carry status, a broadcast station would have to meet a viewership standard, so that signals with minimal viewership in the cable community would not have to be carried.

The FCC adopted a rule that essentially embodied the industry compromise, while adding some carriage requirements to protect public broadcasters and new stations. But in 1987, the court again held that the FCC had failed to come up with a rule and a rationale that passed constitutional muster. With that, the FCC basically gave up and the broadcasters turned to Congress for help.

But the FCC had, with some other actions, made it difficult for broadcasters to get any relief from Congress. During the Reagan era, the FCC had embarked on a fairly successful course of substantially deregulating the broadcast industry. Congress was particularly opposed to the FCC's elimination of regulations regarding children's television. And it hit the ceiling when, last year, the FCC repealed the fairness doctrine—the rule that required broadcasters to present opposing viewpoints on controversial issues. Before Congress would agree to consider helping the broadcasters with must-carry legislation, it wanted to reinstate the fairness doctrine and to reimpose children's programming requirements.

White House monkey wrench

For a while, it looked like it would accomplish both objectives. With respect to children's television, the broadcasting industry was willing to live with—and Congress enacted—a bill that limited the amount of commercial time on children's programming and that would have required the FCC, in license renewal proceedings, to consider the extent to which broadcasters served the special needs of children. Despite broadcaster resistance, Congress also enacted legislation reinstituting the fairness doctrine.

Once these requirements were reimposed on broadcasters, Congress probably would have been willing to listen to broadcasters' requests for a new must-carry law. But the White House threw a monkey wrench into the plans. President Reagan offered the broadcasters some unwanted help by vetoing both bills. According to the President, both bills raised serious First Amendment problems.

In fact, each of the bills did raise First Amendment issues insofar as they sought to restrict the editorial discretion of broadcasters. But the Supreme Court has generally tolerated more content regulation of broadcasters than of other media because of their use of scarce spectrum. Indeed, the Court actually upheld certain aspects of the fairness doctrine 20 years ago, although it has hinted lately that it might be willing to reconsider that decision. So, it's not that the President was vetoing laws that he knew would be overturned in court; it's that the administration disliked these laws as a matter of policy. But in pursuing its deregulatory policy objectives, the administration dashed broadcasters' hopes of obtaining any must-carry relief in the 100th Congress.

Looking to the future

Whether they will fare any better in the 101st remains to be seen. Congress remains adamant about reinstituting the fairness doctrine and the children's broadcasting requirements. In fact, a fairness doctrine bill was introduced in the House of Representatives on the very first day of the new session. Meanwhile, the broadcasters' opposition to the fairness doctrine seems to be hardening. And President Bush has previously indicated his own opposition to the fairness doctrine.

In a January speech, Jim Mooney, NCTA's President, made clear that "the instant we get the signal from Congress," the cable industry will be "willing to sit down with the NAB and the National Association of Public Television Stations, and work out a way to put what everybody agrees was a workable rule back into force, this time on the statute books, this time with a Congressional mandate."

The broadcasters want the rule put back into place, and they and the cable industry now have to wait for Congress to decide when and whether to give "the signal." ■

Reader Service Number 8

Who trains who in what?

I have previously expressed in this column my belief that it is critical that the cable industry find ways to better utilize the labor component of its business. For technical management, this means focusing especially on the drop and house wiring, the most labor-intensive parts of our systems. We need new materials and procedures which will make our drops, as well as the rest of our systems, more forgiving, requiring less training and labor.

That is an important goal, and even partial achievement could save us many millions of dollars each year. Nevertheless, we will never reduce the complexity of our systems to the point where training is not important. It is worth examining how we do training presently and explore some ideas as to how it might be better structured.

Training history

Training has two basic historical models. First is the classical small CATV system. In such systems, the general manager was also often the chief technician. He (almost always "he") might have a couple of installers and a technician or two working for him, in addition to a tiny office staff. In this setting, everyone, including the boss, had to be flexible and able to do most anything that needed to be done. There was plenty of communication about what was happening in the system; lots of feedback. If things didn't get done right, everybody knew about the problems that came along. If contractors were used at all, it was in new construction and the work was usually straight-forward.

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

Classical cable systems were quite forgiving. They rarely carried more than 12 channels, and customers were relatively undemanding (they had little choice if they wanted television reception).

This model actually worked fairly well. Communication was good, training was informal and never really stopped. Perhaps most important, a technical employee's boss actually saw his work and gave him feedback about it, discussed various aspects of his work daily, and generally let him know that he was paying attention and cared. In a sense, the system manager was also the line supervisor and the company trainer.

The advent of MSOs

The second training model became more common as ownership began to concentrate in the hands of multiple system operators (MSOs). These companies began to operate many systems, some of them fairly large. There was increasing specialization, and a system manager tended to be more business-oriented than technical. Thus, as the industry centralized into MSOs and grew larger, the traditional, informal means of training and supervision began to break down.

This was clearly seen by engineering and operations staff people in the expanding MSOs, and they began to seek ways to substitute formal supervisory and training structures. These MSOs were generally relatively centralized. It was natural that there was an attempt to centralize training. A variety of approaches were tried, utilizing correspondence courses and training centers where new employees were sent. There was still on-the-job training at the system level, but rapid growth and the increasing use of installation contractors made it difficult to keep up with the need.

In many cases, the critical link between supervision and training had been broken, with training the responsibility of either a system training manager or training staff in some far-distant location. The feverish pace of growth, and the ever increasing thirst for cash-flow have kept much of the industry from ever really catching up. In addition, frequent changes in system ownership made it difficult to focus on training.

Much of the cable industry is now beginning to settle into a steadier operating mode, hopefully with a longer-term outlook.

While there are exceptions to the pattern outlined, I would submit that much of the industry still has a long way to go in seeing that its field employees, and those of its contractors, are well trained.

Mistakes cost millions

Clearly, we are spending millions of dollars because the installers who do the original work on drops and home wiring don't do it right the first time. We spend additional millions because the service techs who respond to calls from the resulting angry customers too often do not *fix* things right the first time. If we look closely, we will find a significant portion of the work done by our expensive line technical employees could be prevented. This will mean some drop in front-end productivity, as doing it right takes a little more time. The rewards, however, are great.

I believe the way to approach this training challenge is to translate the rather tightly knit teamwork structure of cable systems of an earlier day into today's context. I'm appalled when I find one line supervisor overseeing the work of 20 or 30 installers or technicians, whether they work for the cable company or for an installation contractor. He is not going to be able to examine the work of his subordinates and provide them with any meaningful feedback, so employees will continue to do things wrong, either out of ignorance or because they have gotten the clear message that no one cares very much about their work.

We need to develop an attitude which says an essential part of supervision *is* training, which translates into supervisors having small enough groups that they can truly supervise and train. Additionally, these supervisors must not simply be senior installers who wind up doing all the "tough" jobs; they must be trained in *how* to supervise and train. This requires commitment and effort on the part of system and engineering management. ■

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Further fiber discussion

In reply to Mr. Bias' letter ("Return Path," *CED*, February 1988, p. 25), his assumption that the four-amplifier cascade was trunk and not distribution is due to an error of omission by me. If the fiber system worked like a conventional system, Mr. Bias would be correct, 480 subscribers could be served.

But that is not the case. The four-amp cascade is distribution amps and the maximum cascade following the fiber system is only four units, with or without line extenders. In fact, line extenders would quite probably limit the cascade to just two or three units.

Another error I made was (generously) allowing 2,000-foot spacings for the amps. Realistic spacing should be closer to 1,300 to 1,600 feet, depending on total channels carried. According to Mr. Bias' drawing, the distribution amps are 900 feet apart. If we use those numbers, that means 3,600 to 4,200 feet for the maximum cascade length, or 47 subscribers at a cost of more than $300 each for electronics only.

Also, each fiber to the coax interface is loaded with just 16 video channels, which means stacking two receiver/amplifiers for 32 channels, three receiver/amplifiers and a three-stage electrical (RF) mux for 48 channels etc., all at the same location. This requires additional power, additional engineering for physical load, and more than doubles the failure-service-maintenance problems at each interface location. That means an electronics (only) cost of $9,000 to $15,000 per interface location for 48 channels. The interface units are quoted at $3,000 to $5,000 per 16-channel unit.

The cascade length (four amplifiers) is based on data supplied by SaskTel (Saskatchewan Telephone), and AT&T (through Northern Telecom), acquired by actual field operational results of the system for a period of almost two years. Ortel stated that its system was comparable.

Unacceptable deterioration occurred beyond the four-amplifier point, which is another "argument" against that type of system for "last-leg" or local loop usage. That type of system cannot be justified for other than an R&D project.

As for the process of using optical splitters and feeding several hubs off one fiber, the analog systems depend on high signal strength margins to avoid some of the problems mentioned later on in this article. This makes a multiple hub cascade highly questionable both technically and economically.

A switched system does seem the only realistic approach, but we must remember that a typical subscriber (according to EIA) has between 3.2 and 3.7 TV sets. Therefore, any switched system must have that many channels available at all times, plus, whatever is required for the 1.5 (approx) VCRs. A total of five to seven channels should be available to the subscribers at all times.

The major home video manufacturers say there is no problem adding an optical interface board (receiver/switch) in each VCR or TV set.

By including the card in each device, we would approximate the existing "cable compatible" coax system we are familiar with. By adding some "brains" to the card, we would have the capability of authorizing for each unit.

Gary Moore
Consultant

A grateful honoree

I'd like to thank the staff at CED for the great honor of being chosen the 1988 Man of the Year. I'm quite overwhelmed by all the nice things you said about me, and all of the ads from friends in the industry. While I'm deeply honored, it's important to realize that ATC's accomplishments have been very much a team effort. Nevertheless, I'm very pleased at the recognition represented by being chosen CED's Man of the Year.

I look forward to working with all the folks at CED in the future.

Jim Chiddix
Sr. VP Engineering and Tech., ATC

CLI game rules

I wish to comment on some of the points both stated and implied in the article "Advancements in CLI Flyovers" which appeared in the February 1989 issue of *CED*.

To begin with, the label CLI is often associated with the flyover test, but incorrectly so. To clarify, the flyover is a direct measure in the airspace over the system of the actual leakage field intensities, whereas CLI refers to a calculated index which serves to predict whether leakage fields would exceed some threshold level (10uV/m @ 450m) in the overlying airspace.

Regarding types of measuring antenna, the goal of the flyover is to scan the entire service area of the cable system with sufficient resolution to allow determination of leakage levels over every portion of that area. To this end the test flight normally consists of a series of parallel tracks uniformly offset from one another. Thus, the sense antenna is normally mounted longitudinal to the flight path so as to make it sensitive to leakage sources located between as well as directly under the flight track.

The author's concern with a null directly fore and aft in this configuration seems to overlook the obvious. As the aircraft progresses forward on a track, a leak source that may have been in the forward null will be within the aperture of the antenna as the aircraft passes over it.

I would also take issue with the gain pattern depicted for this type of antenna installation. The tri-lobed plot that was shown is characteristic of a horizontal dipole separated more than ½ wavelength from a reflecting surface. While match impedance and gain can be expected to change, the pattern for such an antenna when the spacing is varied between ⅛ and ¼ wavelength is relatively unchanged.

Position data supplied by a LORAN-C receiver is used in a flyover to provide a record of the flight path thus allowing any leakage measurement to be correlated to specific location of observation. The accuracy here exceeds that obtainable by human observation at 1500 feet above ground level regardless of any improvements in visibility in a particular direction.

It is important to go back to the basic purpose of FCC Pt. 76.611, that being an annual proof or snapshot of system leakage integrity. Neither the ground-based CLI nor the flyover test were instituted with the goal of finding leaks. That is the specific intent of Pt. 76.614, the quarterly monitoring rule.

The stakes are indeed very high in this issue and it is imperative that we all have a clear understanding of what is required to play the game under the "new rules."

Chris Duros
CableTrac Inc.

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Reader Service Number 10

Switched-star fiber optic architectures for cable TV

Despite the tremendous progress of cable television during the last 40 years, the vast potential of broadband communications technology remains largely untapped.

Few doubt that tomorrow's cable television distribution system must be designed to cost-effectively handle an expanded number of channels, deliver new broadband services and operate at higher performance levels. The uncertainty lies in how far we need to go, how fast and just plain *how*.

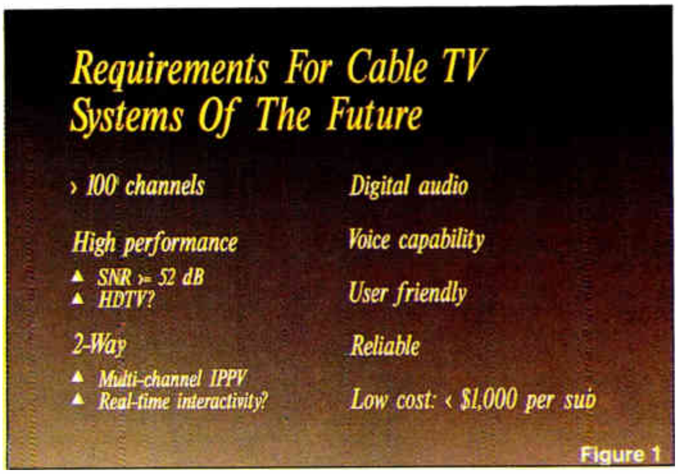

Figure 1

The combination of fiber optic technology and switched-star architecture offers many possibilities—and many traps. Complicating the layman's analysis are assertions by popular business journals that "fiber is magic stuff" and Washington advocacy groups *starting* with the objective of promoting deployment of switched-star, fiber-to-the-home broadband communication systems.

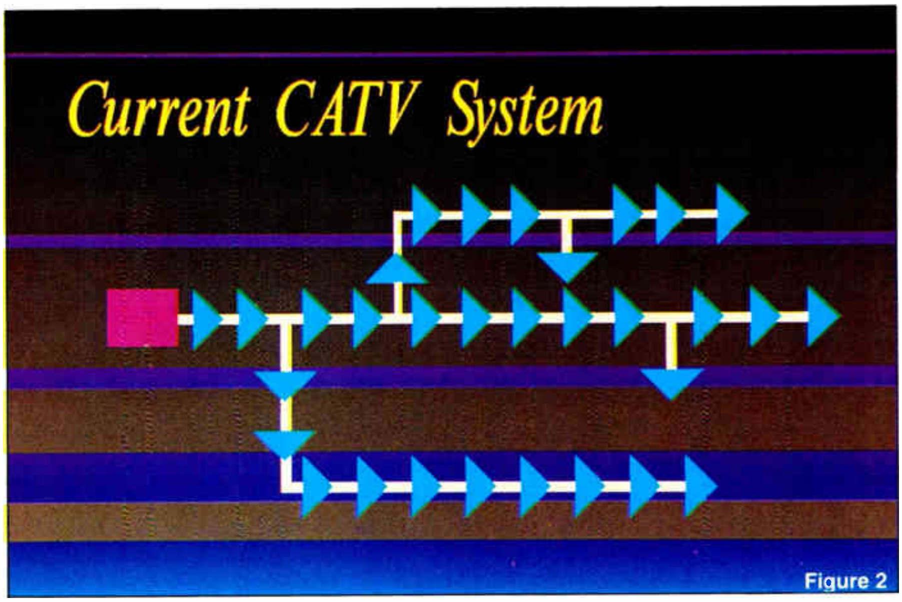

Figure 2

By separating the political nonsense from the key factors of consumer demand, technology and economics, we can minimize uncertainties about the future role of fiber optics and switched-star architectures. This analysis focuses on the likely service, performance and cost requirements for cable television systems five to 10 years in the future. Assessed relative to their ability to satisfy the cable operator's plant requirements during that time frame are three switched-star architecture variations.

By David Robinson, VP/New Business Development, Jerrold division of Gen. Instr.

Future requirements

Figure 1 is an outline of the likely requirements for the cable TV system of the future. When contrasted to the current coax tree-and-branch cable architecture outlined in Figure 2, the areas requiring further development become clear.

For those who think 80 video channels available through existing 550 MHz RF distribution electronic products will be enough forever, we direct you to cable TV veterans who remember when five channels seemed more than sufficient.

Likewise on picture quality performance standards. Today's improved definition NTSC sets quickly reveal the limitations of cable systems designed to older signal-to-noise ratio (SNR) standards of 43 dB or so. And if HDTV becomes a consumer reality, greater system bandwidths will be required. An end-of-line SNR performance of 52 dB may not even be high enough.

Multiple channel impulse pay-per-view services using store-and-forward technology have only recently unlocked the revenue potential of two-way coaxial cable systems. The future of real-time interactivity requirements remain a large question mark. None of the many attempts at broadband videotext have yet proven successful and true videophone and video-on-demand services still look unwieldy.

It now appears probable that digital audio entertainment services will play a part in cable TV systems of the future. To allow at least a response to competitive threats, it is likely that future cable TV distribution systems will need some level of voice service capability as well.

To serve consumer needs efficiently, the system must be user-friendly, reliable and cost something less than $1,000 per subscriber to build.

The current coax tree-and-branch cable TV system architecture is often unduly maligned and vastly underrated. At a construction cost of less than $500 per subscriber, the cable

operator can have a user-friendly two-way plant delivering 80 video channels, impulse ordering capability and digital audio into each subscriber home.

Fiber optic trunking is now being used to improve coax systems.

Telco switched-star

The first switched-star variation is the architecture used effectively during the last century for narrow-band telecommunications. By substituting a broadband single mode fiber all the way to the home in place of old twisted copper pair lines and employing a standardized transmission scheme (B-ISDN), some proponents assert cable TV, as we know it today, will be obsoleted. Figure 3 illustrates a double-star version of this architecture.

The estimated cost of the few telco fiber-to-the-home trials that include cable television services is $15,000 to $20,000 per subscriber. Even at volumes similar to today's RF electronic cable TV systems, the cost of a digital, switched fiber-to-the-home broadband-ISDN system will likely exceed $3,000 per subscriber five to 10 years in the future (see Figure 4).

The biggest problems are with the capacity limitations of broadband switching and digital transmission systems. Full motion video requires a tremendous amount of information to digitize (over 100 mb/s uncompressed for a single NTSC channel; typically 45 mb/s compressed). The bandwidth hunger for digital transmission is about 10 times that of amplitude modulated video. Since the consumer TV receiver requires an AM input, costly conversion equipment is needed at both the headend and subscriber locations. All this adds up to more terminal equipment, more glass and too much expense.

Such a system denies consumers simultaneous and independent channel selection at *all* TV and VCR sets. Just as with telephone service, this architecture in its purest form forces the consumer to pay for additional lines to access more than one program at a time. And busy signals for TV?!

This architecture variation is ideal for plain-old-telephone service (POTS) but is too much of a force-fit for broadband cable TV. It is architecturally inefficient except for the real-time, low data rate interactive services.

