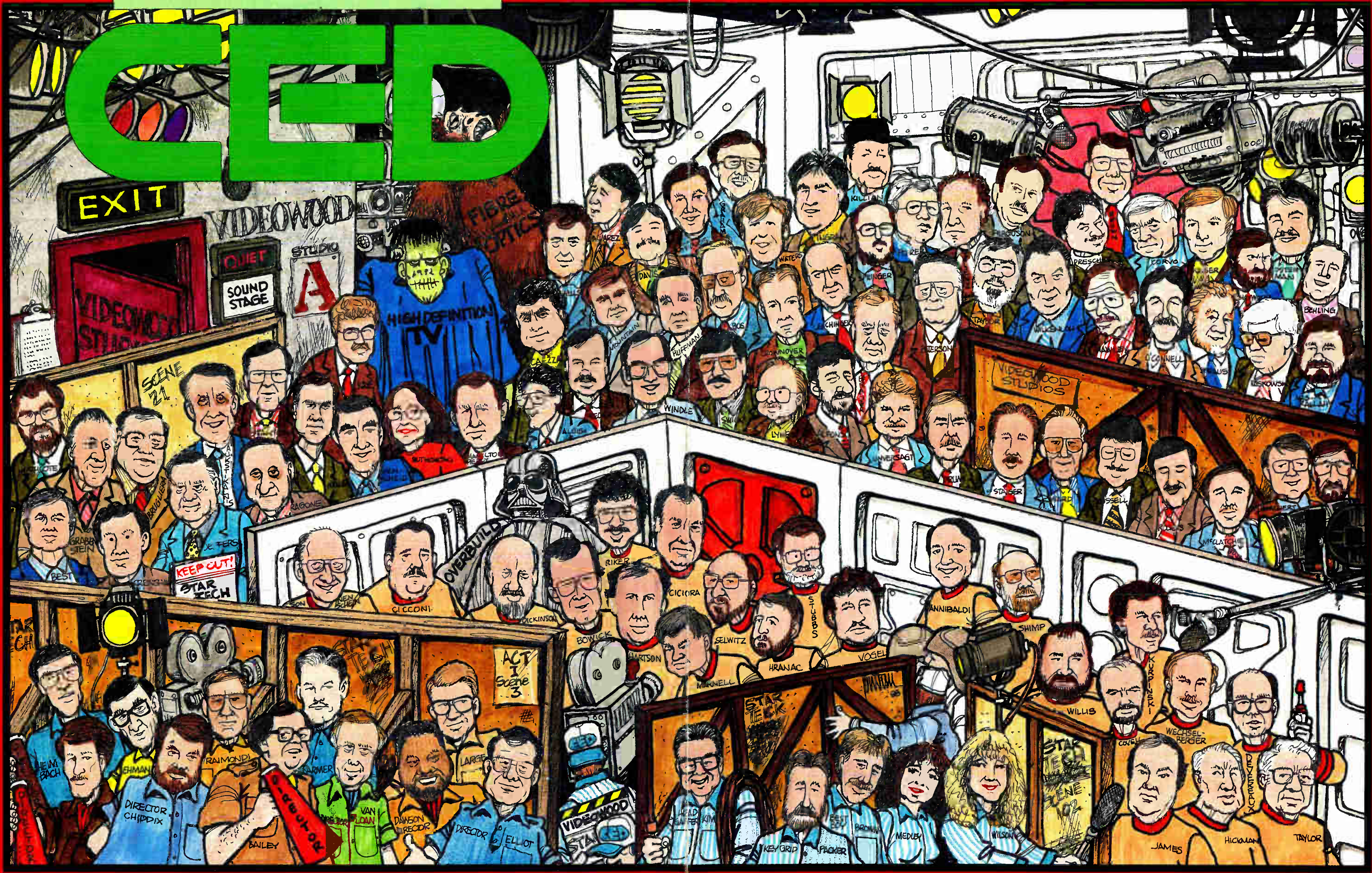
MAY 1988

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

CED



CED

May 1988 Volume 14, Number 5

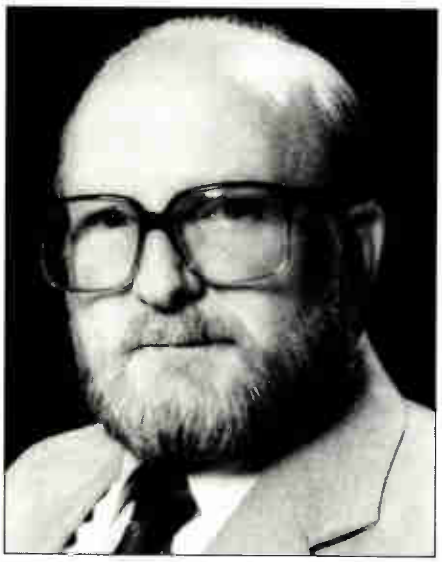
ITCI

INTERNATIONAL THOMSON COMMUNICATIONS INC.

CED (USPS 300-510) (ISSN 0191-5428) is published monthly by International Thomson Communications Inc., 600 Grant St., Denver, CO 80203. ©May 1988, Volume 14, Number 5. Subscriptions free to qualified industry readers. All other one-year subscriptions are $26, prepaid in U.S. funds only. Second-class postage paid at Cleveland, OH. and additional mailing offices. CED is published on behalf of the cable television and broadband communications industries. POSTMASTER: Please send address changes to 600 Grant St., Suite 600 Denver, CO 80203. MEMBERS OF THE BPA.

About the Cover:
A Hollywood back lot is just the place to play out cable's future. The cast is the NCTA Engineering Committee and CATV vendors. Art by Rob Pudim.

spotlight



Austin 'Shorty' Coryell

Weathering the storm

Will the telcos eat cable's lunch one day? Are technical personnel in the CATV industry poorly trained? Does cable have time to react to the threat posed by HDTV, DBS and Super-VHS?

The answer to all these questions is a resounding "yes" if you listen to Austin "Shorty" Coryell—an industry veteran who has been around long enough to know. Coryell, who began his cable career 36 years ago in the cable hotbed of Williamsport, Pa., has seen a lot of companies, people and ideas come and go but says it's the basic things the industry continues to falter over.

Above all else, adequate personnel training should be the foremost priority of MSOs, says Coryell, director of test evaluation at American Television and Communication. "Installers are still being trained the same way they were 20 years ago while technology has advanced tremendously," he says. "Nowadays, when a man goes into a house, he's got 80 or 100 channels, he has to hook up an addressable converter, call and have it adressed, he's got a VCR and A/B switches. He just about has to be an engineer but we still call them installers and pay them the same. I think that's one of our biggest weaknesses."

Coryell started his trip up the ladder in 1952 as a part-time pole climber during the construction of the Williamsport system. (The system was partly owned by Len Ecker—another well-known industry pioneer.) In fact, over the next several years, he worked in various capacities at all three systems that served Williamsport. "We had three companies on the same poles in many cases," he recalls.

Then it was on the TelePrompter as a chief engineer in a New York system, where he worked for just over three years. He then was named director of engineering for Television Communications. He stayed with TVC to set up a research and development lab in Florida in the late '60s and was named director of R&D.

His crew developed an addressable veractor-tuned converter with encoding and a transponder for return communications. "We did that way before anyone else did," says Coryell. But the industry "was looking for a $19.95 encoder/decoder...and our product was a little more expensive than that," he says. Although the product was a technical success, it had no market. Regardless, it remains Coryell's greatest professional accomplishment, he says.

In 1971, Warner bought TVC and closed the lab. Coryell was hired by ATC to be a regional engineer based in Orlando. He moved to the corporate level in 1979 as project engineer, later became director of field engineering and just last year was appointed to his present position, where he's responsible for testing and evaluating CATV hardware.

Are today's products better than they were years ago? Not necessarily, says Coryell. "I've been testing and evaluating products over my whole career," says the bearded Coryell. "I think the quality of products is cyclical. We're finding problems that have to do with the basic design of the equipment. These same companies had products come through here five years ago without anything wrong."

What's the difference? Personnel, according to Coryell. Manufacturers have no shortage of engineering talent, but those engineers might not have prior cable experience or may only design a block, or portion, of the piece of equipment. "They don't understand all the electronics put together," he says.

Coryell, in his gadfly role, continues to pester manufacturers for a system end monitoring device where specs like composite triple beat, cross-mod and signal-to-noise could be monitored over time. He hasn't managed to get any vendor to agree to make it, but plans to continue to ask until they do.

It is perhaps surprising to learn that an ATC corporate engineer admits that training continues to be the greatest stumbling block at the system level. After all, ATC has arguably the best national training program available in the industry. But Coryell is being realistic.

"The training center is an excellent facility, but you only get (to train the employee) for two weeks out of a year," he says. "That leaves 50 weeks where they should have in-house training and I think (few systems) have in-house training programs. I don't think management spends enough time training and developing its people."

The big difference between 1968 and 1988 is the way the industry is run, Shorty says. "Back years ago you could do just about anything and make money," he recalls. "But there's so much competition nowadays that to make money you have to be professional." And in the '50s, cable systems built its plant in rural areas, often with only 10 or 12 homes per mile. "We got our money up-front back then through $250 to $350 installation fees," Coryell says. "Now we give installs away and have to make our money after the plant is built."