Small hub

The second variation (see Figure 5) includes an Alameda, Calif. system deployed during the early 1980s specifically for cable TV. The system links a coax trunk to a series of relatively small neighborhood hubs where LEDs convert the analog RF electronic signals to optics for transmission to subscriber homes via multimode fiber. Systems with this architecture recently were deployed in France and by Bell Atlantic in its Perryopolis, Pa. test.

The many problems of these particular systems are well documented (see Figure 6). The use of LEDs as the light source and multimode fiber as the optic transmission medium drastically limit the bandwidth/distance capability. Performance is further limited by use of a coax trunk (counter to most current deployments of fiber optics in broadband tree-and-branch systems). Digital audio services are typically not employed and difficult to add because of the system capacity limitations. User friendliness problems exist similar to those of the telco switched-star variation already described.

An Alcatel representative from France described the 90-home Perryopolis system during an Atlanta conference in October 1988. The system

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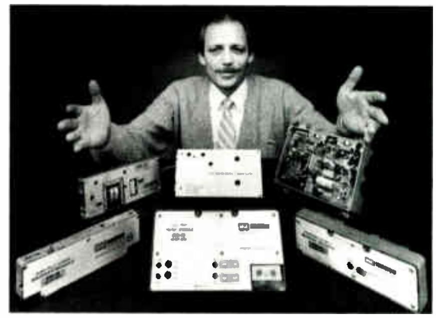

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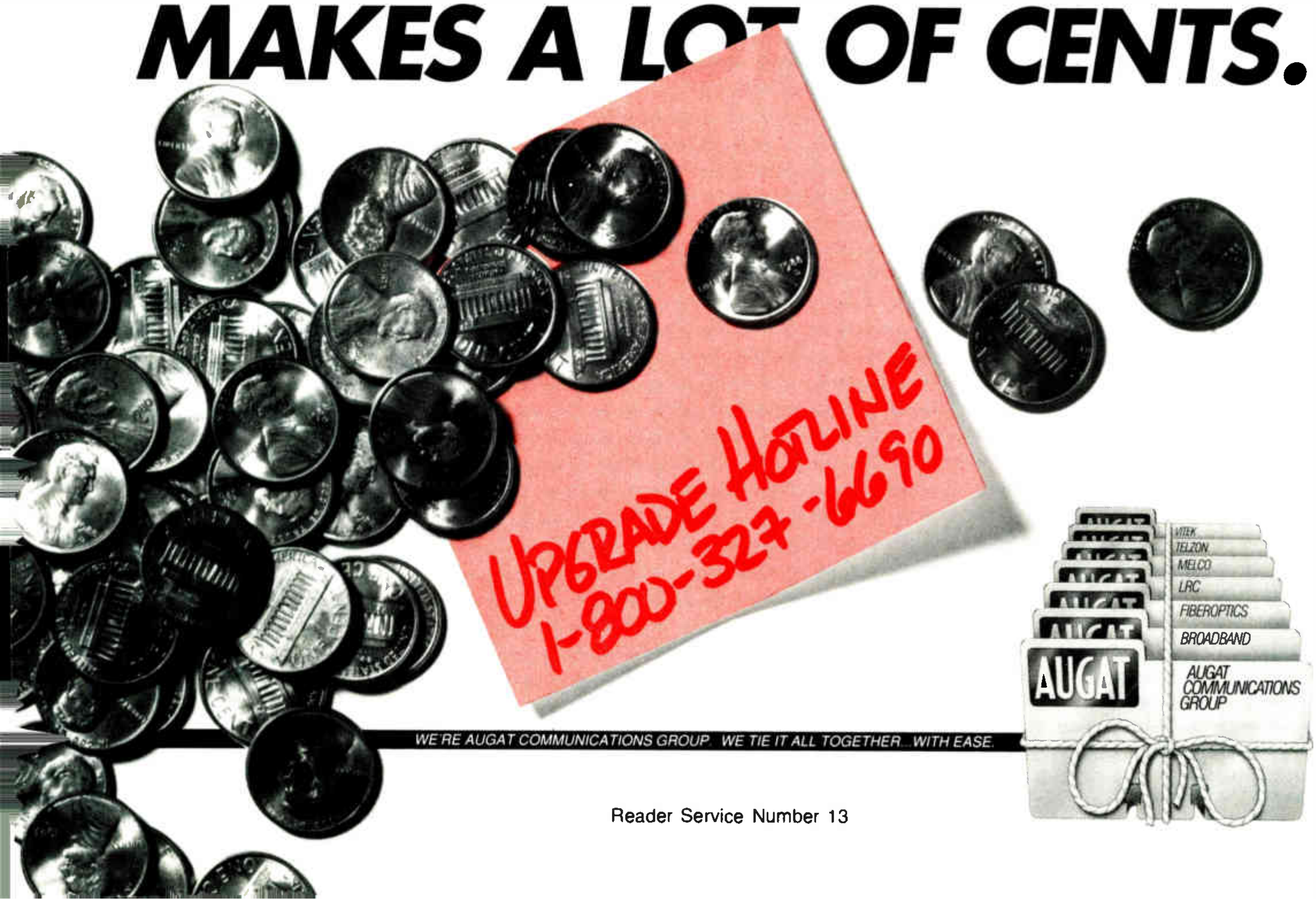

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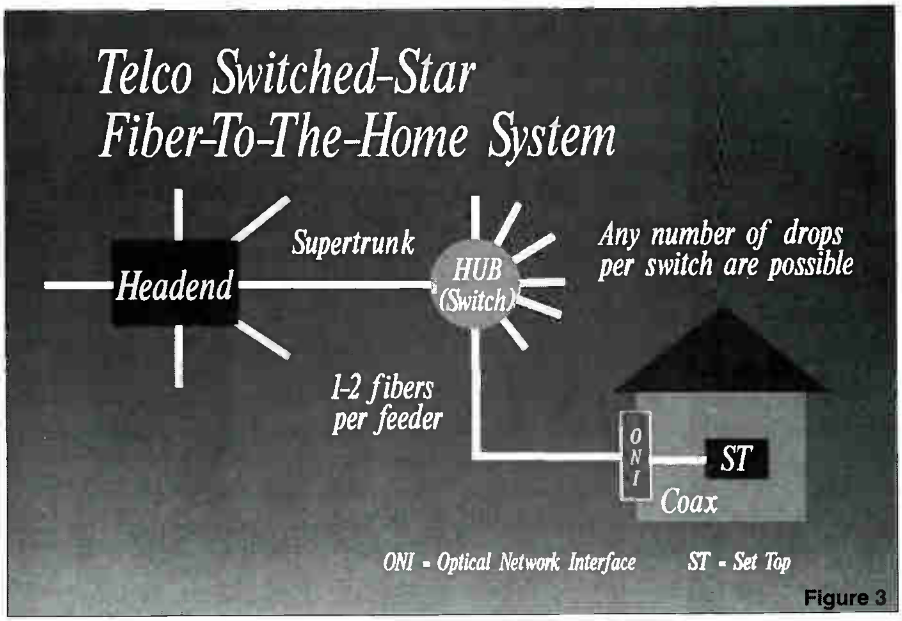

Figure 3

Figure 4

Figure 6

transmits only 40 AM video channels. Only two of those are simultaneously tunable per household. The signal-to-noise ratio at 48 dB is in the same category of today's all-coax systems. By detailing the mechanical requirements of each neighborhood hub, the extensive real estate requirements became clear. The representative noted that a similar system in France passed about 100,000 homes, achieving only a 10 percent subscriber penetration rate.

Reliability, architecture, powering and real estate problems are clear from U.S. experiences with a small hub-type architecture. The biggest obstacle to future deployment is the limited potential of the technology (coax trunk, LEDs, multimode fiber). Costs are much higher than an all-coax electronic system and performance (other than voice capability) is no better and often inferior.

System K

A switched-star fiber optic system designed specifically for future cable TV requirements provides economic and user-friendliness improvements over

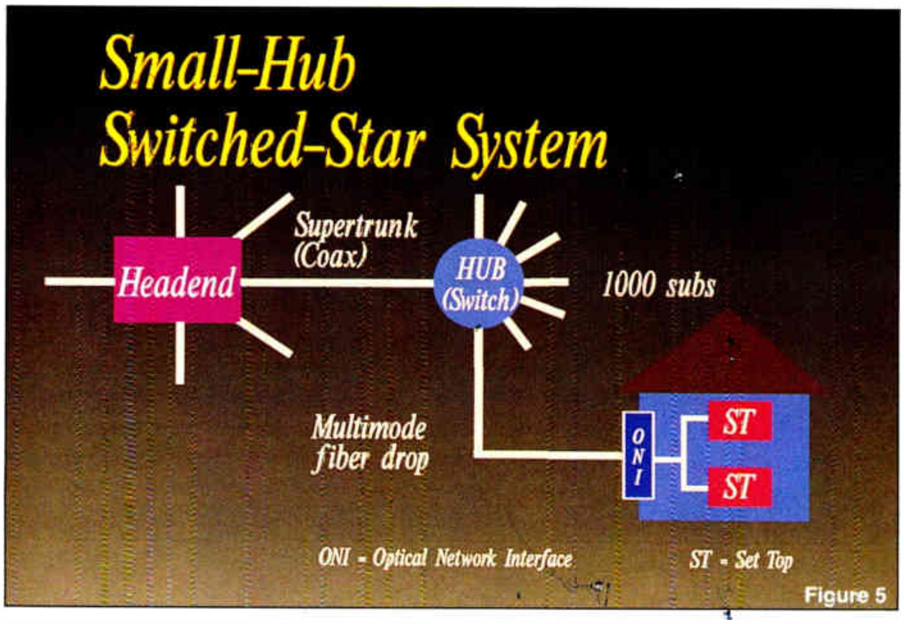

Figure 5

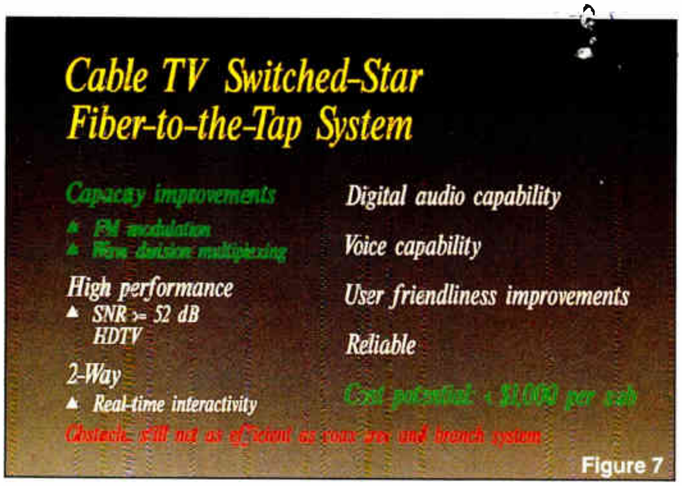

Figure 7

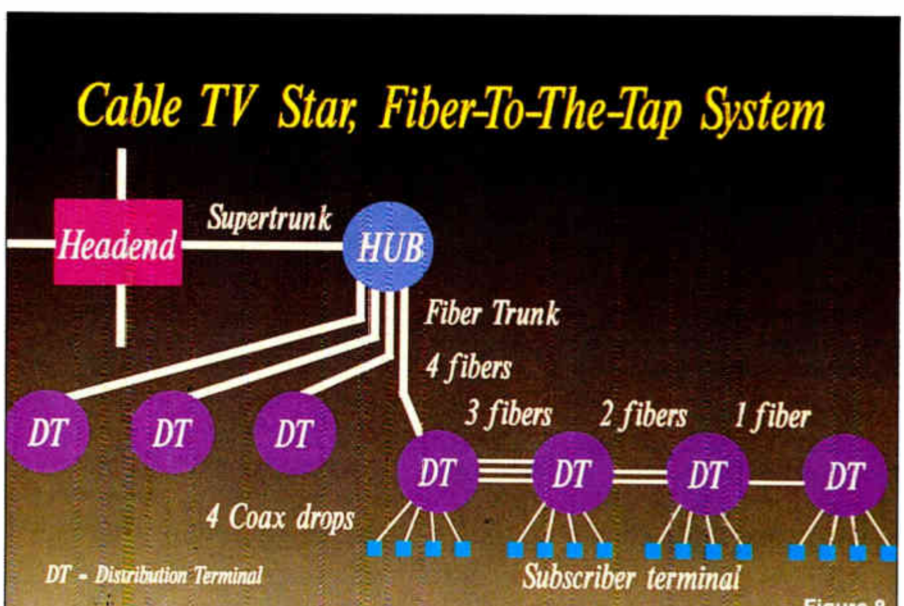

Figure 8

the telco B-ISDN and cable TV small-hub systems without unduly sacrificing performance or reliability. This final architecture variation (Figure 7) extends single mode fiber from the headend to a simple optical-to-electronic tap. It then uses the existing cable TV drop as the broadband pipe into the subscriber's home. FM transmission and wave-division multiplexing further improve the basic switched-star architecture capabilities (Figure 8).

There should be no need to extend fiber beyond the tap for a cable operator with a perfectly good coax drop capable of carrying 1 GHz or so of bandwidth into the subscriber home. A fiber taper plan allows conservation of glass instead of spending for multiple dedicated lines from the headend/hub to every home. FM transmission provides the required high video performance much more cost-effectively. The headend employs advanced digital switching and laser technologies.

The subscriber terminal in this case would be similar to proven, low-cost consumer satellite receivers. Wave-division multiplexing allows simultaneous tuning of at least four channels per home with two-way data and voice capability. The simplicity of the line-mounted optical-to-electrical tap is another key element of ensuring system reliability and minimizing cost. Over a five-to-10 year time horizon, a total system cost of below $1,000 per subscriber appears achievable.

Jerrold has constructed a laboratory demonstration of such a cable TV, switched-star, fiber-to-the-tap system. This proof-of-concept has been dubbed "System K" (rejected switched system alternatives analyzed included systems "A" through "I"). Although System K is the most promising of the switched-star, fiber optic architectures, it is not nearly as efficient as coax tree-and-branch for today's cable operator service, performance and cost requirements. It, like other switched-star systems, is unlikely to become viable for volume deployment for cable television applications during the next five years. But five to 15 years in the future, such a system can not be ruled out.

Conclusion

Switched-star fiber-to-the-home systems are architecturally inferior to coax tree-and-branch systems for cable television applications. For the next five years, the cable operator's fiber optic technology focus will be most fruitfully spent in upgrading RF electronic coax plant with high performance fiber optic supertrunk and trunking links. Depending upon market developments, particularly consumer demand for real-time interactive broadband services, switched-star systems may become viable for cable TV applications during a five- to 15-year time horizon. ■

Digital cable audio using adaptive delta modulation

This paper describes a digital cable audio system which is capable of transmitting eight channels of compact disc quality stereo over a standard cable channel. The system audio inputs are generated by CD players and are digitally encoded using Dolby™ adaptive delta modulation. The digital audio signals and control data are time division multiplexed into a pseudo video format for transmission via satellite to the cable system headend. CATV distribution is done using standard headend equipment. The audio signals are decoded and demultiplexed by the consumer premise equipment using a programmable gate array to perform the majority of the digital signal processing functions. Provisions have been made for audio encryption and addressable converter control.

System considerations

Approximately one year ago, the General Instrument Applied Media Lab decided to investigate the potential of digital cable audio services by implementing a system on a trial basis. Completion of the system design and construction was accomplished by the second quarter of 1988. Field trials are now in process. The system was designed in accordance with the following criteria:

1. The system had to be capable of providing at least eight channels of compact disc quality stereo audio.

2. A robust audio encoding technique which is extremely tolerant of errors was required.

3. Provision had to be made for audio encryption in order to allow the service to be offered at a premium.

4. Provision had to be made to deliver data to the customer premise equipment to enable the use of addressable control systems. This data was to be transmitted with its own error detection/correction data. In addition, this test system had to operate with current addressable control system hardware and software to control the customer premise equipment.

5. The service had to be capable of being transmitted over existing satellite and cable links using conventional video processing and distribution hardware.

By John T. Griffin, Anthony M. Radice, Joseph B. Waltrich, General Instrument, Inc.

General system description

An overall system block diagram is shown in Figure 1. A total of eight CD audio channels are digitally encoded. The digitized audio data are then time division multiplexed into a pseudo video signal format which is capable of being transmitted over a satellite uplink using conventional video and RF signal processing techniques. The satellite signal is received at the cable headend and remodulated for transmission to subscribers. The subscriber equipment consists of a receiver which produces a pair of stereo audio inputs to the customer's amplifier.

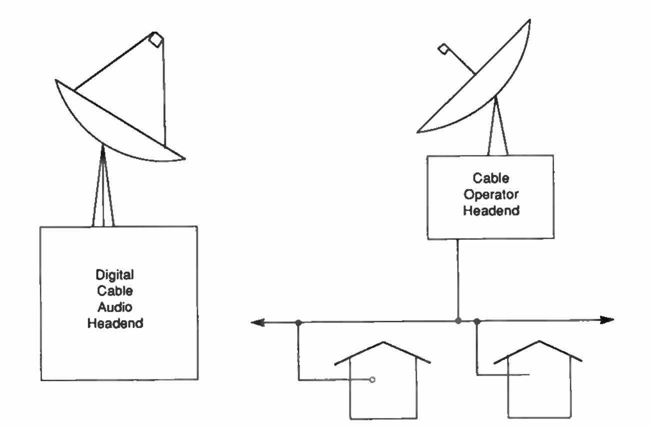

Figure 1. Digital Cable Audio System Overview

A block diagram of the uplink hardware is shown in Figures 2a and 2b. The eight audio inputs are digitized using eight Dolby DP85 encoders. This encoder, which employs adaptive delta modulation, was chosen for the following reasons:

Performance: The Dolby encoder has a wide dynamic range which is particularly well suited for CD audio input. In addition, the unit does not introduce audible degradation in the program material and the use of adaptive delta modulation results in a relatively low bit rate, which facilitates signal compression into the pseudo video format required for transmission.

Tolerance to errors: The use of adaptive delta modulation results in only a slight degradation of audio quality under worst-case error conditions.

Cost: Although the encoder itself is not an inexpensive item, it has permitted the use of a low-cost readily available decoder IC in the consumer equipment. This results in substantial overall cost savings.

In order to better understand the functions of the signal formatting hardware, some understanding of the Dolby encoding process and the pseudo video signal format is necessary. The Dolby encoder inputs a pair of audio signals and digitizes these signals using adaptive delta modulation. The audio is encoded into digital form after the following modifications:

1. The audio is passed through a variable preemphasis network which alters the audio spectrum.

2. The audio is compressed in level, based on its slope.

The encoder output is a single audio data bitstream per audio channel at a rate of 311 Kb/sec. In addition to the audio data bitstream, filter bits (called "step" and "emphasis") are serially transmitted (one each step and emphasis per audio channel) at a much slower 8 Kb/sec. These bits are used to control the adaptive filters in the decoder, thereby reversing the encoding process and recovering the original audio.