Regardless, Coryell believes the industry can weather the storm brought on by competitive forces, but it may not be easy. "We're in a big battle with the telephone company right now and a lot of people don't realize it," he says. Whoever is able to bring fiber optic technology to the home first will be the big victor, adds the ATC 1987 Engineering of the Year Award winner.

"Everyone needs to work and give 130 percent to keep up with technology and hold back the competitors. There's always a challenge—but that's what I *like* about this industry," he says.

—Roger Brown

ALL GUTS = SUPERIOR ATTENUATION

Anyway you slice it, manufacturers of foamed cables have been scrambling to attain the superior attenuation characteristics of MC². The attempt means increasing our familiar MC² diameter of .500" to .565" or .625"; and our .750" must become .840" or .860" or .875".

You may still use MC² in one size smaller than the *old* foamed diameters. Even more MC² per duct, and easier handling. In aerial installations, the effects of wind and ice–loading are reduced even further.

And with the superior attenuation of MC² you don't have to clutter your lines with as many amplifiers — about 20% fewer than with foamed cables.

Low-loss MC² is your gain in many ways.

TRILOGY LEADS IN TECHNOLOGY

Trilogy COMMUNICATIONS INC.

Call or write for a free sample and brochure:

TRILOGY COMMUNICATIONS INC., 2910 Highway 80 East, Pearl, Mississippi 39208

800-874-5649
601-932-4461

See us at the NCTA Show, Booth #2125.

Reader Service Number 3

my turn

Improved NTSC won't be easy

As early as 1936, five years before the first NTSC developed its monochrome television standards, the 6 MHz channel width had already been set in concrete by the Radio Manufacturers Association television standards committees. At that time, 100 MHz was at the frontier of the electromagnetic spectrum considered useful for public purposes. You may laugh, but references even to 75 megacycles as "ultra-high frequency" were commonplace. Frequencies (wavelengths) were measured with Lecher wires (ask some old-timers about those); magnetrons and Barkhausen tubes were used for power oscillators. The RMA recommendation that seven 6-MHz channels be established between 42 MHz and 90 MHz was considered at the time to be both farsighted and a little greedy. In hindsight, it is unfortunate they did not opt for 8 MHz channels.

In the 1936-37 RMA deliberations, there was general agreement on 441-line, 2.5 MHz video bandwidth, using double sideband amplitude modulation. By 1938, however, vestigial sideband technology had been developed. The RMA committees adopted the new technique in order to increase the video bandwidth to 4 MHz. It was only at the last meeting of the first NTSC, in March 1941, that the number of scan lines was changed from 441 to 525.

In January 1950, after the wartime freeze, the NTSC was reconvened to develop compatible color TV standards. By this time, there was no possibility of expanding the 6 MHz channel bandwidth. Therefore, the vestigial sideband, 525-line structure became literally immutable.

The worst of it is that in the 50 years since the RMA first decreed vestigial sideband operation, definition of the VSB characteristics of transmitter and receiver has been sketchy, at best. Deviations from the idealized amplitude/frequency response drawing incorporated in FCC Rules as Figure 5, Section 73.699, although once specified by FCC, have since been withdrawn. Neither the NTSC nor the FCC has ever specified even ideal phase response or group delay characteristics for the lower sideband.

NTSC did give consideration to anticipated receiver phase errors at high video frequencies caused by the sound trap at 4.5 MHz. Assuming that there would be a reasonably uniform receiver characteristic at frequencies above about 2.5 MHz, the committee decided to make appropriate pre-correction at the transmitter to save the expense of equalizing all color TV receivers. The only trouble is that few receivers sold over the years have had the characteristics for which the pre-correction rule was designed.

These two RF components of the NTSC standard, vestigial sideband and envelope delay pre-correction for the soundtrap, can create serious mischief in the displayed picture. Group delay (i.e. envelope delay) errors in the vestigial sideband are usually responsible for leading undershoot, trailing "close ghosts" or "edge effects" (sometimes called "halo"), and the smearing of vertical edges in both monochrome and color pictures.

It is my opinion, therefore, that proposals to improve or enhance NTSC video performance are not likely to be generally successful unless effective steps are also taken to deal with the group delay distortions resulting from the poorly defined phase and amplitude characteristics of the VSB and sound notch filters and traps, at the transmitter and receiver as well as intermediate processing points.

What is really needed for improved NTSC performance, I believe, is (1) a clear definition of the amplitude and phase characteristics in the vestigial sideband region, with allowable deviation limits for transmission and distribution; and, (2) elimination of the pre-correction for the sound trap at the transmitter and all intermediate points. With a reasonably well defined transmission characteristic in this respect, receiver response could be defined by the manfacturer, either empirically for best picture, or analytically for low group delay distortion. This would not be workable unless actual transmission and distribution characteristics were uniform and predictable.

Videocassette players with Y and C baseband connections to the display monitor are not affected by these problems, because they operate at baseband. Cable TV has the opportunity to establish its own vestigial sideband characteristics with respect to satellite-delivered and locally originated programs. This could be incorporated in the *NCTA Recommended Practices*.

Elimination of the NTSC/FCC pre-correction standard would simplify the standardization of distribution systems. However, delay inequality between luminance and chrominance components is also caused by cascaded two-way duplexing filters in the distribution network in addition to the delay characteristics of modulators.

We need to ask ourselves how we will explain to subscribers, who purchase compatible advanced TV receiving equipment, that we are not responsible for these edge effects, smear and color misregistration.

Unless signals can be delivered to the second detector in home receivers with correct VSB phase and amplitude response, and acceptable group delay at the color sub-carrier, clean, crisp pictures may only be available on Super-VHS cassettes (and beyond).

Editor's Note: A more complete discussion of these issues will be included in the Technical Papers of the 37th Annual NCTA Convention.

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

"It's not whether you win or lose. It's how you play the game."

Reader Service Number 4

WRC

And win you will, with Scientific-Atlanta. We're committed to it. To help you satisfy your customers, and do so efficiently. With value-added, user-friendly solutions from us which help you generate revenue, improve penetration and retention, and run your system better. We're committed to you being a winner.

Yo pla wi

WIN THROUGH VOLUME CONTROL

Our new 8590 is the friendliest and fullest featured volume control addressable in the industry. A unique display lets your subscribers *see* sound on a volume level indicator. And it guides them easily through the VCR programming process. The 8590 keeps a secret better, too. With a choice of 50 security modes, utilizing three advanced security technologies: dynamic sync suppression, dropped field, and video and sync inversion. It includes easy-to-implement, plug-in IPPV. It's compatible with the rest of the set-top family. And, since it's also compatible with Oak and a long list of others, the 8590 can help you out with the old and in with the new.

WIN THROUGH VALUE

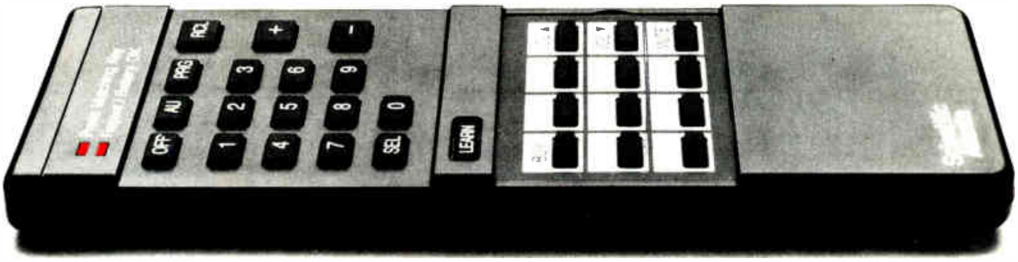
The new 8570 addressable set-top is the value packed younger brother of the industry standard 8580. It comes with all the subscriber features of its older brother. And then some. It shares the same new advanced VCR timer with the 8580 and 8590, taping twice as many events as before. It simplifies impulse like the 8590, with a one-touch buy key on both the remote *and* the set-top.

Scientific Atlanta

ou

y to

n...



WIN THROUGH FRIENDLINESS

Our Complete Remote Control is so smart it generates revenue while solving problems. Ninety percent of subscribers with set-tops have two or more remotes per set; thirty percent have three or more. That's a problem! The CRC eliminates multiple remotes by quickly and easily learning their functions, without the obsolescence risk of preprogramming. And, if your subscriber has a remote control TV–it can provide volume control *without* a volume control set-top. That's friendliness your subscriber will pay for.

WIN THROUGH CONVENIENCE

Our plug-in Micro-Pulse Module makes IPPV easier. Because the easier we make things, the more they're used. And it's backward compatible to over 70% of our cable installed base. That puts our experience with 300,000 IPPV set-tops in hotels, processing ten million transactions per year, to work for you.

Winning today in cable depends on delivering value. Delivering friendly and convenient solutions subscribers will pay for. And stay for.

Reader Service Number 4

The Japanese and HDTV

"Curiouser and curiouser", to quote Lewis Carroll, the issue of higher definition television, along with its sibling technologies, extended definition television (EDTV); improved definition television (IDTV); advanced compatible television (ACTV); and enhanced NTSC (ENTSC) have all apparently come, like so many fictional characters from Alice's Wonderland, to delight, bedevil and mystify us.

Recently, a small delegation of cable officials visited several companies in Japan which are heavily involved in the development of one or several of these technologies. The purpose of the delegation was to convince people working on these projects of the importance of several cable issues while there is still time in the development stage.