The pseudo signal

The pseudo video signal differs from a conventional video signal as follows:

1. The width of the horizontal sync pulse is narrower than the normal 4.5

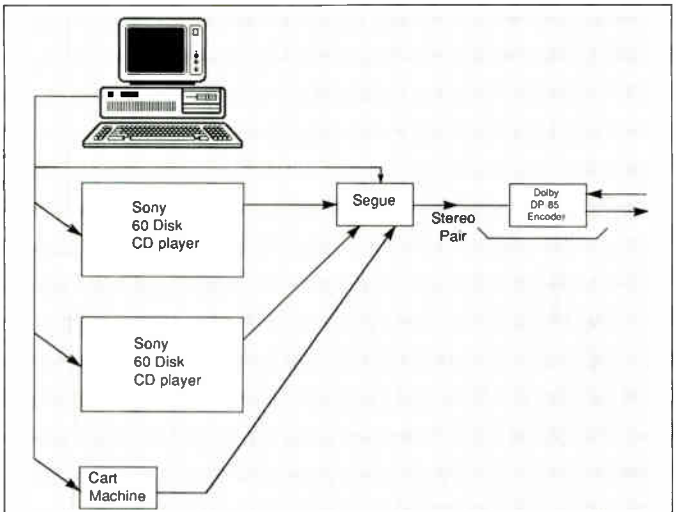

Figure 2a. Single Audio Generation System

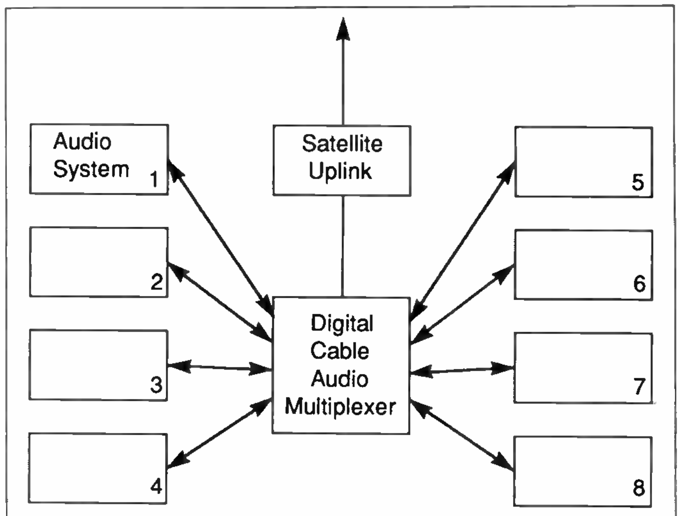

Figure 2b. Cable Audio Headend Configuration

µsec.

2. Following the horizontal sync pulse, there is an eight cycle burst of 3.58 MHz "run-in code" which is used as input to the receiver phase locked loop.

3. There are an even number of cycles of 3.58 MHz per horizontal line instead of the usual 227.5. Consequently, there is no phase alternation of "burst" from line to line.

4. There is no vertical interval and the signal is not interlaced. Frame sync and line count reset are derived from a multiple sample period following the run-in code. This sample period has a unique pattern for one line out of 512, allowing the decoding of a frame sync pulse.

Following the frame sync interval, there is an interval which is reserved for externally generated data. The remainder of each line is occupied by the digital audio data. Each data bit is two samples (140 nsec) wide. The data bits are transmitted as multiple packets of eight bits per packet. Each packet contains one bit from each of the eight channels. Since the receiver audio decoder chip requires the bits to be presented in a pattern, the packets are arranged into the correct order at the output of the interface card.

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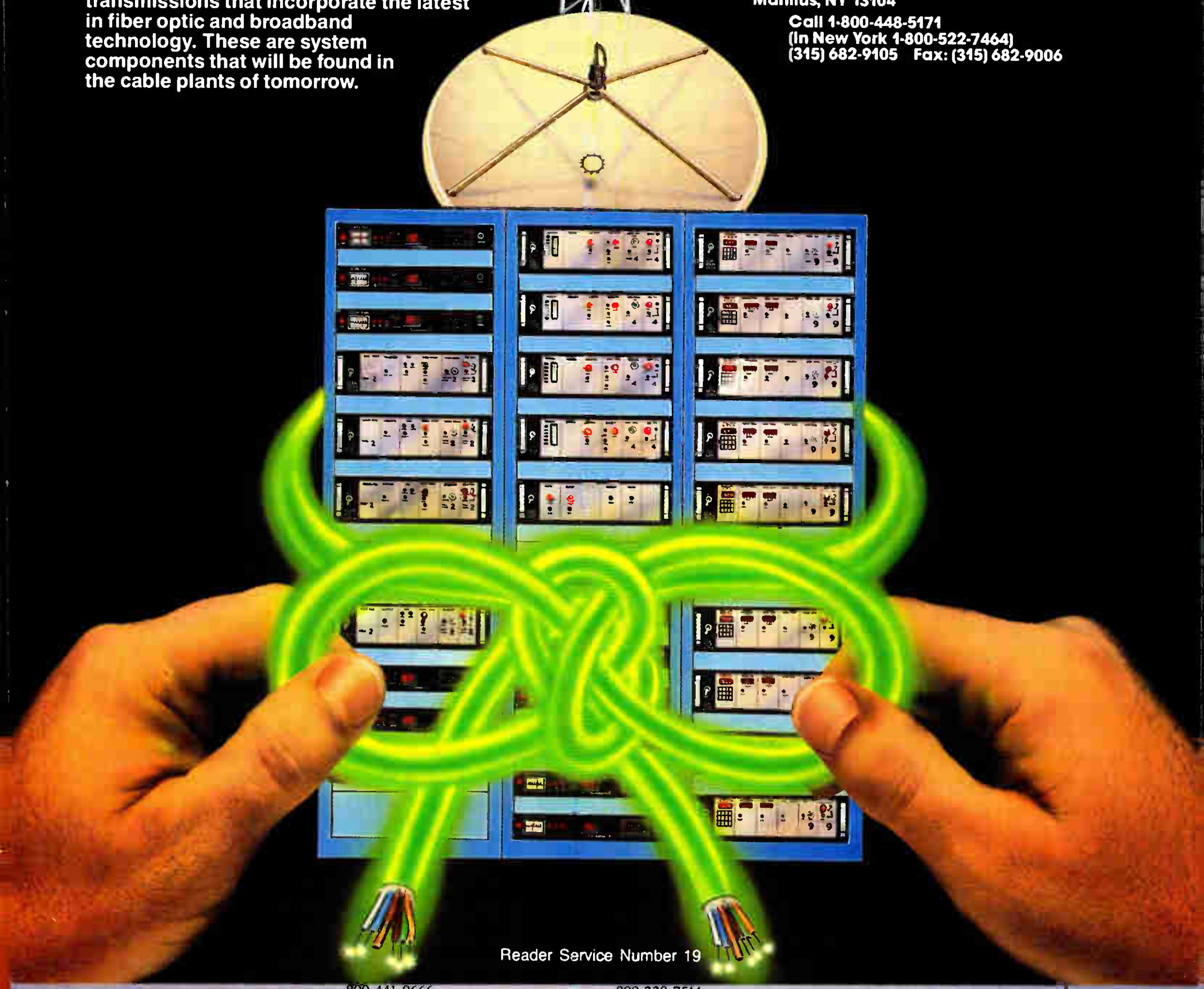

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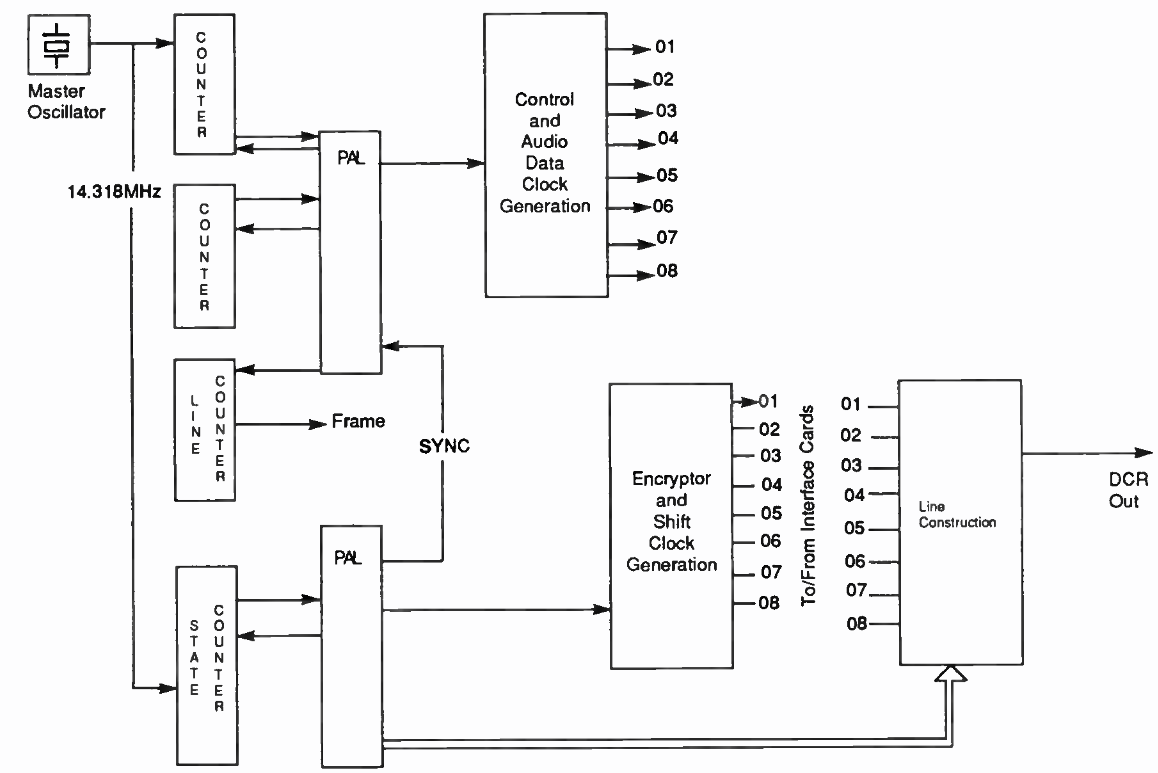

Figure 4. DCA Timing Generation Module

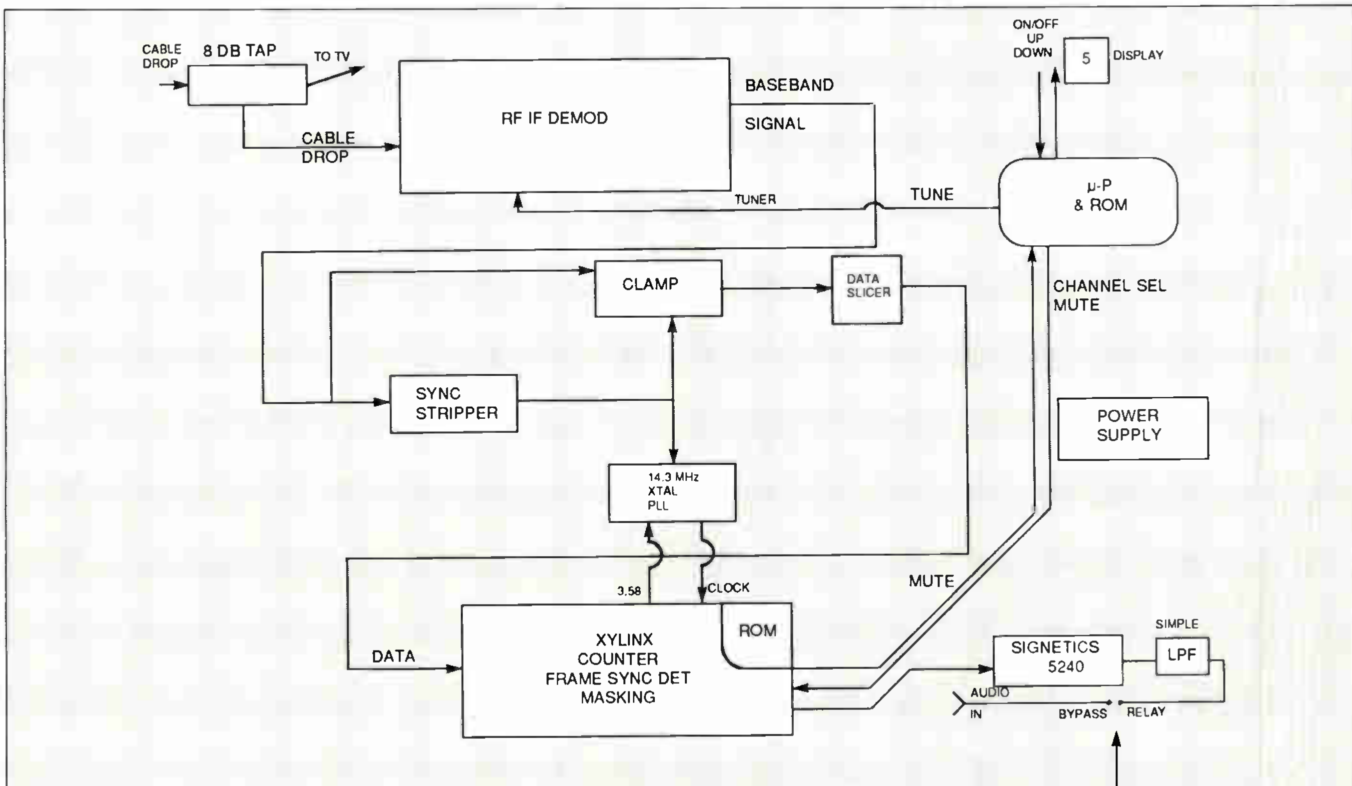

Figure 5. DCA Receiver Block Diagram

and adds the necessary overhead bits to the stream. This is accomplished by two sets of timing circuitry, locked together by both a master clock and hard-wired "Sync" time. One set of logic generates the audio- and control-bit clocks required by the Dolby encoders. These clocks are at 311 kHz and 8 kHz, respectively. These clocks are phased 45 degrees apart for the eight encoders at 311 kHz. These clocks are driven to and through the interface cards to the DP85 encoders.

The second set of timing logic constructs the output line and sequences the serial-out shift registers from the interface cards. This logic operates on a multiple state sequence which first constructs the horizontal sync interval and "run-in code," then allows the insertion of external data. While this operation is taking place, clocks are driven to the interface cards to start encryption logic and set up the output bits for multiplexing together into the output line. These clocks, like the DP85 encoder clock inputs, are phased 45 degrees apart to reduce switching noise in the system and allow settling time for the individual gates.

As stated above, timing and control generates necessary signals to allow

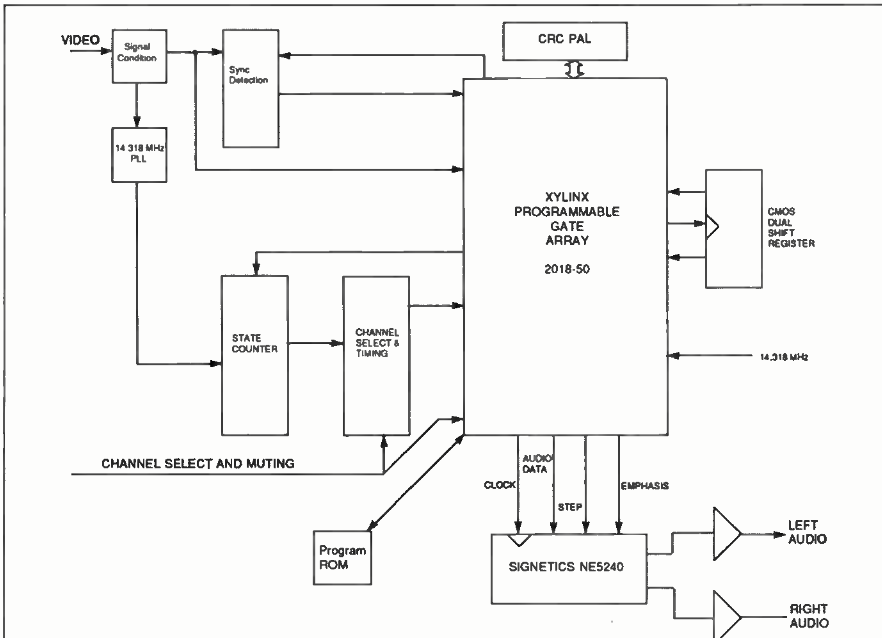

Figure 6. DCA Receiver Logic

the insertion of externally generated data into the bit stream. Each "line" has provision for the insertion of enough bits to have an aggregate data rate of approximately 420 KB/sec. Some of these bits are reserved for future use and as encryption information channels. This capability for data transmission is not the only means of transmitting data through the digital audio signal. In addition to externally-generated data to be inserted in each

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Pembroke, MA	90 Miles
Fredericksburg, VA	120 Miles
Culpepper, VA	80 Miles
Halifax, MA	40 Miles
Loudoun County, VA	100 Miles
Kutztown, Pa	50 Miles
Hallwood, Exmore, VA	75 Miles
Chatham, NY	100 Miles
Glens Falls, NY	250 Miles
Manassas, VA	75 Miles
Hanover, PA	100 Miles
Lawrence, KS	220 Miles
Buena Vista, VA	25 Miles
Danville, NH	25 Miles
Lancaster, PA	100 Miles
Ponce, PR	300 Miles
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Marion, OH	100 Miles
Waverly, OH	20 Miles
Atkinson, NH	40 Miles
Kingston, NH	50 Miles
Rockland, MA	50 Miles
Abington, MA	60 Miles
Bourne, MA	150 Miles
Hershey, PA	100 Miles
Blossburg, PA	20 Miles
Chitenango, NY	40 Miles
St. Albans, VT	50 Miles
Ottawa, OH	50 Miles
Upper Merion, PA	90 Miles
Brockway, PA	10 Miles
Greensburg, PA	200 Miles
Duxbury, MA	125 Miles
Westfield, PA	12 Miles
Norristown, PA	150 Miles
Pelham, NH	80 Miles
Plympton, MA	25 Miles
Sandwich, MA	200 Miles
Windham, NH	85 Miles
St. Clair Twp., MI	50 Miles
Bloomsburg, PA	20 Miles
Wilkes-Barre, PA	10 Miles
Weatherly, PA	25 Miles
Abington, PA	300 Miles
Algonac/Clay Twp., MI	50 Miles
Southern, NJ	2,800 Miles
Bolling A.F.B., MD	5 Miles
University of Toledo, OH	5 Miles
Brandywine, PA	100 Miles
Chalfont, PA	12 Miles
Chesterfield Twp., MI	100 Miles
China Twp., MI	10 Miles
Collegeville Trappe, PA	20 Miles
Doylestown, PA	50 Miles
Egg Harbor, NJ	22 Miles
East Hampton, NJ	25 Miles
Littlestown, PA	100 Miles
Newton, NH	25 Miles
Muncy/Hughesville, PA	25 Miles
Nassawadox, VA	12 Miles
Lower Gwynedd Twp., PA	25 Miles
New Holland, PA	10 Miles
Shamokin, PA	50 Miles
Plymouth, MA	25 Miles
Knoxville, PA	5 Miles
Nanticoke, PA	15 Miles
Onancock, VA	15 Miles
Mays Landing, NJ	50 Miles
Keene Valley, NY	20 Miles
White Marsh, PA	20 Miles
Lower Providence Twp., PA	75 Miles
Eastown, PA	50 Miles
New Britain Twp., PA	30 Miles
Hamilton, NY	50 Miles
Tredyffrin, Twp., PA	150 Miles
Memphis, MI	6 Miles
Northampton Twp., PA	150 Miles
Whitpain Twp., PA	50 Miles
Springfield, PA	30 Miles
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New Haven, MI	10 Miles
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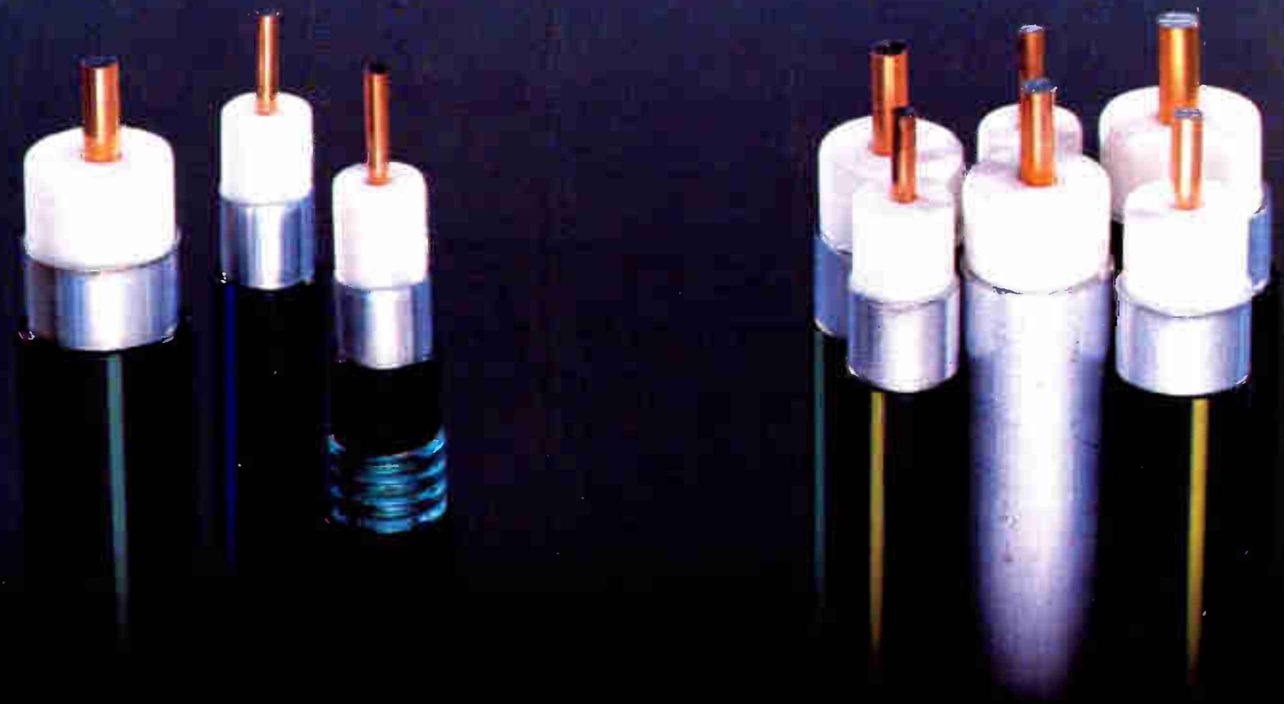

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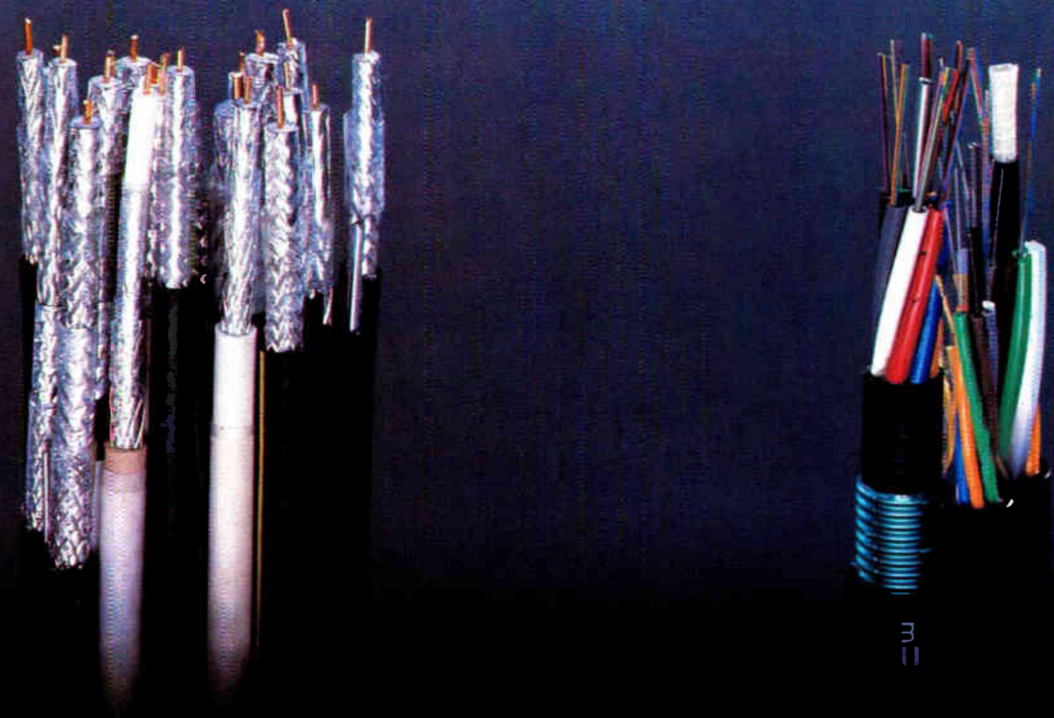

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line as a burst, alternate "lines" may be made to carry additional data. Four bits of data, left and right for each step and emphasis, are transmitted for each channel of data in each line. Only half of these bits are actually required, as the bitrate required for this information is half the line rate. Thus 32 bits for every pair of lines is redundant. (Aggregate bitrate: @250 KB/sec). Provisions are made for utilizing part of this capacity for external data transmission.

The output module performs digital filtering of the data in order to achieve the required video bandwidth. The filtered data are then converted to an analog signal, sync is added in the correct ratio and, after additional filtering and buffering, a "composite video signal" is output.

Since the signal bears a strong resemblance to a standard video signal, no special considerations are required for transmission via satellite or cable. There is no adjacent channel interference either into the signal or from the signal into other channels.

Receiver

A block diagram of the receiver circuitry is shown in Figure 5. The input RF signal is demodulated using conventional techniques and the demodulated pseudo video signal is fed to the signal processing circuitry. This circuitry is shown in block diagram form in Figure 6. Sync is stripped from the input video and used to generate a clamp pulse and a sampling pulse for the phase locked loop. Conventional

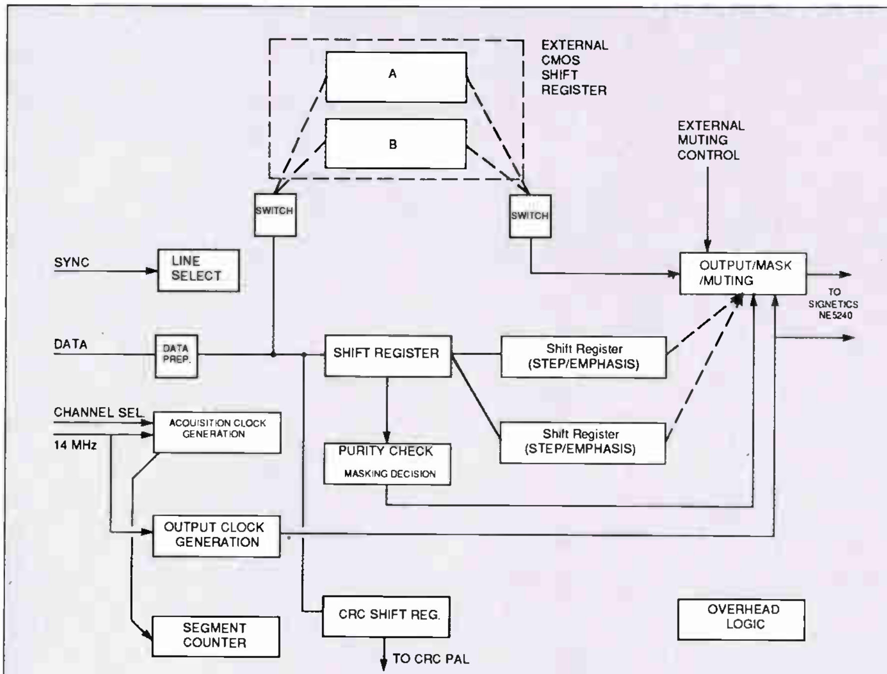

Figure 7. Xilinx Functional Block

phase locked loop techniques are used to generate a 14.31818 MHz clock, locked to input run-in code, which serves as the receiver master clock. This clock is divided by two to generate the data sampling clock.

The input signal is clamped and fed to a comparator to generate a digital data sequence which is used as input to the Xilinx programmable gate array.

The bulk of the digital work of the prototype receiver is performed by the Xilinx programmable gate array, a MOS Shift Register and an assortment of PALS. (In the final product, these will be replaced by custom integrated circuitry). The Xilinx chip contains 100 "configurable logic blocks," or CLBs. These blocks are combined to form several counters, switches and shift registers which:

1. Generate the timing signals necessary to sample the required bit stream from the input pseudo video signal.
2. Switch the signals being required to a holding register, and the data already acquired to the output stream.
3. Detect the presence of incorrect data and implement a masking technique to conceal errors.
4. Remove and retime the much slower step size and emphasis control data from the serial bit stream.
5. Form a portion of the cyclic redundancy check circuitry to detect the frame sync data needed for a knowledge of absolute line number. This is necessary for correct demultiplexing of the audio and control data. The CRC shift register and its associated feedback elements are contained in the Xilinx chip. The shift register output is decoded by an external PAL which generates a frame sync pulse.
6. Remove and make available burst data sent through the externally generated data channel and in place of the step and emphasis bits which are sent twice.

The final functional layout of the gate array is shown in Figure 7. A total of 97 percent of the gate array's resources are utilized.

The Xilinx array outputs the retimed and separated audio data and control bits, along with a 311 kHz clock to the Dolby decoder chip. This IC (Signetics 5240) outputs two channels of unfiltered analog audio. These audio signals are filtered and buffered prior to being output to the consumer's audio amplifier.

A low cost microprocessor interprets the front panel control pushbuttons, drives the front panel display and executes channel changes. The processor also provides addressability by monitoring the control data stream from the headend control system and will be used to control encryption/decryption of the data stream.

Conclusions

The audio transmission system was tested using an Audio Precision System One tester. Tests were conducted both at baseband and over a satellite/cable link. There was no difference in the measured frequency response or total harmonic distortion between the two sets of tests. The measured THD was within specifications for the Dolby DP85 encoder. Listening tests conducted by an independent laboratory showed that listeners could not distinguish between a direct CD output and a CD played through the digital cable audio system. ■

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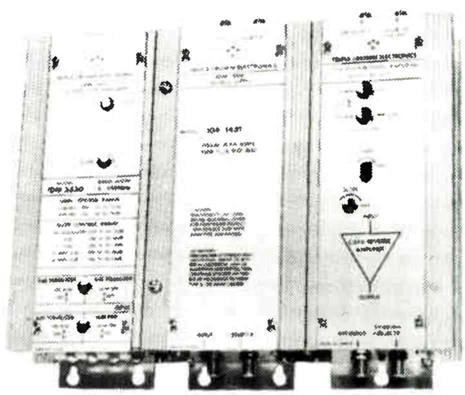
C. Todd, "Efficient Digital Audio Coding and Transmission Systems," Proc. NAB, 1985.



The facts about fiber

Optical fiber is about to change the way America views cable television.

Following years of study and debate, the cable television industry's move toward fiber is gathering momentum. At the recent Western Cable Show, for example, a variety of cable equipment manufacturers unveiled a host of new or enhanced product offerings that will rely on fiber technology.

American Television and Communications' hybrid optical fiber/coaxial system already has been hailed as a means of catapulting cable TV systems into the next generation of transmission technology.

A recent Federal Communications Commission report has indicated that the cable television industry may invest as much as $2.7 billion in fiber optic backbones as fiber continues to make its way from supertrunk applications closer to the home.

Jones Intercable has announced plans to upgrade its Broward County, Fla. (and Augusta, Ga.) cable plants with a unique hybrid fiber/coaxial system of its own, while industry giant Tele-Communications Inc. has demonstrated its confidence in fiber by agreeing to purchase significant levels of AM lightwave transmission components over the next few years. Other leading MSOs are moving ahead with fiber-based systems as well.

The evolution of fiber

Within the cable TV industry, the arrival of this new technology has given rise to questions about optical fiber itself. Cable TV engineers are asking "How is fiber made?", "How many different types of fiber designs are available?", and "Aren't all fibers alike?".

This article provides an overview of advances in fiber optic technology and discusses many of the concerns of today's cable engineers, who likely will have an opportunity to add fiber to their systems in the near future.

Single-mode fiber is used primarily for cable TV applications due to its enormous bandwidth, low signal attenuation (rate of light loss) and its natural immunity to noise.

By Scott Esty, market development supervisor, Corning Glass Works

Corning scientists invented the first practical optical fibers for information transmission in 1970. These early fibers were manufactured by Corning's patented Inside Vapor Deposition (IVD) process. During the 1970s, Corning overcame the limitations inherent in this first processing approach through the development of the Outside Vapor Deposition (OVD) process.

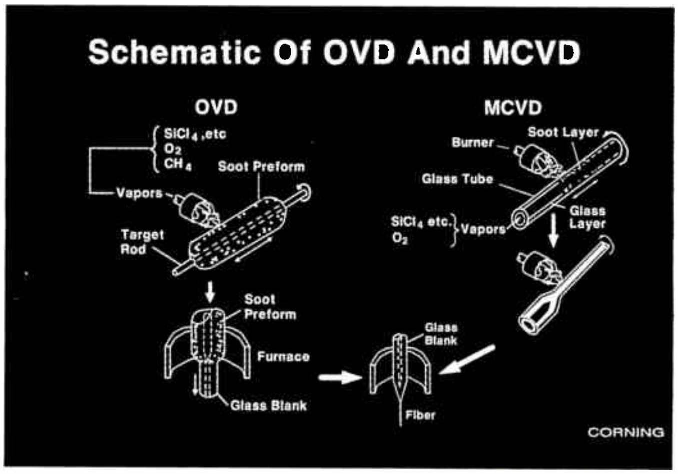
> The cable television industry may invest as much as $2.7 billion in fiber optic backbones.

This original fiber-making process relies on a pre-made silica glass tube that eventually becomes an integral part of the finished fiber. The most commonly used IVD process is the Modified Chemical Vapor Deposition (MCVD) process. In this method, a glass tube is placed in a lathe and rotated while a burner flame traverses back and forth along the length of the tube to heat it.

While these operations are underway, valves control a mixture of gaseous silicon tetrachloride and other dopant chemicals that enter the inside of the tube. These gases react in the presence of heat and oxygen to form a pure, ultra-fine glass dust, known as "soot," along the inside surface of the tube. At first, this glass soot has a white, chalky appearance, but as the process continues, it is consolidated to clear glass. The flame continues to traverse across the spinning tube, consolidating already-deposited layers of glass. Then, more layers of glass soot are deposited on the inside of the surface of the tube until the void is nearly filled.

Finally, a clear glass "blank" is produced. Thin strands of ultra-thin fiber then are drawn from the blank.

The MCVD process has some inherent limitations that are carried through to the geometric dimensions and strength of the resulting fiber. The glass tube that initiates this process, and that ultimately becomes the outside surface of the fiber, is actually the fiber's weakest link. This tube is made by a refractory melting process. Glass melting is much more difficult to control than the vapor deposition process, making the glass tube fundamentally less pure. The presence of these impurities, or flaws, within the glass tube can significantly diminish the strength of the resulting optical fiber.



Therefore, fibers with an outer surface made from tube glass tend to be inherently weaker and more susceptible to breaks.

OVD: A fiber-making revolution

To overcome the fiber manufacturing constraints imposed by using a tube, Corning developed a new process, Outside Vapor Deposition. The OVD process utilizes a starting rod, which, like the MCVD tube, is placed in a special lathe. Unlike the MCVD tube, the rod does not become part of the final fiber product, as it is subsequently removed from the blank.

By changing the raw material ingredient ratios, layers of glass soot—first

A partially drawn outside vapor deposition blank is displayed to demonstrate how a blank is drawn down to fiber.

the core glass and then the cladding glass—are accumulated on the outside surface of the rod. The result is a "blank" structure of ultra-pure deposited glass with greater inherent strength.

The OVD process manufactures fiber from the inside out, rather than the outside in. And the OVD process yields a fiber with fewer flaws, because it eliminates the need for the impure silica-glass tube.

The OVD process includes consolidation of the soot to a clear glass blank, but this is accomplished in a separate step which allows for "drying" of the blank. Drying removes OH "water" contamination of the resultant fiber, lowering attenuation levels between the 1310 nm and 1550 nm windows of operation. MCVD produced fibers have a water-induced attenuation peak in this wavelength region, potentially limiting future wavelength division multiplexing (WDM) options.

Since they don't rely on melted-tube dimensions, OVD fibers have much longer lengths (up to 25 kilometers) available, and much better geometric control of such essential physical parameters as core concentricity and outside surface roundness, which translates to easily repeatable, low loss splices, whether mechanical or fusion techniques are used.

Differences in fiber designs

Today, the OVD and MCVD manufacturing processes have resulted in two distinct single-mode fiber designs: matched-clad and depressed-clad, respectively.

Although they perform comparably in certain ways, there are differences that will be of specific interest to cable television engineers. The major distinction between the two products lies in the boundary between the core—the principal light path of the fiber—and the cladding—the outer glass layer of the fiber.

With all single-mode fibers, part of the light actually is traveling in the cladding, as well as the core; therefore, it is essential that the cladding be comprised of optical-quality glass to enable the light ray, or mode, to travel through it efficiently. The glass, for both the core and light-carrying portion of the cladding, must be vapor deposited.