I have to say at the outset that prior to this delegation's visit I don't believe the various companies working on high definition and improved definition TV in Japan gave much thought to the cable television industry in the U.S. and Canada. What was more startling, however, was the realization (after several meetings) that the companies working on these issues had not given very much thought to broadcasting entities that exist in their own country, let alone in the U.S. and Canada. Indeed, we found a curious mind set.

First, high definition television and the coding scheme known as MUSE was developed specifically for studio-to-satellite-to-home transmissions. The other technologies have different and non-compatible roles to play. IDTV consists primarily of improvements in the receiving equipment in the consumer's home and improvements in the studio equipment that together make better NTSC pictures. All of the consumer electronics manufacturers were working on IDTV. The companies which make professional equipment are making changes too but these improvements are motivated by HDTV and EDTV as well as IDTV.

We found a great ambivalence and apathy about any development of EDTV, with the various industry groups working on improvements in television seeming to take a "wait and see what the rest of the world does" attitude. EDTV would include a wider aspect ratio as well as improvements in resolution in one or more dimensions. We spent time looking at interesting developments by some well-known companies. We saw, for instance, several versions of high definition production equipment (such as one-inch tape machines) at several companies.

What I found startling about this beautiful equipment was that the Japanese, now that a standard has been agreed upon in their country, will honor that standard while competing vigorously on the bells and whistles and operating niceties of different brands of equipment. To see this high definition production equipment already involved in serious competition on operating features was a revelation. It was also a revelation to see intense work being done on improved cameras and flat screen television sets. The flat screen TV set long promised in science fiction and fanciful rhetoric of future thinkers seems to me to be closer today than it was a couple of years ago.

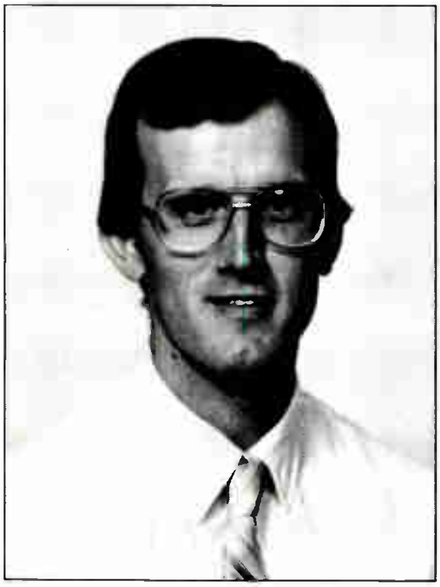
While the prototypes that we saw are certainly not anything that you could sell in a Sears store today, the fact is that the strides made in this peculiar and esoteric technology are rather amazing. The screen still needs to be improved in brightness, but under the correct viewing conditions it is a very watchable screen. The whole idea behind flat screen displays is TV sets the size of very large pictures or, perhaps, the size of a wall. Instead of having them protrude out into the room, they would hang on the wall—not unlike a picture roughly two inches thick.

Once large-screen television sets become commonplace, either as flat screens hung on the wall or projection screens of high quality, the ability of the average consumer to spot artifacts delivered by NTSC (remember the improvements promised in IDTV) or degradations delivered by cable television systems (noise, adjacent channel sound beats, composite triple beat, micro-reflections) will be enhanced.

While these developments were interesting and the learning process was intense, one thing that impressed me more than anything else was the absolute dedication of the people working on these projects. I wouldn't say I saw anyone smarter or better educated than I could find in similar American companies, but what I did see was an intense level of motivation from people working to accomplish improvements in television signals. I also had the sense that there was a strongly held belief that you should deliver to the consumer who buys your product the best pictures that are humanly possible.

The same devotion to providing quality to their customers manifested itself in other ways that were apparent to me, such as the attention to detail given by people serving me in restaurants, hotels, taxi cabs and other public areas. I felt at all times as if the people I was dealing with knew their product, knew what their goals were and had boundless enthusiasm for accomplishing them. This is a formidable combination of factors which have been brought to bear on one of the more complex and important issues that is likely to face the cable television industry. We in the cable industry will have to adopt the same level of enthusiasm and commitment to our customers and our goals if we are to grasp the opportunities that high definition, improved definition and enhanced definition television offer us.

By Wendell Bailey, Vice President Science and Technology, NCTA from the headend



Bandwidth, resolution, and aspect ratio

Industry interest in advanced television systems has sparked considerable discussion on baseband video bandwidth requirements needed to process a certain amount of horizontal resolution at a particular aspect ratio. At first glance, such a discussion might seem to be trivial. There is, after all, a very simple formula which can be derived, that has been used for many years to explain these bandwidth, resolution and aspect ratio interrelationships. Such simplicity is not the case, however, with many of the advanced television systems now being proposed.

Classically, the basic formula which has been used to relate these three parameters for NTSC is shown in Equation 1. This equation can be easily understood in an intuitive sense by going through the following analysis for standard NTSC video.

Since the horizontal scan frequency for NTSC is 15,734 Hz, the time required to complete a single scan line is simply 1/15,734 or 63.5 microseconds. However, horizontal sync and blanking require about 11 microseconds, leaving 52.5 microseconds to scan one line of the "active" video portion of the screen. This is called the active line time. Horizontal resolution is a measure of the amount of detail that is distinguishable as the TV's electron beam is scanned horizontally across this active portion of the line.

Since, with NTSC, we have 4.2 MHz of luminance bandwidth to work with, consider the transmission of a 4.2 MHz sinusoid through an NTSC system at a level of 100 IRE peak-to-peak (blanking to reference white). Such a signal would complete an entire cycle (black/white transition) in 1/4.2 MHz or 0.238 microseconds. Therefore, during the active part of the scan line, there would be 52.5/0.238 or 220.59 black/white cycles that would be visible. Since each cycle consists of two lines, one black and one white, there would then be 2 × 220.59 or 441 lines that would be visible across the entire active portion of the horizontal scan (or lines per picture width).

Resolution, however, is most often (but not always) defined in the literature in units of *lines per picture height.* Since the aspect ratio (screen width vs. screen height) of an NTSC TV is 4:3, you need to multiply the 441 visible lines (derived above) by 3/4 in order to translate to a resolution in lines per picture height. When this is done, you get 330, the number which is so often published for the horizontal resolution of an NTSC picture. By the way, this is the absolute best that the NTSC system is capable of.

Historically, the true luminance bandwidth has been deliberately limited to about 3 MHz in order to minimize cross-color and cross-luminance artifacts (see last month's column). This tended to reduce the system's horizontal resolution to 236 lines per picture height. It has only been in recent years that the full horizontal resolution capabilities of NTSC have been practically realized with the use of comb filters in TV receivers.

Using Equation 1, you can also determine that Super-VHS, which has a published resolution of about 430 lines per picture height, requires about 5.4 MHz of baseband luminance bandwidth.

$$RES = \frac{T * 2 * BW}{AR}$$

where:

RES = Horizontal resolution (in lines per picture height)

T = Active line time (usec) 52.5 for NTSC

BW = Luminance bandwidth (MHz) 4.2 for NTSC

AR = Aspect Ratio 4/3 for NTSC

Equation 1 can also be used to play some "what if" scenarios. For example, what if we wanted to transmit NTSC information in a 16:9 aspect ratio and still remain within our allotted 4.2 MHz bandwidth, what would our horizontal resolution be? The answer is 248 lines per picture height. So it is possible to trade aspect ratio for resolution while keeping the bandwidth requirements constant. The "bottom line" of Equation 1 is that, with all else remaining equal, increases in resolution and/or aspect ratio will require increased transmission bandwidths.

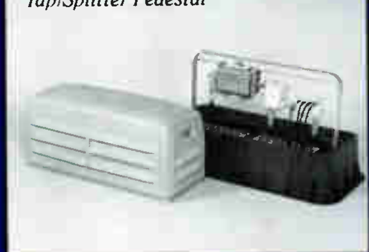
A problem arises, however, when we try to apply Equation 1 to many of the proposed EDTV and HDTV formats. Each of these new video formats makes use of an extensive amount of baseband video processing which has been specifically designed to enhance both vertical and horizontal resolution. The use of frame stores, line-difference signals, luminance time-compression, the Fukinuki Hole, quadrature modulation, and other enhancement techniques render Equation 1 obsolete for these systems. For them, this interrelationship is much more complex. In fact, these very relationships are continuing to evolve as each system is developed.

Because there is no simple relationship (similar to Equation 1) that we can use to perform our own calculations for many of the proposed EDTV and HDTV systems, we must continue to rely upon each proponent to supply useful bandwidth and resolution information. As you begin to wade through the information about advanced TV systems, just be sure that when you compare the various systems, a true apples-to-apples comparison can be made.

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

LIMITED OFFER!
Buy two miles of pedestals, get another mile free through July 31, 1988

If you still have doubts about Channell's plastic pedestals, this deal is for you!


CPH-1230B Line Extender, Tap/Splitter Pedestal


CPH-1730B5 Trunk Amplifier Pedestal. 500 series heat dissipation cover shown.

BUY TWO MILES OF PEDESTALS AND GET ANOTHER MILE FREE!

HOW TO ORDER:
Call Channell toll free and say you want the deal. Select the color you want—beige or light green. Consider locking options and other accessories. Remember, stakes and brackets are pre-installed and included in the price. Expect delivery in 14 to 21 days.