In the OVD process, all of the glass is deposited. There is a continuous "match" of the index of refraction of the interior light-carrying region of the cladding and the outermost cladding. OVD easily produces matched-clad fiber—a fiber that can move light with great efficiency within the core/clad boundary.

In the MCVD process, a "flux" ingredient is required to deposit the initial layers of silica cladding glass. Unfortunately, this flux raises the index of refraction of the deposited cladding glass above the tube cladding, possibly enlarging the effective core region. Fluorine is introduced as another dopant to lower the index, compensating for the flux.

Balancing these two counter-acting indexes to "match" the rest of the "tube cladding" index of refraction (which is not precisely controlled) is difficult. Consequently, MCVD fiber manufacturers add more than a balancing amount of fluorine to depress the index of the vapor deposited layer of cladding below that of the tube.

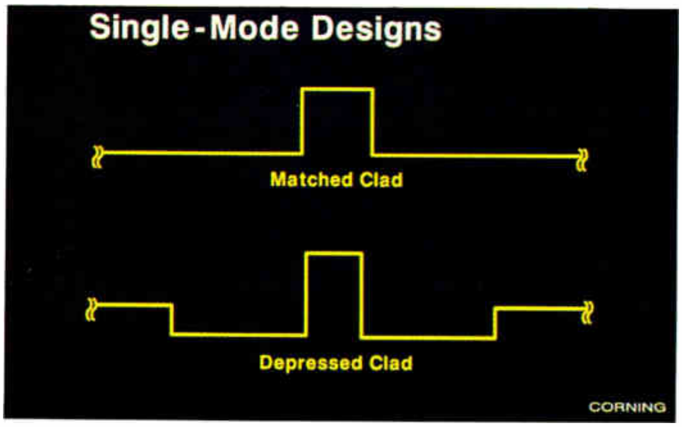
This depressed-clad design results in a smaller mode-field diameter in order to equal the overall optical performance of matched-clad fiber. A smaller mode-field diameter limits the light-capturing capability of the fiber and increases the difficulty in aligning the cores for splicing.

The truth about bending

All fibers are not created equal. This is evidenced in the mechanical strength, environmental ruggedness, ease of spliceability and bending performance differences between matched-clad and depressed-clad fibers.

In nearly all real-world situations, matched-clad fibers demonstrate better bending performance than their depressed-clad counterparts. At bend diameters around 2 inches (50 to 70 millimeters)—the lower operating range recommended by all fiber cable manufacturers—matched-clad fibers exhibit lower attenuation than depressed-clad fibers.

Matched-clad fibers also exhibit lower losses at all larger diameter bends, exceeding or equaling 3.2 inches (80 mm). With the standard loose tube cable design, the fiber bundles are wound into the cable in a helical/spiraled configuration that introduces extra fiber length into the cable, reducing stress on the glass. Depressed-clad fibers are typically laid straight into a cable, which may result in the fibers being installed under permanent stress.



In fact, the only region where matched-clad fiber exhibits higher losses than depressed-clad fiber is around 1550 nm and only when both are bent far smaller than the recommended minimum bend radius of 50 mm. And this loss level is only relative, since all fibers, matched- and depressed-clad,

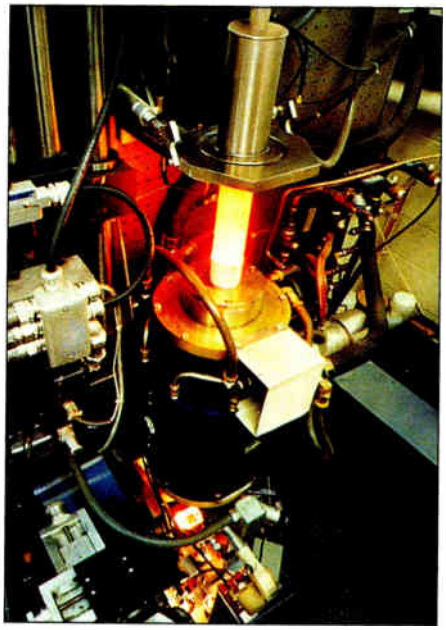
subjected to these tiny bends (less than 1 inch or 25 mm) exhibit unacceptably high losses at 1550 nm.

nds smaller than recommended by manufacturers' installation guidelines induce increased stress along the outside surface of the fiber, which may result in breakage over time.

In the mid-1980s, depressed-clad fiber manufacturers promoted their products in the telephone markets as performing better than matched-clad at small bend diameters. It was shown conclusively that the low bending losses were primarily a function of depressed-clad fiber's smaller mode-field diameter, not fiber design. It was also demonstrated that fiber can fail prematurely at bends below the minimum specified bend radius.

It's likely that cable operators will actually make use of matched-clad fiber's higher losses at tiny bend diameters. With the matched-clad design, if a fiber is accidentally bent too tightly (below the recommended 2-inch or 50-mm radius) it will provide a high-loss alarm on an optical time domain reflectometer (OTDR) trace to alert installation crews.

With depressed-clad fiber, there is virtually no way to detect these excessively tight bends, except by visually inspecting all fiber terminations. The expected result: potential fiber breakage at some undefined future date.



An outside vapor deposition blank is lowered into the draw furnace to begin the fiber drawing process.

Repair length realities

Minimum cable repair lengths are another important difference between the two fiber types. With depressed-clad fibers, it is necessary to have a repair length of 60 feet—minimum—(20 meters) in order to attenuate higher order modes that can be generated at substandard splice points. Storing this length of repair cable can be a problem, especially in emergency repair situations.

With matched-clad fiber there's no need to specify a minimum repair length because the typical 2- to 3-inch (50-mm) bend in the splice enclosure attenuates higher-order modes. Any length of cable can be used in a repair situation.

Future for optical fiber

Optical fiber is not an entirely new concept for the cable television industry. In fact, as early as the mid-1970s, cable operators began incorporating fiber into point-to-point supertrunk applications. The advantages of fiber are even clearer today. They include:

- **Increased channel capacity.** The enormous bandwidth of fiber enables cable operators to virtually multiply their channel capacity. As changes in end electronics occur, fiber's bandwidth will continue to provide the capacity to support advanced TV technologies.
- **Reduced maintenance costs.** Optical fiber's low signal attenuation enables cable operators to increase the allowable distance between amplifiers, which translates into fewer in-line or remote electronics and, consequently, fewer system failures.
- **Improved picture quality.** Fiber allows for unamplified transmission over distances as great as 20 miles, significantly reducing signal degradation caused by repeated reamplification. Because optical fiber doesn't pick up RF energy, it is immune to the "noise" that can cause picture quality problems. It also has absolutely no radiation of RF energy.

> Fiber is poised to unlock the extraordinary potential of cable television communications in the 1990s.

- **Transmission reliability.** With fiber feeders from the headend out to neighborhood hubs, the number of customers affected by isolated outages can be reduced significantly. Fiber is also nonconductive, which means that outages due to lightning strikes on cable are virtually eliminated.

Fiber is poised to unlock the extraordinary potential of cable television communications in the 1990s. Pay-per-view, interactive video and high definition television are just a few of the "next generation" cable services that can be made possible by this advanced communications medium.

Understanding the differences and distinct advantages of optical fiber designs and manufacturing processes is the first step toward harnessing this technology. But don't delay. A bold new adventure in cable television awaits. ■

Satellites ready and waiting for HDTV

The 525 scan line, 60 field, 6 MHz set of standards known as NTSC (from the National Television Systems Committee which established the black-and-white standards in 1941 and the color standards in 1950) will be partially replaced by so-called High Definition Television in the next few years.

(Actually, today's High Definition Television is a misnomer, since the 525-line system was also called "high definition television" as opposed to the lower definition proponents competing when it was originally proposed.)

Satellites compatible

If new advanced definition standards are adopted in 1991, it will be exactly 50 years since the original NTSC standards were adopted. But by some estimates we are not even close to setting new standards. And not all of the NTSC standards will be replaced. Some will be replaced, such as the line scan number, others altered, such as the terrestrial transmission format, and some continued, such as the 6 MHz wide channelization. All this remains to be seen. Happily, things are different as far as satellite delivery is concerned. No matter what HDTV standard or standards are adopted and eventually approved by the FCC, the present and next generation of satellite technology can deliver it without much, if any, change.

"Satellites are just a bit pipe at the first look," says Bob Waldron, executive vice president of Hughes Communications. "The issue becomes the ability to get more information in whatever bandwidth we can come up with. Then the key issues are how to maximize the bandwidth and not have interference from other satellites or the adjacent channels." Waldron adds, "That's where our concentration in technical areas is going to be." Hughes Communications is developing its own HDTV DBS system and plans to launch it in 1992.

Bandwidth and power

Waldron's counterpart at GE Americom, Richard Langhams, vice president of engineering and operations, agrees. "We've been looking at a lot of the candidate systems in the U.S. including the HDS-NA Philips format, the Faroudja Super-NTSC, the Sarnoff HDTV systems, the ACTV-E, the ACTV-1, the ACTV-2, as well as the newly proposed Zenith system and the MUSE system," Langhams says. "We believe that all of those formats can be accommodated utilizing the current and upcoming generation of satellites," Langhams reports.

By George Sell, Contributing Editor

Current satellites include the Ku-band 45 watt power levels that GE Americom has in its existing K-1 and K-2 birds. He adds, "We have proposed higher power levels on our K-3 and K-4 satellites of 60 watts."

For GE Americom, the transponder bandwidths are either 36 or 54 MHz. "Some proposed systems in Ku-band have gone as low as 36 MHz in the transponder bandwidths," says Langhams. "That might require in some of these transmission formats, a slightly larger aperture dish. However, that's the only negative."

And, it may not be the case. Testing will tell. "But in the 54 MHz bandwidth, which is what we basically have on K-1 and K-2 and are proposing for K-3 and K-4 satellites, there would be no restriction as to minimum antenna size. It would be restricted only by power level capability of the satellite," says Langhams.

"Basically, it's a trade-off of satellite power or EIRP versus dish size," Langhams says. Waldron adds, "It is a power-bandwidth product that determines what you can put through the satellite. So, if in fact you pick a FM signal and modulate it through the transponder at narrow bandwidth and you put in high enough power, or you have a big enough antenna, then you can still receive the signal. The trade-off is to try to get that balance whereas you have adequate power, within limitations on the bandwidth, and still live with small dishes in the DBS world."

Besides those concerned with the impact of HDTV on cable and DBS, other worries surface about satellite resources. Al Norcott, vice president of operations and engineering at Comsat Video Enterprises, a division that delivers pay-per-view and programming to more than 1,600 hotels using four transponders to send seven channels over SBS-3, doubts whether the bandwidth and power levels being proposed for HDTV transmission will be adequate.

"Certainly the impression I have is that in order to provide an equivalent viewing experience you are going to need another order of magnitude of signal strength over what you might expect for DBS," Norcott says. "You are going to need a little more bandwidth so you're going to need a little more power. I think that is a significant factor in allocation of spacecraft resources for DBS."

Existing TVRO base

Which brings up the question of the applicability of a particular HDTV format to the existing C-band TVRO base, Norcott says. "That's something that I think, in the course of evaluating proponents, the FCC Advisory Board will be taking a look at."

Waldron at Hughes is less concerned. "Maybe you will have to have a bigger antenna. I doubt the latter is true," Waldron surmises. "I think that it can be handled OK without the bigger antenna."

Dr. H. Allen Ecker, senior vice president for technical operations and Scientific-Atlanta's chief technical officer, expresses confidence that S-A's HDTV B-MAC satellite transmission system will function well with the existing TVRO base. "The multiplex analog component (MAC) format was initially designed to be optimized FM, which is the basic modulation used for satellite. So some of the advantages there include the fact that you don't have subcarriers for color or audio, and therefore you could get a more rugged signal over satellite. All other things being equal in terms of bandwidth and so forth, you can operate with a little bit better carrier-to-noise than with some of the formats that have multiple subcarriers."

"As a matter of fact," Ecker adds,

"you will find that the B-MAC is a little more rugged and forgiving than NTSC on some of the equipment. The basic principal is that you are never sending the chrominance and the luminance, you are time-multiplexing (them) in the active line. So you don't get them occurring simultaneously in the interference between the chrominance and the luminance that can come in the non-linearity in the system."

Full definition B-MAC

The currently implemented standard B-MAC system was originally developed by Scientific-Atlanta for Comsat and its subsidiary, Satellite Television Corp. (STC) back in 1983. While S-A's B-MAC format is officially an HDTV proponent before the FCC, it is not a "full HDTV standards" proponent. Rather, it is a satellite transmission method presented for consideration on its technical parameters and for informational purposes, and intended for use with other proponent systems.

North American Philips is one proponent that configures the HDTV B-MAC into its satellite HDTV proposal and others are considering B-MAC. The Zenith proposal includes a satellite transmission method using time division multiplexing, a maximum baseband bandwidth of 6 MHz, and digital transmission of low frequency average picture information. For satellite transmission, the Sarnoff Labs has not yet proposed a specific implementation, nor has MIT. Others, such as the Faroudja system, remain essentially an NTSC signal.

As originally designed in 1983, S-A had the foresight to engineer into B-MAC the evolutionary "hooks" to allow a progression to an extended B-MAC and further to an HDTV B-MAC. According to Ecker, "Some of those features were having a component system built around multiplex analog components having very high quality digital audio with the Dolby (Adaptive) Delta Modulation (ADM) system." The extended B-MAC was shown a year ago at the NCTA convention.

Ecker explains, "We have both standard MAC and extended definition MAC right now built into the custom ICs. Extended definition has improved horizonal resolution approximately 50 percent, and wide aspect ratio or normal aspect ratio is at the discretion of the viewer," Ecker claims.

"The next step was to have twice the vertical resolution and to extend the horizonal resolution as well and that was the system we presented to the FCC as a high definition B-MAC really focusing in on satellite delivery." According to Ecker, the high definition B-MAC has the parameters to interface with a variety of production inputs or different types of displays once standards are decided.

FM and time division multiplex

"There are better ways to treat a signal and not so good ways to treat a signal," says Norcott at Comsat. "We would prefer to have something that is time-multiplexed than something that has a subcarrier with which you have to pay a noise penalty. Even the people who are proponents of over-the-air broadcast have suggested that they have time-multiplexed versions of their signals," Norcott adds.

In a December 1988 report of a CCIR Study Group looking into HDTV formats authored by Norcott, he stated, "Systems designed for amplitude modulation do not necessarily perform optimally in the frequency modulation environment of satellite transmission.

Many proponent systems employ double sideband suppressed carrier quadrature modulation of two signals, where time division multiplexing is generally considered to be more effective with FM."

HDTV decoders

Another implication of HDTV for satellite transmission is the decoders necessary for earth station reception of an HDTV format. According to Hughes' Waldron, "They obviously have to have a new decoder. No matter what system is selected, it's a whole new format."

Ecker explains, "In all situations, if you are going to full high definition television, you will have to have a different processor at both the front end and the receiving side. They will require additional bandwidth and additional processing both at the uplink and the downlink." Ecker adds, "Obviously, what you would prefer to do is to have more sophisticated processing at the uplink so that you can minimize and keep low the cost of that downlink equipment." Overall cost will be reduced because there will be many more downlink processors and one uplink processor.

Friendly interfaces

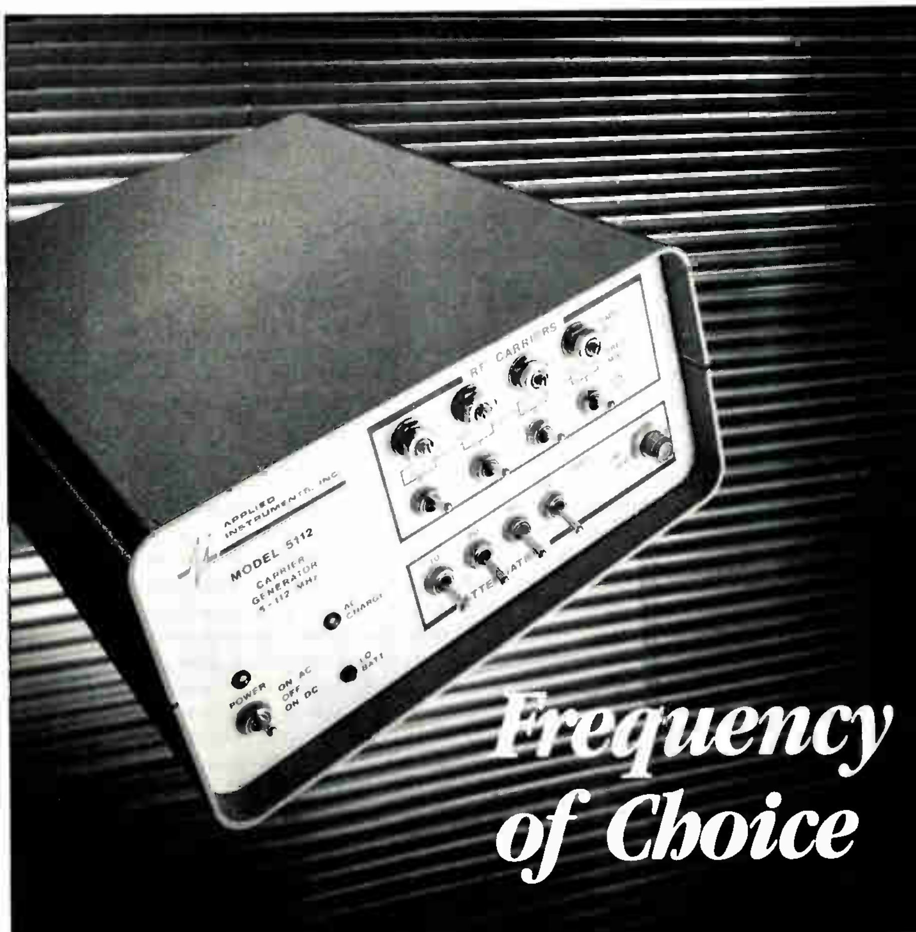
"One of the things that we have seen is that all of the people in the industry want to see an HDTV system that has 'friendly' interfaces," says Ecker, "and that means to me that scan rates and the aspect ratios are easily transcoded from one part of the overall system to the other."

Ecker, a member of the blue-ribbon EIA Advanced Television Committee, is an advocate of the concept of the multiport HDTV set. "One of the things we've (proposed) is that new TV sets will be multiport. That is, they'll have an RF input and baseband input so that if you've got basic scanning parameters that are consistent and can come in with a baseband input, you can really have a variety of formats possible as long as some of the fundamentals, like the multiples of the scan rate and the aspect ratio, are standardized."

"What (the committee has) been saying is that you really can't ask the set manufacturers, from an economic point of view, to have a multiprocessing TV set that would handle formats for all the different delivery media." In one scenario, the multiport set would allow broadcast to come in through an RF input and other inputs via a baseband or S-video connector. The VCR would come in at baseband as would cable after descrambling and processing in a set-top device. Ecker argues that if the bandwidth, the scan rate and the aspect ratio are essentially the same for each format, a multiport set can do the trick.

"So, you really don't have to define as many parameters as you might think," Ecker believes.

Some feel the multiport concept is already unpopular, but Ecker disagrees. "On this committee we have all of the set manufacturers represented that sell into the U.S. market. The two things that we've been able to agree upon have been the over-the-air broadcast system should have a compatibility with NTSC and that the TV sets should be multiport." The EIA committee has testified before Congressional committees to that fact, says Ecker.



HDTV viewing center

Hughes Communications has announced plans for creating an HDTV Viewing Center which will be used for testing proponent systems and collecting market and consumer responses. The Center will employ a mobile unit capable of receiving satellite delivered HDTV signals and presenting them before consumers and assessing their subjective reactions. Waldron describes the Center: "It will have a viewing room, but secondly, it will also be mobile. We will be moving with our mobile center out into the community to try and get consumer feelings and impact on HDTV."

Managing the activities of the HDTV Viewing Center, which Hughes Communications touts as the satellite equivalent of the research labs formed by the cable TV and broadcast industries, will be Kirsten Roth, manager of HDTV programs at Hughes. According to Roth, "One of the advantages of having a mobile terminal is that we can bring the equipment to wherever we want relatively easily and at the same time view it live over satellite."

"We plan to do a variety of customer tests, focus groups and interviews. That will happen with each of the proponent systems as well, depending on their particular interests and whatever time the equipment is available," says Roth.

Information will be made available to the FCC. "We have talked to the FCC and we will work with them to make much of the information available," says Waldron. "On the other hand, we are also in a business opportunity of our own and if we obtain information that is vital to our business plan and ought to be proprietary, we will so keep it."

A second center

GE Americom, Hughes' satellite delivery competitor, is also planning something similar but may be oriented more to equipment manufacturers. "We are now formulating a program, which is in the early definition stages, which would be somewhat similar to what Hughes is proposing right now, going to makers of HDTV studio and transmission equipment and determining whether we can put together a test bed which might or might not include a mobile capability," says Langhams.

GE Americom is looking to provide hard data to themselves and the industry that the HDTV formats are fully compatible with existing and proposed satellites. "That test bed would enable people from the industry to view, via a satellite loop-back system or a satellite transmission system, the different HDTV formats delivered by satellite."

Mobile market research

The HDTV Viewing Center proposed by Hughes will emphasize market research and place less emphasis on technical evaluation. "In fact, we are not putting ourselves up in the role, at this time, of selecting the best HDTV system. Our position is more that we see it coming, we better be prepared for it, both for our DBS and our delivery to cable headends, because we are in the satellite communications business. Secondly, we feel we want to determine how significant it is in our overall DBS planning. And then, through the demos

 Reader Service Number 40

Some working assumptions in the economics of CATV HDTV

"We are figuring that the cable industry is going to be adding channels constantly, as they always have, with or without high definition television," says Shelley Rosser, vice president for CATV sales and marketing for Anixter and a member of the FCC's Systems Subcommittee, Working Party 3: Economic Assessment (SSWP3).

"The channel capacity to carry HDTV will definitely be there by the time HDTV sets are at the retailers' showrooms." Working Party 3 is chartered to develop a working model for the analysis of the economic impact on the U.S. industries involved in high definition television. The computer simulated economic model and the findings of this Working Party will be published in the 1989 NCTA Technical Papers.

"In the economic model we are not adding any plant upgrade costs as a factor directly related to HDTV implementation. It will be there and it will be done anyway," Rosser adds.

"That's a point that has been a bone of contention with a lot of folks in the cable industry. It has been a bit controversial but it is something that we believe is really critical if you're going to even try to undertake analysis like this."

Obviously, that means that if a 12 MHz standard is adopted, it's going to be harder on cable companies than if a 6 MHz, a 9 MHz or an 8 MHz standard is adopted, says Rosser. She also makes the point that there is no way to quantify those costs for the sake of creating a formula, given that standards for HDTV have not been established and given that the capacity and performance quality of each cable system varies widely.

"We've got our spread sheet based on a 450 MHz system with x-number of channels being carried and so many HDTV channels being added. And if a particular proponent system takes you beyond that, we are assuming they can be accommodated by dropping a character generator channel or a redundant shopping channel, one or another of the things that cable operators do every other week as they try to make room for a new service," Rosser suggests.

The model assumes a 100,000-subscriber system. "We are making the assumption that the first place it will be adopted is in major metro areas," she continues, "and that's generally the larger systems."

The model also assumes that each HDTV subscriber will need to use a set-top converter or decoder. Working Party members feel that satellite-delivered HDTV programming will need to be secured. "When you are at that level of technology they are probably not going to use traps. They will probably be secured with addressable devices," Rosser explains. "The open architecture sets don't seem to be getting a whole lot of support. We are really trying to look at worst-case scenarios here so we are assuming that a discrete set-top device, an addressable decoder, will be needed to reach the set."

Operators will probably need addressability to offer HDTV channels as premium services or for HDTV pay-per-view.

"And the revenue side of this is not being considered at all," Rosser points out. "There are no assumptions being made (in the Working Party deliberations) about additional subscribers coming on because you have HDTV or additional charges made by offering HBO in high definition format. That may or may not happen."

Offering cable channels in HDTV format may be something that operators will just have to do as a service for subscribers. "Along with that goes the assumption that pay-per-view is going to be especially attractive in high definition to try to make back some of the capital expenditures that have to be made for the equipment," says Rosser.

"Some of the other assumptions, such as programming sources will be receivable in the same format, and that the off-air terrestrial broadcast signals received will be put on cable in the same format that they are broadcast over-the-air, all these things just mean that if you make those assumptions, then you don't have to slide in extra dollars in the headend for format conversions (in the economic model)," according to Rosser.

"We are just trying to simplify this (model) down to the point where you can plug in the different proponent systems and come up with the difference," Rosser says. ■

and things like that we want just to try and promote generally HDTV," Waldron stresses.

What proponent systems will be tested? Philips' for one. "We are talking to two to four others," he adds.

Whose afraid of the VCR and DBS?

Many feel that the general public will first experience HDTV in the home via an HDTV VCR hooked up to an HDTV receiver. Mitsubishi has already demonstrated such a baseband VCR at last year's NCTA convention. "Because, in Japan, the Japanese plan is to deliver HDTV via DBS, and they have just chosen that media," suggests Waldron, "if they turn around and emphasize VCRs, things could change pretty fast."

Given that HDTV programming may be slow to materialize in quantities necessary to stimulate the market, and given that the viewing public may not take to HDTV quickly without extensive exposure to the HDTV viewing experience, it may be necessary for there to be an interim period. It is during this period that the public could view HDTV programming for the VCR or satellite delivery of HDTV signals to a large screen in a local cinema just to create awareness and perceived value.

In any case, plans are proceeding for DBS delivery of satellite HDTV and Hughes is active in that arena. James Ramo, Hughes Communications' vice president for video services, has previously stated that Hughes' HDTV DBS, planned for launch in 1992, will require at least 2 million subscribing homes to break even at $1,000 for the dish and receive unit. That's a lot of hardware in the hands of consumers who may or may not be potential cable subscribers.

"We, in our plans of putting DBS together, are working with the cable industry and are working to come up with a 'cable-friendly' approach to DBS," says Waldron. "That means that they would participate in some way. We haven't worked that out yet."

Waldron feels the cable industry should not worry about Hughes' plans for DBS. "A lot of the primary market is to areas that don't have cable going in front of them. There are something like 15 or 17 million in that category. If they are in a cable area and they subscribe, we would like to work out an arrangement that is 'business-friendly' to the cable operator," Waldron suggests. ■

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Reader Service Number 43

Mergers, agreements open door to innovative product developments

Mergers and agreements abound. Leading this month's list, **3Com Corporation** of Santa Clara, Calif. recently announced an agreement with Telesystemes Reseaux (a division of Cogecom, France Telecom Group) to co-develop an X.400-based gateway and X.25-based router that will allow exchange of electronic mail worldwide among 3Com computer networks and those of other leading computer vendors.

3 + Open Reach/X.400 and 3 + Open Internet/X.25 will enable workstations, including IBM PCs, Personal System/2s and Macintosh computers on 3 + and 3 + Open networks to exchange "E-mail" on a worldwide basis with other mail systems, including IBM's Professional Office System (PROFS), DEC's All-In-1 and such public mail systems as Telenet's Telemail and Transpac's Atlas 400.

X.400 gateways convert E-mail into the messaging format of the International Standards Organizations' (ISO) Open Systems Interconnections (OSI) standards for global transmission through X.25 routers to X.25 public and private networks.

The two products, Reach/X.400 and Internet/X.25 will be available in French and English language versions in the summer of 1989. For more information, call 3Com, (408) 562-6871.

C-COR signs VAR deal

Secondly, **C-COR Electronics** has inked a VAR agreement with two Japanese companies. The State College, Pa.-based electronics manufacturer has entered into an agreement with Aichi Electronics Co., Ltd. and Nissho Iwai Factory Automation Corporation (NIFA). The agreement enables Aichi (acting as NIFA's agent) to distribute C-COR LAN products on an exclusive basis in Japan. C-COR, (814) 238-2461.

NaCom, a division of AmeriLink Corp., based in Columbus, Ohio recently announced the signing of a VAR agreement with **Chipcom Corp.** of Waltham, Mass., a leading supplier of "Ethernet on broadband" and fiber optic communications components and products. For more information, contact NaCom, (614) 895-1313.

And finally, **Brightwork Development Inc.** of Red Bank, N.J. recently announced its merger with **Integrity Software** of Austin, Texas. The company will continue to do business under the Brightwork name and market NETreports and SiteLock, products formerly known as ANET and SiteLock of Integrity Software.

NETreports is a set of network management programs which, among other functions, determines use (and abuse) of disk space and document fileserver configuration. SiteLock is a software metering and monitoring tool for NetWare LANs.

Brightwork, Keylogic tie knot

In another development, Brightwork entered into an agreement with **KeyLogic Inc.** Through this agreement, described as one focusing on "strategic developments," the two companies will market an advanced batch processing system for use on Novell's Advanced NetWare networks. For more information, call Brightwork, (213) 645-5500.

Netronix recently announced the introduction of its Fiberstar PC network. The product is a ready-to-ship LAN utilizing plastic (as well as glass) optical fiber that can span distances of 500 feet between two nodes.

The network consists of two basic components: PC optical fiber LAN adapters and optical fiber hubs, supplemented by cable, wall plates and other accessories.

The plastic optic fiber system's advantages are reported to center around cost and flexibility. In general, the system uses less expensive fiber, less costly connectors and the fiber can be looped more tightly than glass. In addition, it is easy to troubleshoot because it uses visible light, as opposed to infrared (as with glass fiber).

The Fiberstar LAN inter-operates with Ethernet, StarLAN and broadband networks utilizing Netronix's line of media-independent bridges. It includes a NetBIOS emulator and Novell NetWare driver as well as an optional TCP/IP communications package, which provides compatibility with a variety of network applications.

The product is available for immediately delivery. Adapter cards cost $595 or $895 with the TCP/IP package; 16-port hubs cost $2,195. ■

—Greg Packer

Designing a digital system

The concept of digital technology is simply this: Any analog signal may be represented by a series of finite numbers. In a digital process we operate on those numbers, instead of the analog quantity. Further, if an analog signal is sampled at twice the rate of the highest frequency of interest, the original signal may be reproduced with no loss of information. This rule is key to understanding digital sampling and is called the Nyquist theorem.

The advantages

One advantage of the digitizing process is that the signal-to-noise ratio (S/N) and dynamic range of an analog signal, after the digitizing process, are strictly a factor of the digitizing process itself, not the transmission medium over which the signal is being sent. As long as the signal is readable by the decoder, the original signal may be reproduced to the accuracy of the encoding/decoding process. As the digitizing process increases in accuracy, (i.e. a larger number of bits) the S/N and dynamic range get better.

Another major advantage of digital systems is their security. Numbers can be manipulated according to mathematical formulas that make them reasonably unreadable to unauthorized persons. Encryption and decryption can be carried out quickly and inexpensively by currently available integrated circuits.

Digital systems also make the most efficient use of transmitted power. A digital signal has a bandwidth requirement which is a function of its number of transmitted bits (not converted bits, as we shall see) multiplied by the sampling frequency. This spectrum is flat across the band of interest, instead of containing peaks of power at certain critical frequencies.

By Anthony M. Radice, Senior Design Engineer, General Instrument

BACK TO BASICS

With digital communications rapidly gaining ground in both scope and application, now may be the time to examine some basic technology involved with digital signal transmission. Does it have advantages over analog? Will it increase available bandwidth? These and other questions are discussed in the first installment of a planned monthly feature series, called "Back to Basics."

Written by Anthony Radice with General Instrument, the article, "Designing a digital system," briefly touches on design considerations using digital technology. The article also discusses analog transmission and digital modulation techniques. It is not meant as an in-depth treatise but rather, an attempt to refresh memories or enlighten those unfamiliar with the technology. ■

Digital disadvantages

With the advantages of digital technologies come several notable disadvantages. The most significant disadvantage is the digital transmission system's voracious appetite for bandwidth. As noted above, the bandwidth requirement for a typical digital system is the sampling frequency multiplied by the number of bits sampled. But we also noted that the larger the number of bits, the better the improvement in signal-to-noise ratio and dynamic range.

For example, a compact disc player typically has a digital word length of 16 bits, and is sampled at a 44.8 kHz rate. (Note that the 44.8 kHz is slightly more than twice the highest frequency of interest for audio purposes: 21 kHz.) If all this information were to be conveyed in a transmission system, it is not unreasonable for a *single channel* to require 716.8 kHz (44.8 kHz × 16 bits) plus a 50 percent overhead for forward error correction (358.4 kHz). This totals 1.075 MHz and is obviously not acceptable.

This bandwidth would be required for a binary coded system. One solution to this problem would be to use a different coding system, such as quadrature phase shift keying (QPSK) or one of the methods of quadrature amplitude modulation (QAM). These alternate coding methods pack more digital information into a given bandwidth, but have a corresponding larger cost in circuitry.

Another disadvantage of a digital system is the necessity for error detection and correction. This is actually a dual edged sword. A digital system has a need for EDC because of the problems which may be generated at the digital-to-analog converter by incorrect samples which "hit" the output filters.

Analog versus digital

We should now consider analog transmission systems. In an analog transmission system, a great deal of attention must be paid to linearity within the bandwidth of interest. If this band is not linear, the transmitted signal must be predistorted, or the receiver must compensate for the non-linearities of the system, or both. In either case, there is no way of knowing (other than a closed system) that what is transmitted is actually what is received.

There is also the problem of securing the analog signal. Analog scrambling systems often degrade the desired signal by slight differences in characteristics in the transmitter and receivers. Analog scrambling systems are also static in nature, and once compromised are difficult to make secure again. This is not so with digital transmissions, as encryption codes can be changed so often as to drive the cost of the pirate box up to the point where it costs more to pirate than to receive legitimately.

Finally, analog signals cannot, in themselves, carry the necessary information to verify the correctness of the transmitted signal. Analog transmission systems rely on noise reduction techniques which are heavily influenced by the strength of the received signal. Dolby® B and dbx in BTSC are two of these methods.

Analog-to-digital conversion

Within the world of digital coding systems there are two primary methods of conversion from the analog to digital domains: Pulse code modulation (PCM) and delta modulation. Within the technique of PCM there are several variations, each with its own strong and weak points.

Pulse code modulation samples an input analog signal at a point in time, and assigns it a number on a scale from 0 to X. "X" is a number equal to 2 raised to the number of bits the converter is working with (minus one). For example, an 8-bit converter would assign the input sample a number from 0 to 255 (255 = (2^8) − 1). A larger number of bits has a higher resolution, but comes at a corresponding increase in price. The higher the sampling frequency, relative to the highest frequency of interest, the better the reproduced signal at the receiver. However, analog-to-digital and digital-to-analog converters which operate at higher frequencies come at a higher cost.

PCM also has some usage restrictions. The input analog signal must have no frequency content above one-half of the sampling frequency. This requires the use of an anti-aliasing filter to prevent those frequencies from presenting interference in the desired output. Once the input signal is filtered, we must be able to transmit the smallest variation that is significant.

For example, if the 8-bit converter had an input signal with a peak-to-peak value of 2.55 volts, the smallest variation we would be able to resolve would be 10 mV. This is not acceptable in many applications. One solution to this problem is to increase the number of bits in the converter. Another solution is to have a variable gain block in front of the converter to increase or decrease the peak-to-peak amplitude of a given passage (a relatively long period considering the frequencies of interest) and thus use the entire range on the converter on differing peak-to-peak values. The 2.55 volt full scale value may then be changed temporarily to 1.28 Vfs. We would then be able to resolve 5 mV. The system must then transmit this change information to the receiver to allow the digital-to-analog converter to change its full-range scales. This technique, and several specific variations of it, is called companding.

Delta modulation

Another digitizing technique, delta modulation, uses a serial stream of bits for each transmitted channel. This digitizing rate takes place at a much higher frequency than a PCM system. For audio, the digitizing rate may be as low as 200 kHz or as high as 10 MHz. The bit stream from a delta modulator may be thought of as a direction in which we want to make the output voltage to change, rather than an absolute value. The digital-to-analog converter is a leaky integrator. If we want the voltage of the output channel to increase, we send a string of "1"s to the integrator. If we want the voltage to decrease (faster than its normal decay, which is a function of the system), we send a string of "0"s.

To further refine the system to adaptive delta modulation, we send two very low bandwidth (rate) signals for each audio channel. One of these signals controls the relative step size of the audio information. The other controls aspects of the output de-emphasis network. The step size is a form of companding, which is an integral part of adaptive delta modulation. De-emphasis is a form of noise reduction which is also inherant in Dolby® ADM. ■

Standard and procedures for video level measurement

Setting video levels would be easy if only the cable operator could call up a test pattern when he was ready to set levels. In that sense the broadcast engineer has it much easier. The cable-TV headend technician must make-do with whatever TV signal happens to be on at the time he is ready to set levels. A video waveform can be subjected to a wide variety of measurements that are outside the scope of this paper. We will limit our discussion to measurement of the voltage of the video waveform.

Video level measurement trouble can exist because the peak voltage, as seen on a wideband oscilloscope, and maximum brightness are not *necessarily* the same thing. Only the luminance component of the signal contributes to the picture brightness. Thus, if there is considerable color saturation (chrominance) in the picture at the time that peak-to-peak video voltage is measured, the scope reading could be 10 percent to 20 percent higher than the actual luminance component of the video signal.