Type of Pedestal and Description	Pedestal Quantity Required per Mile of Plant*	Price You Pay for Two Miles	Third Mile Free
CPH-658B Tap Pedestal with bracket and stake pre-installed	22	44 Pedestals @ $14.35 each $631.40	22 Free CPH-658B Pedestals
CPH-816B Tap/Splitter Pedestal with bracket and stake pre-installed	6	12 Pedestals @ $24.80 each $297.60	6 Free CPH-816B Pedestals
CPH-1230B Line Extender, Tap/Splitter Pedestal with bracketry and ground skirt pre-installed	4	8 Pedestals @ $90.80 each $726.40	4 Free CPH-1230B Pedestals
CPH-1730B Trunk Amplifier Pedestal with bracketry and ground skirt pre-installed	1	2 Pedestals @ $159.80 each $319.60	1 Free CPH-1730B Pedestal
TOTAL		$1,975 — Your cost for 2 Miles	Third Mile Free... Valued at $987.50 when you buy 2 miles!

*Pedestal quantities based on Channell's national averages per mile. Your usage may differ.

There are still a few people who haven't tried Channell's new plastic pedestals. If you happen to be one of them, don't let this great opportunity pass you by.

Through July 31, 1988, buy two miles of Channell's rugged ABS pedestals and get another mile *FREE!* With a three mile installation, you'll be able to make a true evaluation of our pedestals... and we're convinced you'll see why Channell has become the leading enclosure manufacturer in the CATV industry.

Unlike other pedestal manufacturers, Channell continues to meet the changing needs of the CATV industry with new and innovative solutions, such as:

- Aesthetically pleasing, low profile designs
- High quality ABS plastic that is resistant to impact, chemicals and sunlight degradation
- Hot-dipped galvanized stakes and brackets—factory installed to assure quality control
- State-of-the-art active equipment pedestals that provide superior ventilation
- Broadest selection of pedestal accessories available

If you've been using metal closures, here's your opportunity to *save big bucks* and see why 55% of the CATV industry has switched to Channell's plastic pedestals and accessories. To take advantage of this special offer, call Channell today...*toll free!*

See us at NCTA, Booth #6122

Terms and Conditions

Offer only applies to cable systems who have not directly or indirectly purchased pedestals from Channell Commercial since December 31, 1986. A change to MSO affiliation does not constitute a new system.

Channell reserves the right to refuse any order that is considered to be in conflict with this offer.

Freight F.O.B., Glendora, CA.

Terms are NET 30 days upon approved credit.

C.O.D. orders will be accepted.

Channell COMMERCIAL CORPORATION
Technology you can trust!

620 W. Foothill Boulevard
Glendora, CA 91740 • (818) 963-1694
(800) 423-1863 Except in CA
(800) 345-3624 in CA

Reader Service Number 10

Advanced television systems

Part I

The 525 lines per frame, 60 fields per second, 2:1 interlaced scan television system has been serving the United States public for almost 50 years. Performance of this television system has improved significantly over the years, clearly one of the reasons for its long life.

The most significant single improvement was the addition of color. Engineers were able to add color information to the black and white signal without increasing the transmission bandwidth. To achieve this, luminance information was decreased and a subcarrier, containing color information, was introduced. The result for black-and-white receivers was lower resolution and the appearance of a dot structure, a loss considered to be acceptable.

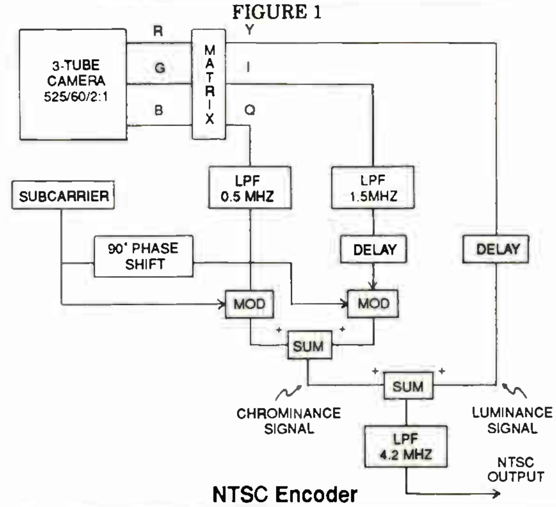
Other improvements have taken many forms and arise from constantly expanding technology. Both pick-up devices and display devices have improved dramatically. Solid state circuits now perform complex functions not possible before.

Current technology will permit another significant improvement: high definition television. Although everyone recognizes that HDTV is here to stay, there have been many debates on the need for it, the timing, and, of course, the technical standards.

NTSC

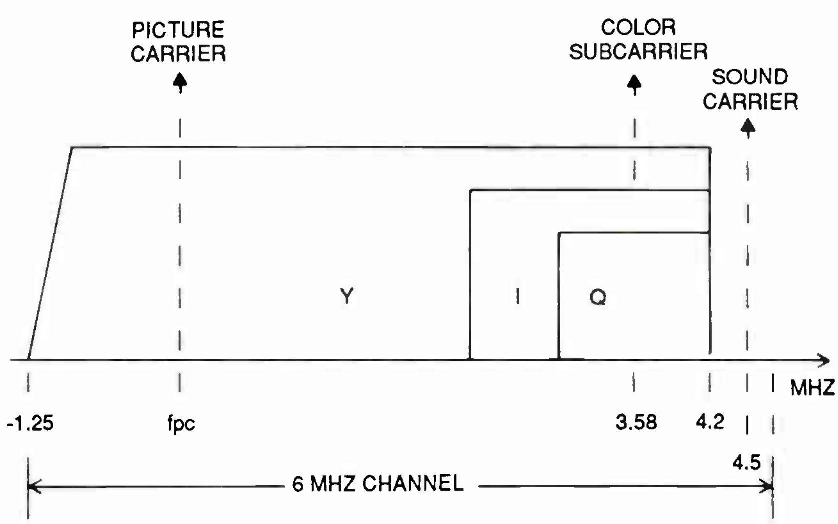
Although many people are not aware of this fact, there have been two NTSCs. The first National Television System Committee was convened around 1940 to establish the technical standards for an American black-and-white television system. The agreed upon standards were 525 lines per frame, 60 fields per second, 2:1 interlaced scan and 4:3 aspect ratio. The field frequency was precisely 60 hertz. Channel spacing for broadcasting was set at 6.0 MHz. The picture carrier frequency was 1.25 MHz above the lower end of the channel. The maximum video bandwidth transmitted was 4.2 MHz. Vestigial sideband amplitude modulation was chosen—single sideband for the upper frequency components and double sideband for the lower frequency components. The sound carrier frequency was set 4.5 MHz above the picture carrier frequency.

FIGURE 1



NTSC Encoder

FIGURE 2



Spectrum of transmitted NTSC signal

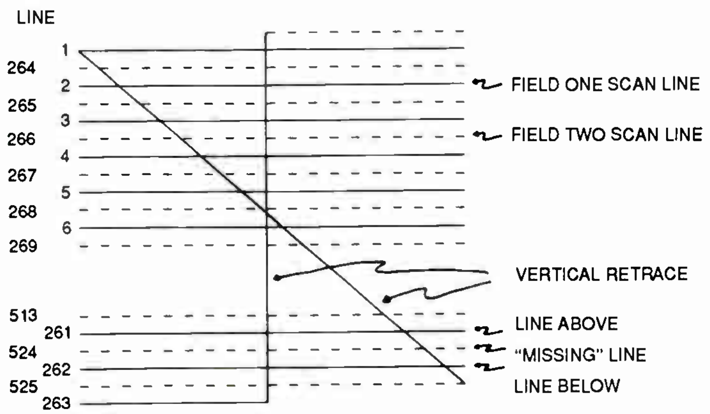
The second NTSC was convened in the early 1950s to establish technical standards for an American color television system. The black-and-white parameters were maintained with the exception of the horizontal scanning frequency and thus the field frequency. Each frequency was increased 0.1 percent. This will be explained later.

The color information was added to the black-and-white signal by inserting a subcarrier modulated in quadrature by two color-difference signals. The two color-difference signals, called the I and Q signals, are in quadrature on a color diagram. The I signal was specified with a bandwidth of about 1.5 MHz while the Q signal specification was only 0.5 MHz. The human eye has greater color resolution for colors near

By Robert Hopkins, U.S. Advanced Television Systems Committee

The two color-difference signals, called the I and Q signals, are in quadrature on a color diagram.

FIGURE 3



An illustration of the 525 line, 2:1 interlace scan system. The solid lines are displayed in 1/60 second. The dashed lines are displayed in the next 1/60 second. The picture can be improved by displaying 525 lines every field, although only 262 1/2 lines are transmitted each field, by:

A) Displaying each line two times in succession (poor approximation of "missing" line, distorts diagonal lines)
B) Displaying the average of the line above and the line below the "missing" line (better, but still has distortion of diagonal lines)
C) Displaying the "missing" line using a field store (very good for still pictures but motion compensation circuitry is required)

525 line 2:1 interlace scan

the I axis than near the Q axis and thus, to conserve bandwidth, these axes were chosen. The equations for the luminance signal (Y) and the color-difference signals are derived from the red, green and blue signals as follows:

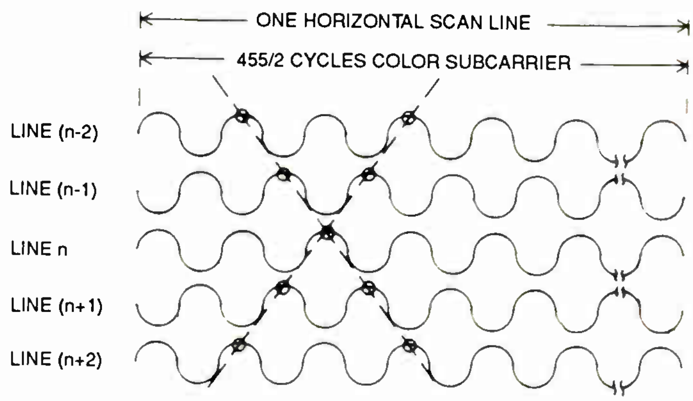
$$Y = 0.59G + 0.11B + 0.30R$$
$$I = -0.27(B-Y) + 0.74(R-Y)$$
$$Q = 0.41(B-Y) + 0.48(R-Y).$$

The color subcarrier frequency (f_{SC}) was chosen to be an odd multiple of one-half the horizontal scanning frequency (f_H) to minimize the appearance of the subcarrier in the picture. The multiple was also selected to have small factors. The resulting relationship is given by:

$$f_{SC} = (13)(7)(5)/2\ f_H = 455/2\ f_H.$$

The color subcarrier was interleaved with the sound carrier to minimize interference.