The chrominance component of a color television signal can be found clustered about the color burst and occupies the frequency band from about 3 MHz to 4 MHz. The luminance component of the color television signal is located primarily in the 2 kHz to 600 kHz frequency band. Fine luminance picture detail does of course overlap the band occupied by chrominance, but since the energy of the luminance component in the 3 MHz to 4 MHz band is usually quite low, it may be filtered out to make luminance measurements without significantly impairing test accuracy.

Since only the luminance component of the video waveform contributes to picture brightness, a filter must be provided to separate the chrominance signal from the luminance signal when the brightness produced by a given video waveform is to be measured.

A talented video professional can closely estimate the actual luminance amplitude on a test pattern, even when buried by chrominance signals. However, even the experts disagree when the picture content continually changes. Technicians often interpret the waveform they observe differently according to their own experience and the setting of the oscilloscope controls. This is particularly true if a regular oscilloscope is used. Even with a video waveform monitor a significant reading error will occur if the wrong video low-pass filter is switched in.

By Frank McClatchie, FM Systems Inc.

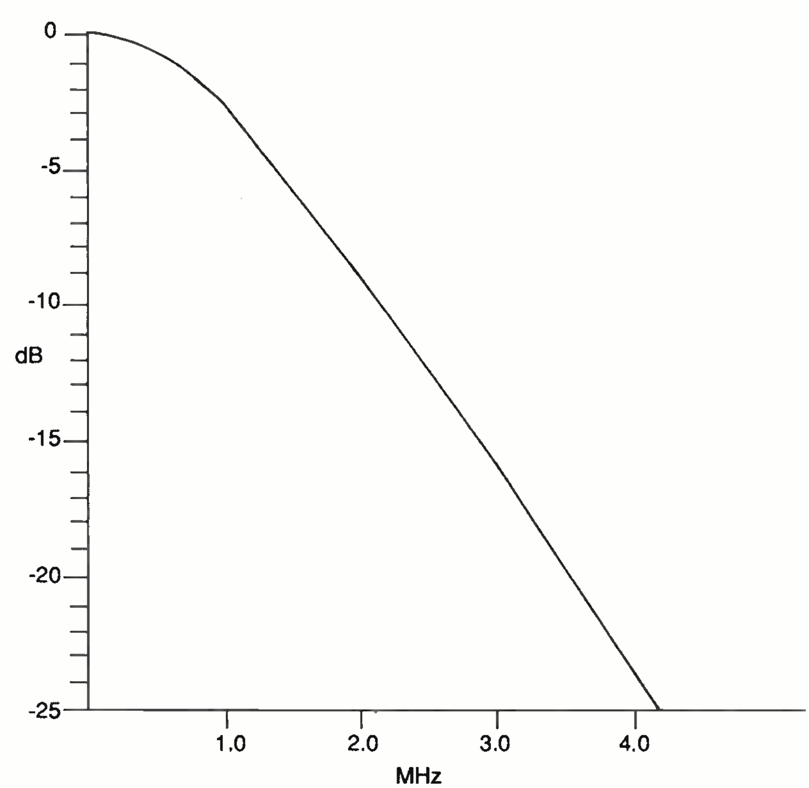
New technology

An entirely new type of test instrument has recently become available, called the VVM Video Volt Meter, that measures sync, white and composite video amplitude on a digital scale instead of an oscilloscope. This video volt meter is the size of an ordinary hand-held digital voltmeter, and is battery-operated for portability. Since the VVM read-out is digital, video level setting becomes more consistent.

This measurement technique recognized that high frequency chroma information can cause error in TV luminance measurement, so a special filter was proposed that retains the luminance part of the TV signal but filters out the chroma component. This filter is generically known as the "IRE" filter (see Figure 1). Television waveform monitors are equipped with this filter (as well as others) which must be switched *in* when making video voltage measurements.

(Unfortunately, ordinary scopes do not have such a filter. If you do not have a proper television waveform monitor with the IRE filter, do not despair, you can obtain an IRE filter to connect to your scope. With this filter connected to the broadband scope you can at least get the same volts peak-to-

Figure 1



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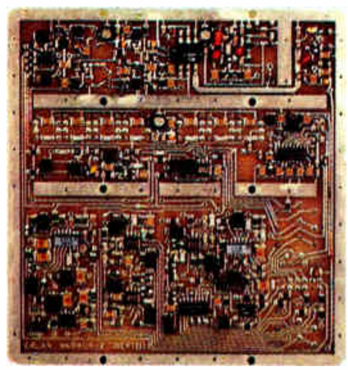

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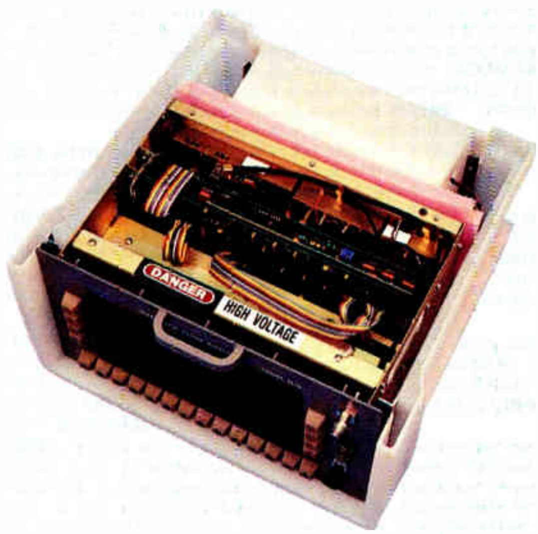

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PERSONNEL: Berry Cokely, Operations Manager; Leonard DeRenzo, Director of Sales; Ken Wood, Director of Product Dev.
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DESCRIPTION: Manufacture 600 MHz non-interfering system sweep and spectrum analyzer.

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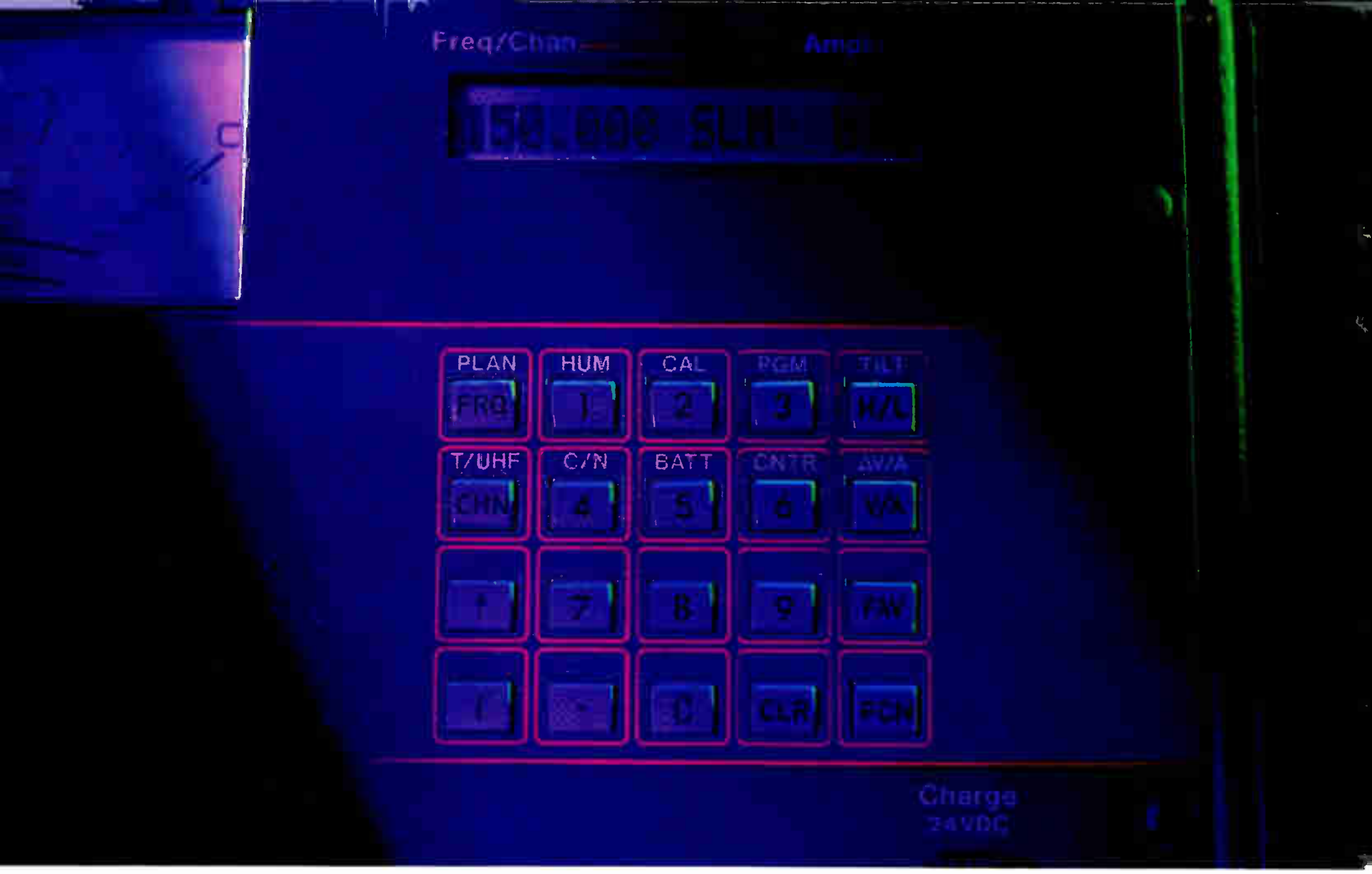
DESCRIPTION: Full line manufacturer of broadband cable and LAN test equipment including signal level meters, system analyzers, system sweep equipment, leakage detection equipment and bench sweep equipment.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peak reading as with a standard video waveform monitor.)

The IRE (now IEEE) standard measures video in IRE units instead of volts peak-to-peak. Since most cable companies and equipment manufacturers consider 1.0 Vp-p as representing the maximum brightness of a video picture, then this translates to 140 IRE units. Of that, 40 IRE units constitute the amplitude of the sync pulse as measured from the "back porch," and 100 IRE units constitute maximum brightness, also as measured from back porch (see Figure 2). For 1.0 Vp-p video signal, each IRE unit represents 7.14 millivolts peak-to-peak. So when the video signal is 1.00 volt peak-to-peak, then the sync pulse should be 0.2857 volts or 28.6 percent and the picture component should be 71.4 percent of the composite video signal.

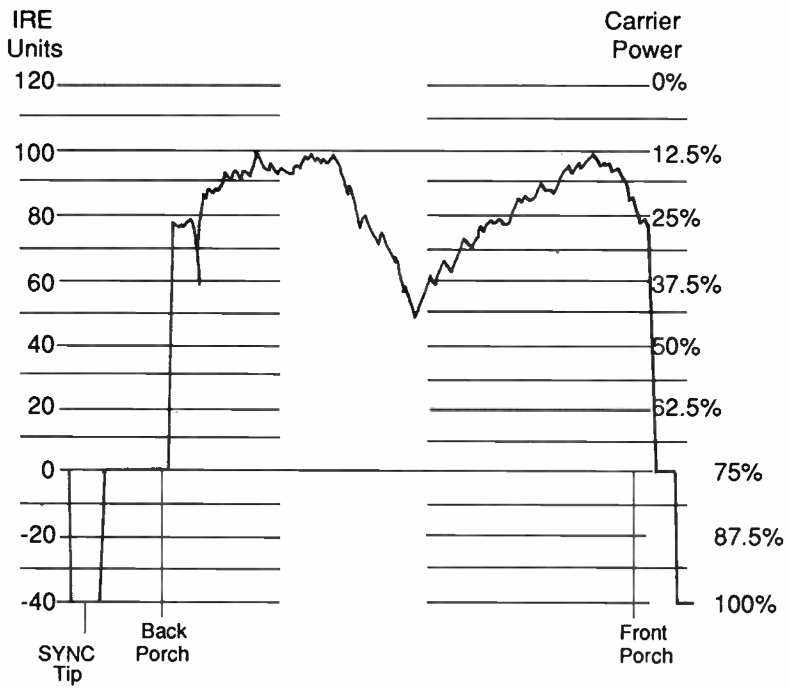
Waveform monitors are also equipped with a special scale (see Figure 3) calibrated in IRE units. However, it is not necessary to use this unit of measurement when the main interest is to set video to 1 Vp-p everywhere that the television signal appears at baseband in the headend. Thus, an ordinary scope, without the special IRE graticule can be used, as long as an external IRE filter is used with it to remove the chrominance component.

The maximum video carrier power occurs during the tip of the sync pulse, therefore -40 IRE units corresponds to 100% carrier power (see Figure 2). Also note that 100 IRE units equals 12.5% video carrier power, not zero carrier power. Since 12.5 carrier power corresponds to 87.5% depth of modulation (100% − 12.5% = 87.5%), then this is the maximum modulation permitted for the luminance component of the video signal. The extra 12.5% remaining of the video carrier is reserved for the chrominance components, otherwise color would be "wiped out" on bright scenes. These relationships reveal why "scope" readings (without the IRE filters) can easily result in serious misadjustments of the TV modulator.

Measurement of the video signal amplitude can be made without interrupting service by including a "BNC-T" connector in the cabling between the baseband video source (i.e. the satellite receiver video output connector) and the input to the television modulator. Since the video volt meter has a high impedance input, the video signal can be measured without changing the level when the meter is connected.

The video volt meter or waveform monitor, or scope with the IRE filter, should be directly connected to the BNC-T because a long cable attached at this point could create reflections that may impair the picture by causing ghosts or ringing to appear. It is particularly useful to provide a panel-mounted BNC-T so that all of the TV modulators in one rack of equipment can be measured from the front of the rack. A short 10-inch to 12-inch cable can be used to connect the video voltmeter to this panel-mounted connector without impairing the video signal.

Figure 2



I.R.E. Scale

Video signal with I.R.E. low pass filter (Note that "color burst" on back porch is filtered out as part of chroma signal)

Accuracy

Even with an IRE filter, scopes do get out of adjustment so that calibration for 1.0 Vp-p becomes "iffy." Also, the waveform amplitude can be read differently according to the interpretation of each operator.

A digital video volt meter ensures consistent video voltage readings independent of operator "eye." It reads sync amplitude, white luminance amplitude and peak-to-peak composite video amplitude. The scale is calibrated in IRE units as well as volts peak-to-peak. Since the meter has a digital read-out, there is a minimum of interpretation required. The IRE filter is built-in, insuring measurement according to IRE standards.

The video volt meter has a basic accuracy of 1 percent ±1 IRE unit or 1 percent ±0.01 volts, so readings taken with this meter will be many times more accurate than even a recently calibrated scope.

Conclusion

This paper emphasizes that video peak-to-peak readings must be made with a filter that blocks out the chrominance component and that measurements made with a standard broadband oscilloscope can lead to substantial errors in headend level setting. Video waveform monitors are available that enable video level measurements according to IRE standards, but these monitors are quite expensive. Ordinary scopes can be used, provided that an IRE roll-off filter is used in conjunction with them. Finally, it is proposed that peak-to-peak voltage measurements of video can be made much more accurately and conveniently by a digital video volt meter than with a waveform monitor. ■

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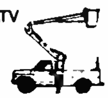

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March 12-14 *The Razorback Chapter* is sponsoring a technical seminar at the L'ARK Show in Hot Springs, Ark. The seminar will be held at the convention center and include: "Sweep Systems", with Terry Bush of Wavetek, "Terminal Devices", with Jim Farmer of Scientific-Atlanta, "Signal Leakage and CLI", with Tom Polis of Communications Construction and "Satellite Signals", with Paul Beeman of Viacom Networks. BCT/E examinations will be administered in all categories. Call Jim Dickerson (501) 777-4684 for info.

March 18 *Florida Chapter*, South Florida Group and Central Florida Group will hold a technical seminar. Call Dick Kirn, (813) 924-8541 for location, time and subject matter.

March 18 *The Cactus Chapter* is sponsoring a technical seminar. Call Harold Mackey Jr. (602) 866-0072, ext. 282 for location, time and subject matter.

March 22 *Ohio Valley Chapter* will meet for a technical seminar, "Data Networking and Architecture", with Ronald Perrett of Allen-Bradley Corp. BCT/E examinations will be administered. Call Bill Ricker, (614) 236-1292 for time and location.

March 29 *The Great Lakes Chapter* will meet for a technical seminar. Call Daniel Leith, (313) 549-8288 for info.

April 10 *The Florida Chapter*, South Florida Group will gather for a technical seminar on "HDTV". For details call Dick Kirn, (813) 924-8541.

April 13 *Chesapeake Chapter* will host a technical seminar on "Satellite Communications" at the Holiday Inn in Columbia, Md. Call Tom Gorman, (301) 252-1012 for info.

May 10 *North County Chapter* will meet for a technical seminar on BCT/E Category III, "Transportation Systems", with Dane Walker of Hughes Microwave. The seminar will be held at the Sheraton Midway Hotel in St. Paul, Minn. Call Douglas Ceballos, (612) 522-5200, ext. 705 for details.

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April 25-27 *C-COR Electronics Technical Seminar* will be held in Columbus, Ohio. Call Teresa Harshborger, (800) 233-2267, ext. 326, to register or for more information.

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The Magnavox CATV Systems mobile training center is a fully-equipped laboratory on wheels for cable training. The three-day seminars combine instruction in theory and practical hands-on training, using gear and test equipment common throughout the industry. The fee is $300.

March 21-23 *Magnavox Mobile Training* will be held in Milwaukee, Wis. Call Amy Costello Haube, (800) 448-5171 (in NY state, 800-522-7464), to register or for more information.

March 28-30 *Magnavox Mobile Training* will be held in Minneapolis, Minn. Call Amy Costello Haube, (800) 448-5171 (in NY state, 800-522-7464), to register or for more information.

April 4-6 *Magnavox Mobile Training* will be held in Rapid City, S.D. Call Amy Costello Haube, (800) 448-5171 (in NY state, 800-522-7464), to register or for more information.

Etc.

March 14 *Real World Systems Inc.* presents Connectivity Day 89. With a focus on computer networking, the multivendor exhibit will be held at the Pulsations Entertainment Complex in suburban Philadelphia. The event targets buyers who use or evaluate local area networks, wide area networks, connectivity hardware and software, and communications products. Call Maria Moen, (215) 358-3245 for details.

March 15-17 *The University of Wisconsin-Madison* is sponsoring a system design tutorial "Understanding and Applying Cable Television Technology", to be held at the Wisconsin Center, Madison, Wis. The fee is $525. For more info call (800) 262-6243.

April 12-13 *Jerrold*, in conjunction with *CTAM*, will sponsor "Cable Insights '89—Taking the Mystery out of Cable TV Technology" at the Hyatt Regency Tech Center, Denver, Colo. Call Helen Werkheisor, (215) 674-4800 for details and registration.