FIGURE 4



Phase of color subcarrier

This frequency is about 3.58 MHz. Since there were concerns that the color subcarrier and sound carrier would cause mutual interference, and that the sound carrier frequency could not be changed and maintain compatibility with receivers already in use, the horizontal scanning frequency (and thus the field frequency) was changed. The color subcarrier was interleaved with the sound carrier to minimize interference. The ratio of the sound carrier frequency (f_A) and the horizontal scanning frequency had been:

$$f_A/f_H = 4{,}500{,}000/15{,}750 = 285.71.$$

The horizontal scanning frequency was changed so that the sound carrier frequency would be an even multiple of the horizontal scanning frequency. The factor closest to 285.71 satisfying this requirement, 286, was selected. The new field frequency was precisely 1000/1001 times 60 hertz, or 59.94 hertz.

Figure 1 is a block diagram of an NTSC encoder while Figure 2 is a diagram of the spectrum of the transmitted NTSC signal.

The manner in which the color information was added gives rise to some of the artifacts observed in the NTSC system. High spatial frequencies in the imaged scene can produce luminance information which is treated by the NTSC decoder as if it were color information. A wide bandwidth luminance channel in a receiver can cause

Most engineers felt that the number of lines should not be decreased below 1,000 to compensate for the greater bandwidth.

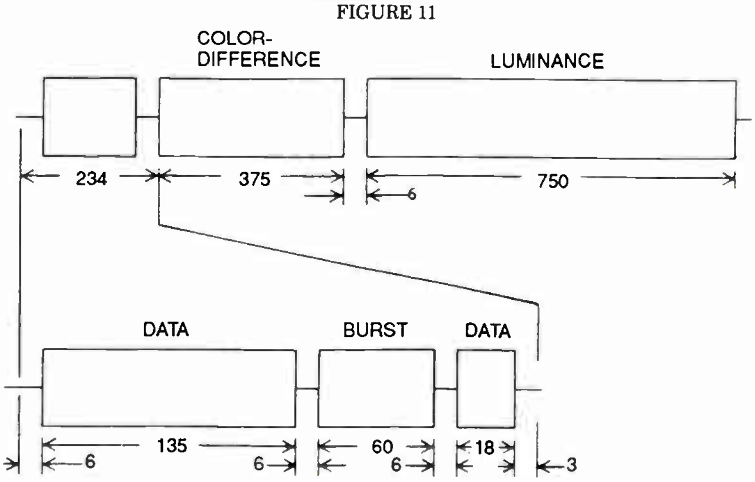
scanning because of the reduced bandwidth. They believed the aspect ratio should be at least 5:3, perhaps as wide as 2:1, and selected 5:3.

Studies in the United States supported each of these parameters except the aspect ratio. The U.S. proposed an aspect ratio of 16:9 to give greater flexibility in shooting and releasing a program. By using a "shoot and protect" scheme with a 16:9 aspect ratio, releases could be made conveniently in any aspect ratio between 4:3 and 2.35:1. If the master has a 16:9 aspect ratio, a 4:3 aspect ratio release would use the full height of the master and the appropriate width, as shown in Figure 12. A release with 2.35:1 aspect ratio would use the full width of the master and the appropriate height, also illustrated in Figure 12. Releases with an aspect ratio between these two extremes would use either the full width or the full height. The outer rectangle in Figure 12 represents the 16:9 aspect ratio master. The inner rectangle represents the image area in which the critical portions of the image should be contained.

Several engineers wanted a progressive scanning format, arguing that post-production would be easier and artifacts would be reduced. However, with twice the number of lines per field, the bandwidth doubles. Camera sensitivity, already limited, is reduced. Videotape recorders cannot handle the extra bandwidth. Most engineers felt that the number of lines should not be decreased below 1,000 to compensate for the greater bandwidth. On the other hand, some argued that if the bandwidth were to be doubled, it would be preferable to continue to use interlaced scanning but with twice the number of lines.

NHK proposed that the studio system have separate luminance and color-difference signals. However, the bandwidths being considered today are greater than those first proposed by NHK. The Advanced Television Systems Committee suggested that sample representations of the signal should be specified as well as specific bandwidths. The European Broadcasting

FIGURE 11



The number of clock periods for each portion of the waveform is indicated. There are 1365 total clock periods in the line.

Three clock periods are required for each data symbol. Each data symbol carries two bits. The digital data rate is 910 bits per line.

Luminance signal compression ratio = 3:2

Color-difference signal compression ratio = 3:2

B-MAC horizontal line

NHK proposed a new concept for the synchronizing signal, a three-level signal.

Union suggested that only sampled representations should be specified.

In order to decide how many samples per line should be used, the ATSC argued that the CCIR has defined HDTV as having about twice the horizontal and vertical resolution of current television systems. CCIR Recommendation 601 specifies 720 luminance samples during the active line and half that number for each of the two color-difference signals for current television systems. Twice the resolution would then imply twice 720 samples multiplied by the ratio of aspect ratios (16:9 divided by 4:3) resulting in 1,920 samples per active line for the luminance and half that number for each of the two color-difference signals. The resulting bandwidths would be about 30 MHz for luminance and 15 MHz for each color-difference signal.

The ATSC also proposed that the sampling frequency should be 74.25 MHz which results in 2,200 samples per total line. With 1,920 samples in the active line, 280 samples are left for blanking, 3.77 μS. These figures are being specified by the various standards organizations for the 1125/60 system.

The standards organizations are specifying SMPTE "C" colorimetry. The equation for the luminance is:

$$Y = 0.701G + 0.087B + 0.212R.$$

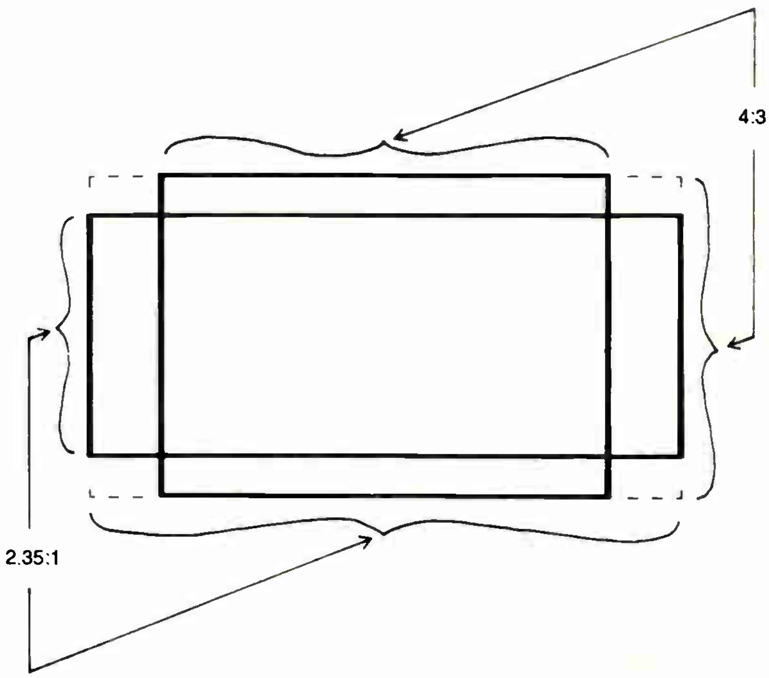
This equation applies following gamma correction, also fully specified. The gamma was not fully specified in the NTSC system.

NHK proposed a new concept for the synchronizing signal, a three-level signal shown in Figure 13. The precise timing information is carried by zero crossings between negative and positive pulses rather than negative going edges. NHK believes the timing accuracy improves significantly with this waveform.

The ATSC agreed in March 1985 to recommend to the U.S. Department of State that the 1125/60 system be proposed to the CCIR as a single worldwide standard for HDTV studios. After the U.S. CCIR National Committee unanimously agreed, the CCIR Plenary Assembly postponed any decision on a studio standard until 1990.

Next month: transmission proposals.

FIGURE 12



INNER RECTANGLE ASPECT RATIO = OUTER RECTANGLE ASPECT RATIO

$$= \sqrt{\frac{4}{3} \times \frac{2.35}{1}} = 1.770$$

NOTE THAT 16:9 = 1.7777

Shoot and protect with 16:9 aspect ratio

FIGURE 13

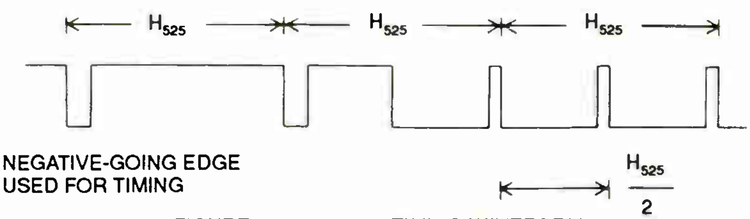


FIGURE 14A — 525/60 TIMING WAVEFORM

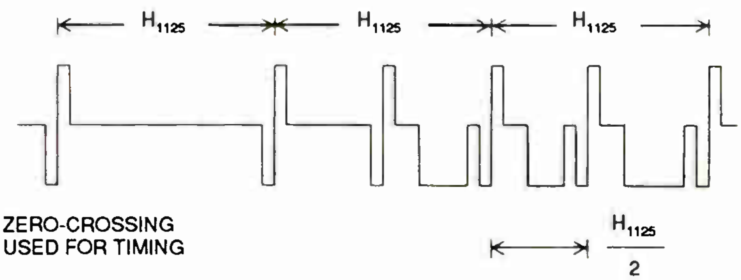


FIGURE 14B — 1125/60 TIMING WAVEFORM

NHK proposal for 1125/60 sync waveform

Utilizing advanced amplifier technologies...

...to achieve a total drop-in (trunk and feeder) upgrade.

As the homes passed by cable plant approaches saturation, and the requirements for expanding channel capacity of older plants increases, the attention given to upgrade/rebuild alternatives has become critical. As discussed in a February 1988 article in this magazine entitled "When Is a Drop-In Upgrade Possible?," (p.54), the savings associated with a drop-in upgrade are considerable (approximately $18,000 per mile for a complete rebuild vs. $4,000 per mile for a drop-in upgrade).

Almost by definition, a drop-in upgrade will require the use of higher technology amplifier products. Maintaining existing trunk amplifier and line extender locations in an upgrade demands that devices perform with higher gains, more channels and elevated operating levels with no loss in overall system performance. Though the IC vendors have made signficant improvements in their standard push-pull devices over the years, almost any upgrade beyond adding a few channels (usually less than five) requires the performance characteristics only available through power doubling, Quadrapower or feedforward technologies.

To qualify as a candidate for a drop-in upgrade, however, the existing cable plant must meet certain criteria. Topping the list of requirements is the need for good cable. If the cable cannot support the increased channel capacity without excessive degradation, all the improvements in amplifier technologies that are now available will not overcome this basic system flaw. Therefore, an SRL test of the existing cable (trunk and feeder) must be the first step in the process.

By Bob Young, Director, Product Marketing, Jerrold Distribution Systems

In addition to qualifying the existing cable, reasonable bridger, line extender and tap levels must be in operation. If the system is already operating with high bridger and line extender levels, the drop-in upgrade may be restricted to the trunk system only. For an existing 300 MHz system to add five channels (330 MHz) the bridger and line extender levels and gain must be increased by 1.5 dB. For 400 MHz and 450 MHz upgrades to be possible, the requirements are for 4.5 dB and 6.5 dB of additional level/gain, respectively. If the existing bridger and line extenders are presently operating in the 49 dBmV to 50 dBmV range, the drop-in feeder upgrade will be severely restricted.

Conversely, tap levels that are too low will also inhibit a drop-in. Every dB of increase to tap levels required for the upgraded system will add directly to the level/gain requirements for the bridger and line extenders. In many instances tap faceplate changes (if original vendor's product has maintained backward compatibility) which may be required to support through-loss bandwidth expansion of the taps allows for tap value changes. By changing tap values in connection with drop cable improvements, tap levels can be modified to reasonable levels.

For purposes of examining the advantages of the higher technology amplifier devices in drop-in upgrades three different 35-channel (300 MHz) systems will be evaluated. For each system a total (trunk and feeder) drop-in upgrade to 330 MHz, 400 MHz and 450 MHz will be examined. For simplicity, it will be assumed that existing tap levels are either sufficient or can be modified to support the upgrade requirements.

All three of the existing 35-channel systems are utilizing the standard 300 MHz push-pull technology which was available in the late 1970s and early 1980s. Table 1 details the performance characteristics of the amplifiers in use. For the purposes of this article, only carrier-to-noise (C/N) and composite triple beat (CTB) distortion will be examined.

TABLE 1

300 MHz amplifier performance (35 channel loading)

Push-pull trunk	Operating gain: 22 dB
	Noise figure: 9dB
	CTB: -85 dB at 31 dBmV
Push-pull bridger	CTB: -66 dB at 47 dBmV
Line extenders	Operating gain: 25 dB
	CTB: -65 dB at 47 dBmV

TABLE 2

Existing system performance characteristics

	System A	System B	System C
Trunk input level (dBmV)	9	9	9
Trunk output level	31	31	31
Bridger output level	47	44	47
Line extender output levels (dBmV)	44	41	44
System distortion			
CTB -dB	53	53	51
C/N -dB	45	44	44

TABLE 3

Upgrade systems' required levels and gains

	Systems A & C			System B		
	330	400	450	330	400	450
Bridger outputs (dBmV)	48.5	51.5	53.5	45.5	48.5	50.5
Line ext. outputs (dBmV)	45.5	48.5	50.5	42.5	45.5	47.5
Line ext. gains	26.5	29.5	31.5	26.5	29.5	31.5

The progressing art of system sweeping

Testing frequency response is commonly accepted as a fundamental requirement for verification of broadband RF system performance. The sweep can be used at any point in the system's life cycle to cross reference actual system characteristics with the design. Contributors to response variations that aren't apparent when the system is designed, such as signature build-up and diplex filter roll-off, are easily discovered when a frequency response test is made. Other RF discontinuities caused by faulty construction or the effects of nature (suck outs or severe high- or low-end roll-offs) also become apparent when the system is swept, helping to avert possible future system outages.

Since a frequency response test reveals so much about the performance of the system, it has become the single most important system test. Until now, there have been two basic methods for testing system frequency response: low level sweeping and high level sweeping. These methods have been effective but have required the sacrifice of either technical grace or subscriber satisfaction.

Low level sweep

Method. The low level sweep measures system frequency response by injecting a sweeping carrier at a low level (at least 15 dB below video carrier level). This sweep is detected using a specially designed tracking analyzer. Since the sweeping carrier is at a low level, interference is reduced and it can sweep continuously—providing good frequency resolution, with the added benefit of a spectrum analyzer.

Madness. There are two significant sources of technical discomfort caused by the low level method: the way the response is displayed and effectiveness on long cascades. The response display readability is hampered by the presence of system video and audio carriers. The response information must be picked out from around these carriers on the display. Another technical difficulty is that as system carrier-to-noise degrades with cascade length, it becomes difficult for the analyzer to segregate the sweeping carrier and the system noise.

By Steve Windle, Senior Applications Engineer, Wavetek RF Products

FIGURE 1

Low level sweep display

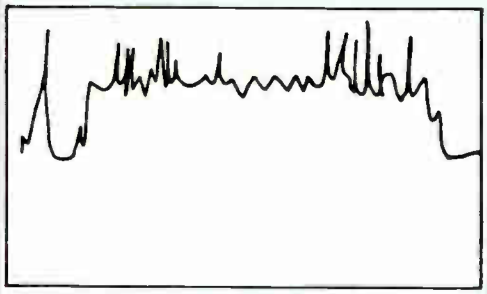


FIGURE 2

High level sweep display

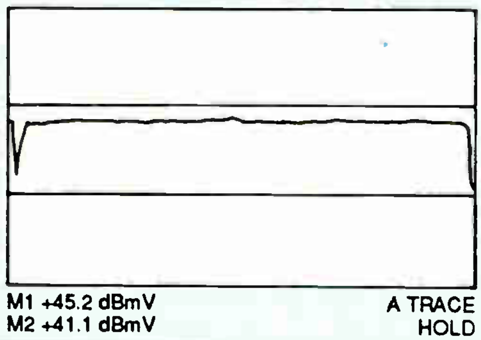
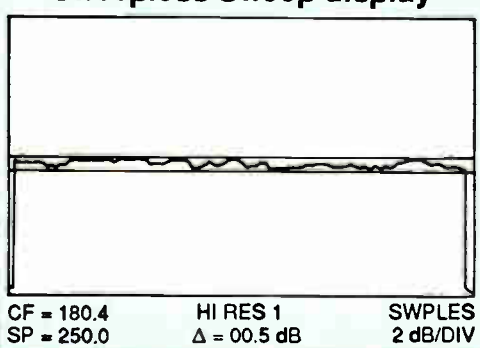


FIGURE 3

Sweepless Sweep display



High level sweep

Method. The high level sweep measures system frequency response by injecting a sweeping carrier at a high level (as much as 20 dB) above the video carriers on the system. This carrier, which sweeps at a high rate of speed (usually 1 millisecond from start to stop frequency), is detected at system test points using a specially designed broadband sweep receiver. This system is very effective, providing highly accurate measurement results with great amplitude resolution and the best frequency resolution of any currently available alternative.

Madness. This system sounds pretty sweet so far, but it too has problems—not related to its technical effectiveness, but to its effect on system services. As might be expected, even though the high level sweeping carrier travels through the spectrum at a very high rate of speed and is timed to occur only once every five seconds, it can be detectable on subscriber TV pictures. When the high level sweep was first introduced this interference manifested itself as a small "blip" which only took out a fraction of a line of TV information. This "blip" was considered acceptable because it was barely noticable and usually took a trained eye to find.