Illinois Bell

AN AMERITECH COMPANY

Illinois Bell offers a two and a half day course in Fiber Optic Communications that emphasizes practical application and implementation. The course is designed for those responsible for planning, engineering, evaluating, selecting, installing and/or maintaining a fiber optic communications system. The fee is $775.

March 14-16 *Illinois Bell* Fiber Optic Communications seminar will be held in Hilton Head, S.C. Call (312) 655-3096 for registration or info.

Jones announces 2nd fiber rebuild; contracts with Anixter for hardware

Jones Intercable will rebuild its 60,000-subscriber Augusta, Ga. system with a combination of AM and FM fiber optic technology. **Anixter Cable TV** has been contracted to provide $3 million in fiber hardware as part of the total $15 million rebuild.

The announcement clearly establishes Jones as the leader in fiber optic system implementation for transmission of CATV signals. Several MSOs have experience using fiber for traditional FM supertrunk applications, but AM technology is just beginning to gain acceptance, both technologically and economically.

Jones will once again utilize an architecture that features route and signal redundancy, a design Jones has dubbed Cable Area Network (CAN). The Augusta system will be the second Jones rebuild to heavily rely on fiber (Broward County, Fla. was the first.)

Signal redundancy

The CAN system leaves the traditional coaxial plant in place and adds fiber as an alternative transmission medium. If the fiber, or primary, plant should ever fail, an internal automatic A/B switch kicks in and routes the signals through the coaxial plant (see "The Broward Cable Area Network fiber model," *CED*, February 1989, p.27)

Presently, the Augusta system has five AML links to deliver 35 channels of video over coaxial cable with amplifier cascades approaching 40 amps deep. The system will be rebuilt with 550 MHz electronics and 54 channels will be activated when the rebuild is completed at the end of this year, said Bob Luff, Jones group vice president of technology. For the time being, the AML links will remain in place.

Under the fiber plan, seven FM links will eminate from the master headend (see Figure 1) to hubs, where the signals will be converted to AM and delivered to 20 fiber points of presence in the various neighborhoods. From there, the signals will be converted to RF and sent to each drop. Cascades will be reduced to between five and 16 amplifiers.

The FM portion of the plant will utilize 12-fiber cable (with four fibers left for future use) while the AM portion will use six-fiber cable (with five left dark). Hardware from Synchronous will drive the FM section, while AT&T's Laser Link product will be used for AM. Luff said Anixter was selected because it won the bidding war. In Jones' Broward system, Catel hardware is being used.

A cost-effective system

More than 1,200 miles of fiber will be used, making the cost of the fiber portion of the project work out to $2,500 per mile, a figure which compares favorably with traditional construction methods. The system will feature entirely aerial construction, according to Luff.

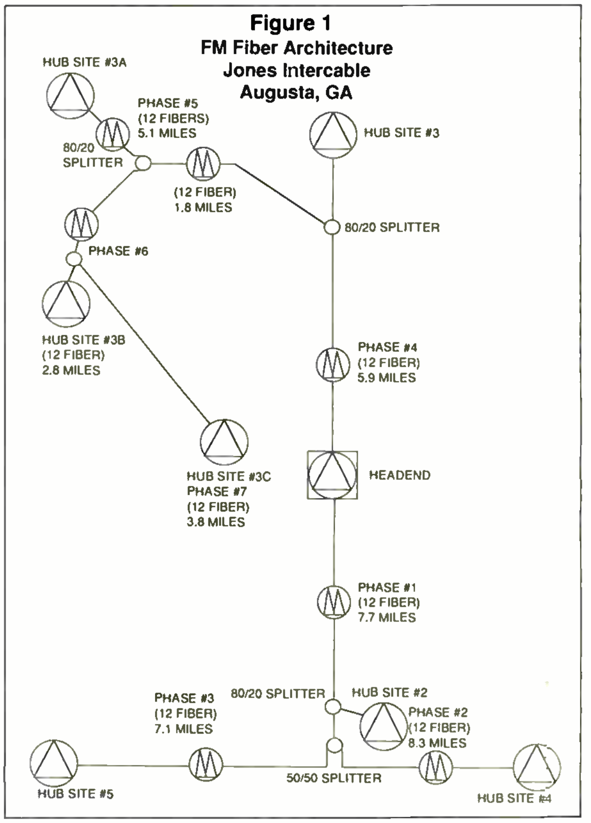


Figure 1
FM Fiber Architecture
Jones Intercable
Augusta, GA

As mentioned above, the AM portion of the plant will be built in parallel with the coax plant. The FM part, however, will require a "ring" architecture for back-up. (A ring architecture was selected because it would actually require less fiber than building a parallel path.) That portion of the plant, said Luff, will be built next year.

With path redundancy, the system will become much more reliable. According to Luff, traditional coax plants experience several outages per year, but with fiber, subscribers should see no more than one outage every five years. Because of that reliability, Jones will begin to aggressively seek data and business customers for its system.

Comcast, Jerrold ink deal

In other fiber contract news, **Comcast** has selected **Jerrold** to supply FM supertrunk technology for its rebuild in West Palm Beach, Fla. The $10 million contract (which includes traditional RF distribution gear) calls for Jerrold to provide fiber electronics for a 50-mile FM supertrunk connecting a new headend near Greenacres to three hub sites in Jupiter, West Palm Beach and Boynton Beach.

The entire $25 million rebuild will cover 1,100 miles and 18 communities. The project will take four years to complete, according to Frank Ragone, Comcast's vice president of engineering. When completed, the system will be outfitted with 550 MHz electronics, but will be activated with 40 channels of video.

The supertrunk will replace four existing headends and eliminate an obsolete microwave system. A regional system office will be built to act as a repeater site and commercial insertion facility, making one portion of the plant two-way.

According to Ragone, Jerrold was selected as the equipment vendor because Comcast had already had discussions with the Hatboro, Pa.-based company for conventional distribution equipment and addressable converters and when the FM fiber product became available, the ability to have one vendor provide the total package was attractive.

For Jerrold, the Comcast order both legitimizes fiber as a technology and Jerrold as a fiber supplier, said Lem Tarshis, vice president and general manager of distribution systems. "It's (the Comcast contract) a significant step...it proves fiber has a role in CATV," he said.

The Comcast deal, which represents Jerrold's first fiber system sale, will be followed shortly by contract announcements for both more FM equipment and AM hardware, said Tarshis. In fact, "half a dozen MSOs" have agreed to provide beta test sites for the AM product, and will begin thoses tests in the second quarter of 1989, Tarshis said.

Orchard Communication's FMD 1000

Orchard develops new product

And finally, **Orchard Communications** has introduced a new series of FM fiber optic hardware. The 1000 Series of equipment can deliver 16 channels of video over a single fiber at performance levels often approaching short-haul specs (but Orchard only guarantees medium-haul performance).

Orchard is a company that was created as the result of a management buy-out of Pirelli Communications Systems. Pirelli was highly successful in marketing its products to schools as "learning networks," where students and teachers could interact via television. The company is now planning to aggressively market its hardware to the CATV industry. More products, including AM-based gear and an IF-based system, will be introduced before the year is out, according to company officials.

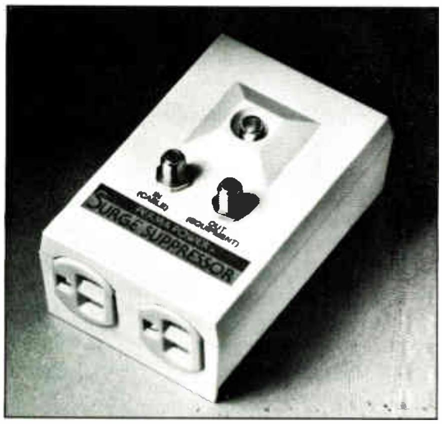
Features of the 1000 Series include frequency agility, high-quality audio and the ability to accept NTSC or composite video inputs from varied sources, such as VCRs, computers and video cameras. For information, call (800) 523-7893.

ISS's GL5020 IRD satellite receiver

New IRD

In other product news, **ISS Engineering Inc.** has announced a new C-and Ku-band IRD satellite receiver, the GL5020, scheduled for release in the first quarter of 1989. The GL5020 features a VideoCipher module that can be removed from the front panel via quick release latches. It meets RS-250B video quality, is a compact unit, and allows for tuning by either channel or frequency. The GL5020 also allows for remote control via a built-in RS-232 control. Call (800) 351-4477 for details.

A new Cable-Line™ surge suppressor from **Perma Power Electronics**



Perma Power's Cable-Line™ surge suppressor

Inc. is designed to protect electronic equipment from transient voltage surges on a television cable or antenna line, as well as on the power line. The surge suppressor Model PTC-209 can be used on antenna cable or satellite lead-in wires without creating a snowy picture or loss of picture, even in the UHF frequencies, the company said. The PTC-209 is housed in a low profile case weighing 11 ounces. It is rated at 1,800 watts, with a let-through voltage of less than two volts. For more information, call (312) 647-9414.

Viewsonics introduced its Ultra Seal tape designed to seal and weatherproof all aerial and underground fittings. Ultra Seal is a self-bonding tape which can be used to protect all types of fittings, including 90 degree and housing-to-housing connectors without interrupting service. For more information, call (800) 645-7600. In New York call (516) 921-7080.

Foresight's MR series of utility pole earth anchors

Foresight Products Inc. has extended its original MR-1 Manta Ray utility pole earth anchor, with a holding capacity of over 20,000 lbs., to include three new anchors. The MR-2 is designed to hold 10,000 to 20,000 lbs. in normal soils and the equivalent of the MR-1 in harder soils. The MR-3, rated between 6,000 and 8,000 lbs. holding capacity, was designed for the cable industry when new aerial lines, guy lines and anchors must be installed. The MR-4, rated at 3,000 to 4,000 lbs. in normal soils, is intended for small holding capacities. Call (800) 325-5360 for details.

Hughes' fiber alternative

In a demonstration conducted at the Western Show, **Hughes Aircraft Company's** microwave products division displayed its new AM-modulated transmitter/receiver combination. The new system provides 60 dB carrier-to-noise (C/N) at distances up to 32 kilometers with 40 TV channels and 56 dB C/N at 32 kilometers with 80 TV channels. The system also included 72 dB C/CTB and 62 dB C/CSO. Hughes is currently accepting orders for the new system offering delivery within 150 days. For details, call (213) 517-6233.

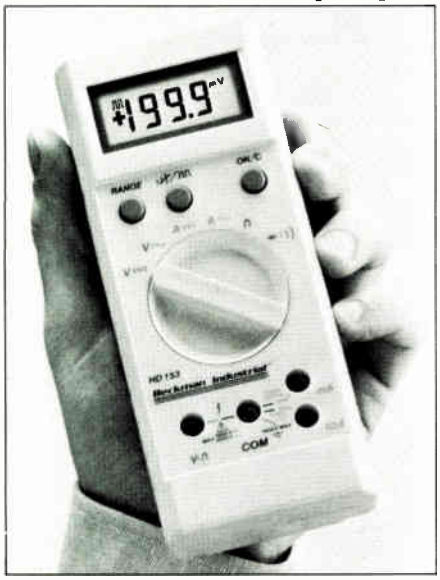
A new Quad Sync Repeater has been designed by **Falcone International Inc.** to eliminate problems encountered in syncing video tape sources to network. The unit retains the quality of incoming video signals while boosting power in order to drive two 75 ohm loads. One source connects directly to the insertion equipment, the other to the sync input of the video tape player. Each unit can handle up to four independent inputs and be used with other insertion equipment. Call (404) 427-9496 for details.

Cable related

In an announcement for the field of broadcast electronics, **Leitch Video**

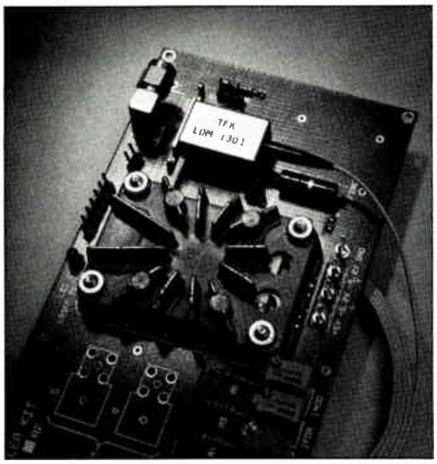
Leitch's ViewGuard System

has made available an addressable digital signal encryption system, the VGE-2000N ViewGuard Encoder and the VGD-2100N ViewGuard Decoder. The ViewGuard system offers hard encryption of both audio and video to prevent against unauthorized use (except for video lines 10 through 21 which are not encoded to allow passage of VITS, VIRS, or station ID). This would be applicable to cable systems in pay-per-view situations, according to John Walter with Leitch Video. Call (800) 231-9673 for more information.



HMC's Model HD153 Series DMM

HMC-HUB Material Company has introduced the HD150 Series DMM, digital multimeters. Available in three models, the digital multimeters are waterproof, drop proof, auto-ranging, and slim-styled. The HD151 has 0.7 percent DCV accuracy, the HD152 provides 0.5 percent DCV accuracy and the HD153 is 0.25 percent accurate. All HD150 Series DMMs come with a full two-year warranty. For more info, call (617) 821-1870.



New Tektronix laser controller kit

Tektronix has released a Laser Controller Kit for use by designers of RF-modulated laser diode applications. The kit provides a reduced-risk test environment with user-adjustable operating parameters. Protection is furnished by current-limiting and time-delay circuitry that prevents thermal or static damage to which laser-diode modules (LDMs) are vulnerable during laboratory operations. For details, call (800) 835-9433, Ext. 100.

More fiber news

Ortel Corp. has introduced the System 6000, a TVRO fiber optic link used to transmit the LNB output from a satellite earth station antenna to a remote receiver or headend over distances up to 15 miles. The System 6000 consists of a model 6300A fiber optic laser transmitter and a model 6400A photodiode receiver. The system can transmit all 12 channels from a single polarization. Call (818) 281-3636 for info.

—Roger Brown and Kathy Berlin

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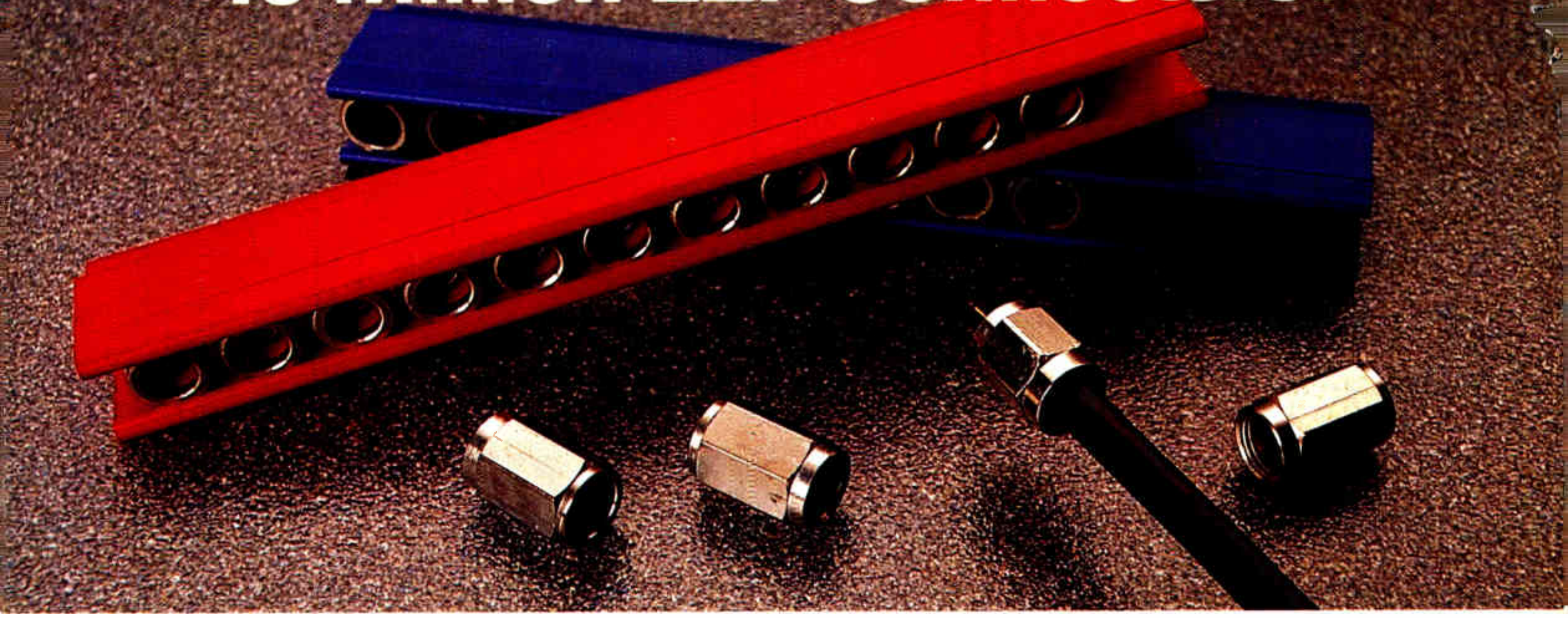
CORPORATE OFFICES, ANIXTER CABLE TV, INC., 4711 Golf Road, Skokie, IL 60076, (312) 677-2600

Reader Service Number 51

Why have MSO's ordered over 40 million EZF Connectors?



Lower Maintenance Costs and Improved Customer Satisfaction

In both new builds and rebuilds, users of the EZF connector system are experiencing a dramatic reduction in drop related service calls. RF leakage trouble calls resulting from improper connector installation and corrosion are no longer the single most problem in a CATV system when the EZF connector system is used.

PROVEN: Fewer problems occur during installation

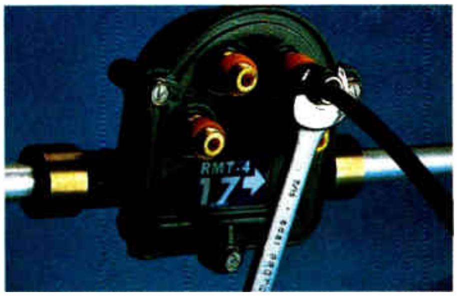
• One color-coded connector for each cable size minimizes connector selection problems.

• The cable is prepared for installation the same way every time with the EZF cable preparation tool.

• Only a 7/16 inch wrench is needed for installation.

• Cassette packaging facilitates proper installation and reduces connector loss.

• Immediate inspection for proper installation by installers and QC inspectors.



PROVEN: Fewer problems occur during service life

• A circumferential, environmental seal is automatically made at the connector/cable interface during installation.

• The EZF sealing sleeve supplied with the connector prevents moisture penetration at the connector/port interface.

• Material compatibility and corrosion resistance are ensured by specially selected and tested materials and platings.

• Rugged connector design and consistent installation quality contribute to reduced RF leakage and reliable performance.

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