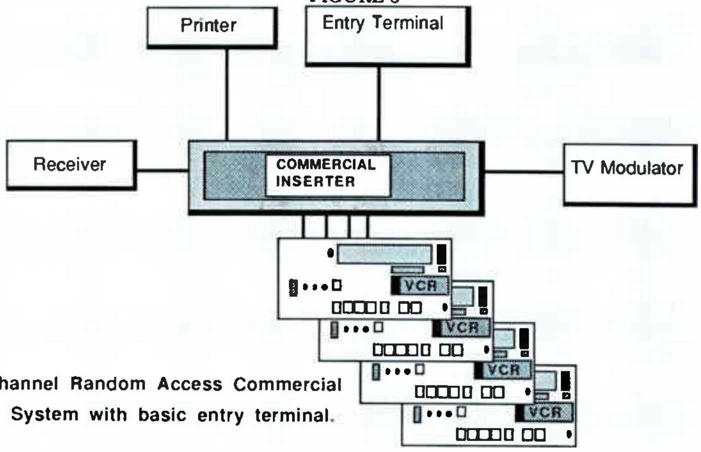
But, with the advent of many "cable-ready" devices (TVs and VCRs) and some scrambling methods, the nature of the interference changed. Devices "designed for use on cable TV systems" were not capable of ignoring the transient sweep signal. TVs would have a "bar" appear while the AGC settled down after the sweep passed through the video bandwidth; tape recorded TV programs would have "torn" fields at five-second intervals; and descrambled programs would momentarily scramble every time the sweep passed. These phenomena have forced many sweep crews to work the late, late night shift.

Sweepless Sweep® process

Method. The Sweepless Sweep® process, through application of the normalization concept, makes it possible to accurately measure system frequency response without injecting a sweeping carrier. The analyzer is connected to the output test point of the first amplifier in the cascade. A refer-

The first cable automated traffic and billing systems were developed for multiple channels in a single headend.

FIGURE 3



Single Channel Random Access Commercial Insertion System with basic entry terminal.

use of the advertising department resources by simple program alterations and does not require constant editing of the tapes.

When an advertiser or ad agency is presented with an invoice they want to know several things: Did the spots air when they were supposed to? What days and what times? How did the commercial look when it was on the air? Did the spot run for the full length? In other words, "Was the contract fulfilled?"

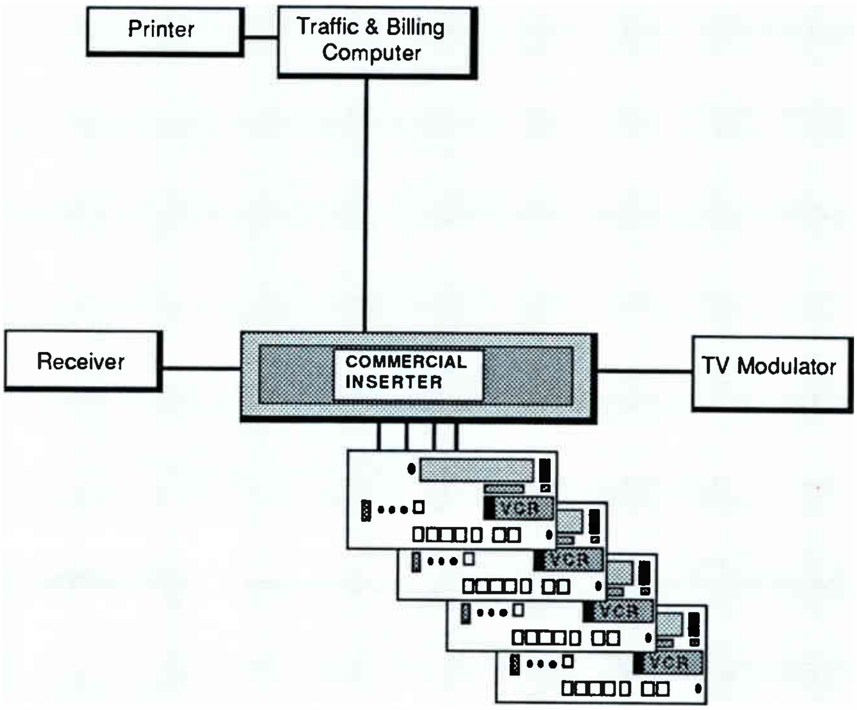
Broadcasters can provide this information so advertisers are not willing to settle for less from a cable system. As an outgrowth of the requirement to provide true and accurate logging came the development of still newer versions of insertion equipment. Deciphering cryptic messages on strips of adding machine paper was not enough. The systems needed plain-English reports. The information needed to be complete, with time and date, spot name and number, ad agency and sales representative. The insertion systems had to verify the video for the duration of the spot and report discrepancies.

Some way had to be devised so a computer could track the advertiser's request from contract through cablecasting to invoicing. Remember, the competing broadcaster has to deal with only one output signal and cable operators are dealing with tens of output signals. Handling inventory, contracts and affidavits for multiple clients on multiple channels led to the introduction of automated traffic and billing systems specifically designed for cable. The first cable automated traffic and billing systems were developed for multiple channels in a single headend (Figure 4A). Rapid growth of advertising networks with "soft" interconnects dictated supporting multiple channels in multiple headends and serving multiple users. There are some cable advertising systems that currently have separate traffic and billing departments comprised of several individuals, servicing five to six channels in 24 different headends (Figure 4B). This phenomenal growth from one headend to multiple headends and multiple operators occurred in under two years.

Growth of alternate video insertion

Many times, with a "hard" interconnecting microwave feed, an advertising system is able to take not only a whole break but a portion of a break. The local cable operator may get three of the four 30-second spots in a two-minute avail and the remaining time slot is given to the interconnect. Since this time slot may not necessarily occur at the beginning or end of the avail, the equipment must switch in, log and verify a secondary or auxiliary source (Figure 5A). Requiring this switch to occur in the vertical interval means adding another box (Figure 5B). Other

FIGURE 4A



Single user, Locally controlled Traffic and Billing sytem

LARGE SYSTEM PERFORMANCE AND RELIABILITY AT SMALL SYSTEM SAVINGS

Jerrold's New S300M Frequency Agile Modulator Combines Superior Performance And Economy Together In One Unit

Jerrold's New S300M Frequency Agile Modulator breaks the performance barrier that has traditionally separated large and small cable operations without sacrificing economy.

We have designed the S300M with Jerrold CATV video performance, incorporated SAW filtered frequency agility over the entire 54 to 300 MHz band and added BTSC stereo compatibility. All "spurs" are greater than 60 dB down. Further, a full 60 dBmV output capability eliminates the need for "noise" producing headend post amplification.

The S300M is compliant with all applicable FCC regulations and is designed to UL/CSA standards. It is a space-saving $1\frac{3}{4}$ inches high so that it takes up only one EIA rack unit. Front panel controls make in-field modifications as easy as a flick of a switch. Now there is no need to special order such features as scrambling compatibility, FCC frequency offsets and spectrum inversion capability.

This all adds up to top-of-the-line performance at a price that is affordable even in small systems. Premier performance from the CATV electronics leader...Jerrold.

Jerrold Division
General Instrument Corporation
2200 Byberry Road
Hatboro, PA 19040
(215) 674-4800

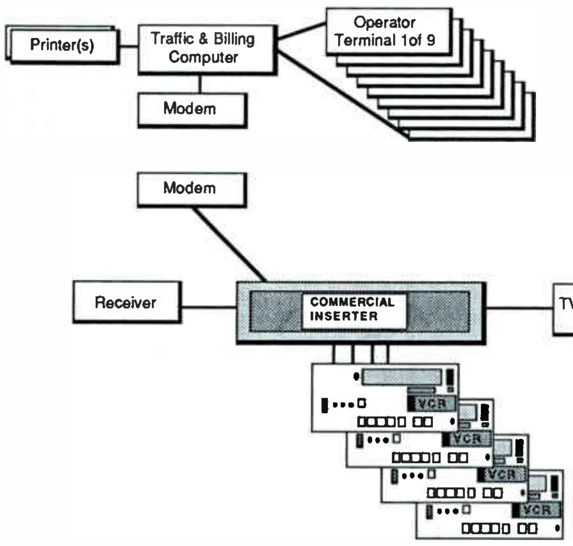
GENERAL INSTRUMENT

Send Today For Our Free Catalog!

Reader Service Number 39

When stereo television became a reality, a number of manufacturers had to again rethink their equipment.

FIGURE 4B



B) Remoteable, Multi-User, Multi-Headend Full Traffic and Billing System

sources of auxiliary inputs could be in the area of photoadvertising. With equipment like MSI's Image Capture System or NuCable's CACS, an ad sales manager may mix photoclassifieds with other full motion, VCR-based, video spots.

The promise of future satellite delivery of cross-channel promos provides the next link in the chain. The recent marriage of NuCable's Cross Promotional Service and Lenfest's StarNet will provide the cable system real time feeds of video based promotional material. The NuStar system, as it is referred to, precedes the commercial insertion equipment in the loop. The NuStar switch will pre-empt the normal satellite feed going into the commercial inserter as shown in Figure 6.[2]

Stereo television

When stereo television became a reality, a number of manufacturers had to again rethink their equipment. Stereo TV meant stereo commercials. Standard VCRs provided only two linear audio channels, of which one was normally used for spot information. The leading manufacturers now offer stereo commercials for the operators who produce commercials in stereo. Coupling this to a BTSC encoder and an FM modulator the overall configuration grows, as shown in Figure 7.

Scrambling

Various reasons brought forth the introduction of scrambling equipment. Both satellite services and local cable operators added different types of channel scrambling. The most popular scramblers rely on rigid timing relationships in the video signal. Any perturbation of this timing will cause the scramblers to unlock, the set-top converters will lose reference and scramble, resulting in a partial or totally scrambled signal. Because every analog VTR exhibits a property known as time base error, depending on the type of scrambling system utilized, the incorporation of a time base corrector may be required. Since the correction operates on feedback of an advanced sync signal, many TBCs cannot accept a time stable input signal without overruning their buffer. This results in a tearing of the video picture.

Placing the TBC at the output of the commercial inserter is fine when it is outputting a videotape break—but not when the satellite or auxiliary signal is present at the output. One solution is to place a TBC in line with each VCR. This works but the expense is usually greater than the VCRs and commercal inserter combined. The addition of an external processor loop provides a cost effective method of sharing this device among the VCRs. Internal routing and distributed feedback lets a single TBC be used on the VCRs with no degradation of the incoming satellite or auxiliary signal.

An alternative to including TBCs is to switch the scramblers into bypass prior to switching to the videotape. If the scrambler and converter can cleanly go from clear to scramble and back without problem, the commercial inserters should be able to provide control. Note the dotted line in Figure 8.

Non-traditional distribution systems

The final consideration is based on the ever changing structure of the cable system itself. Not all cable operations have a single headend feeding the distribution system. Distributed hub sites, remote headends, commercial only feeds, microwaved interconnects, etc. are non-traditional arrangements. Future requirements may place some of the equipment across the room, in another room and in some cases in a separate facility.

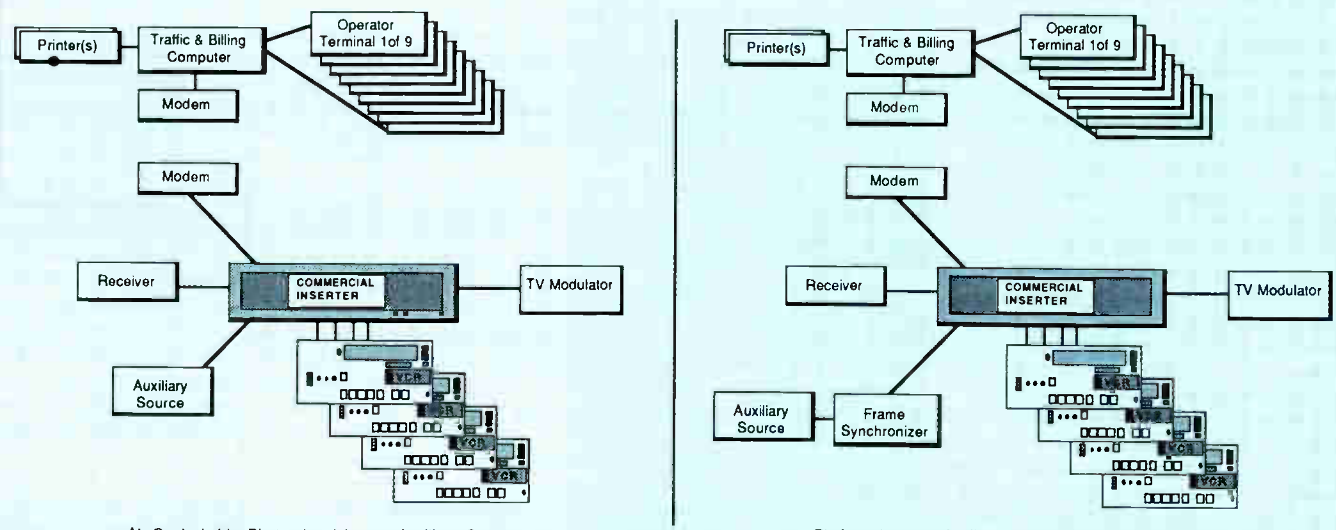
These unique configurations place unique specifications on the commercial insertion equipment since it is the center of the system. The non-standard systems require specialized switching arrangements and control. If the commercial insertion equipment is designed for a specific topology it may not be well suited for more specialized or difficult tasks. Other equipment is flexible and unique functions can be implemented with a minimum amount of change. The design in Figure 8 shows the complexity that has evolved around a single channel. Multiply this by the number of channels in a headend or advertising system and the amount of equipment becomes striking.

Burden of evolution

The changes that have occurred over these past few years have not come free. That doesn't imply that equipment costs have risen dramatically, but the overall system has gained an enormous amount of complexity. Com-

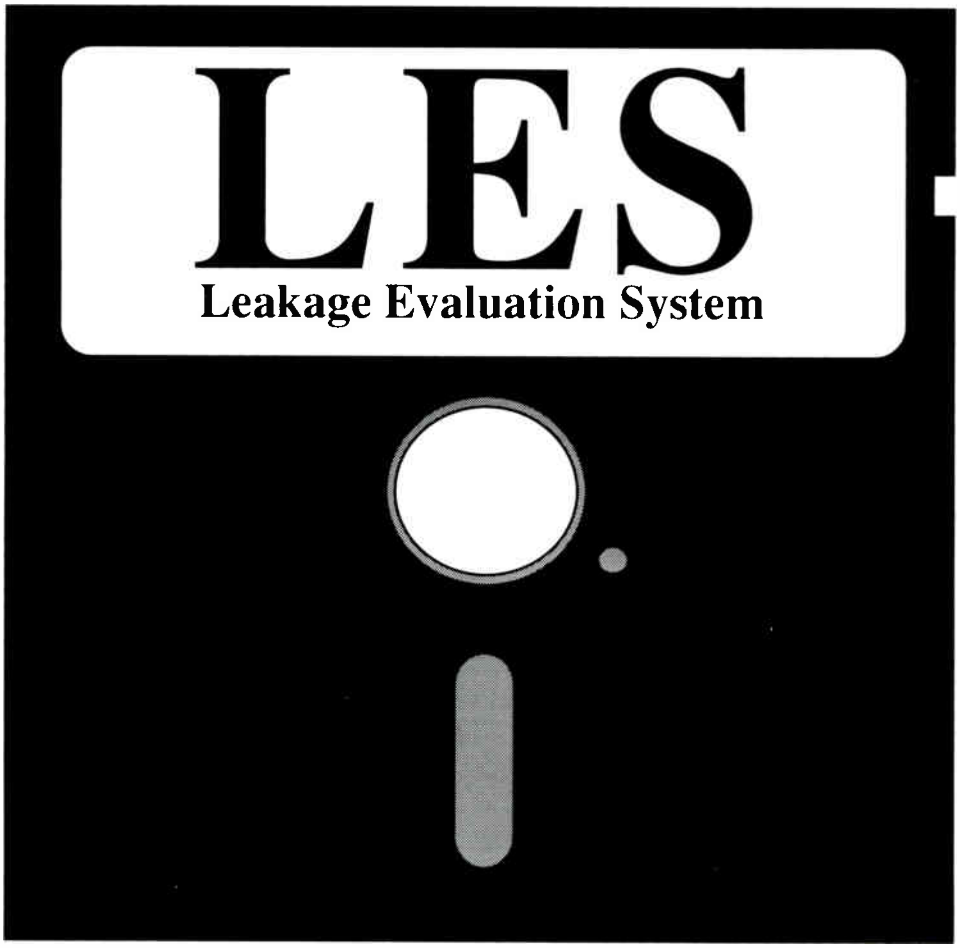
The changes that have occurred over these past few years have not come free.

FIGURES 5A, B



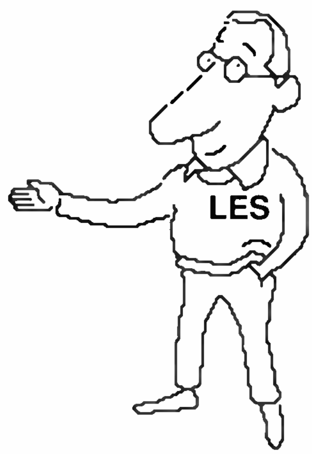
A) Genlockable Photoadvertising or Auxiliary Source. ie. ICS, CACS, Character Generators, etc.

B) Asynchronous Auxiliary Source. ie. Remote microwave feed, Secondary channel, etc.



"July 1, 1990, is a deadline for compliance, not a program to meet compliance. Programs for leakage detection and correction should start now."

Ron Wolfe
CED, October 1987



Now, the industry's first full featured software to handle leakage from A to FCC. The LES - Leakage Evaluation System records leaks, calculates CLI, prepares Repair Work Orders, prints leakage and repair logs, plus much more.

Not a mere spreadsheet, LES is a complete system. Imagine at a press of a button knowing largest to smallest leaks, or analyzing leakage by probable cause. Visualize yourself sleeping restfully because all your leakage data is organized and safe in one place.

Many innovative companies have already chosen LES as their solution to the leakage dilemma. Current users include systems operated by: Times Mirror, Contineneta1 Cablevision, Warner Cable, Cablevision Systems, Jones Intercable, and many more. Don't be the last on your block!

For further information on how you can join those already on the forefront of leakage control, call us at (619) **530-1926**.

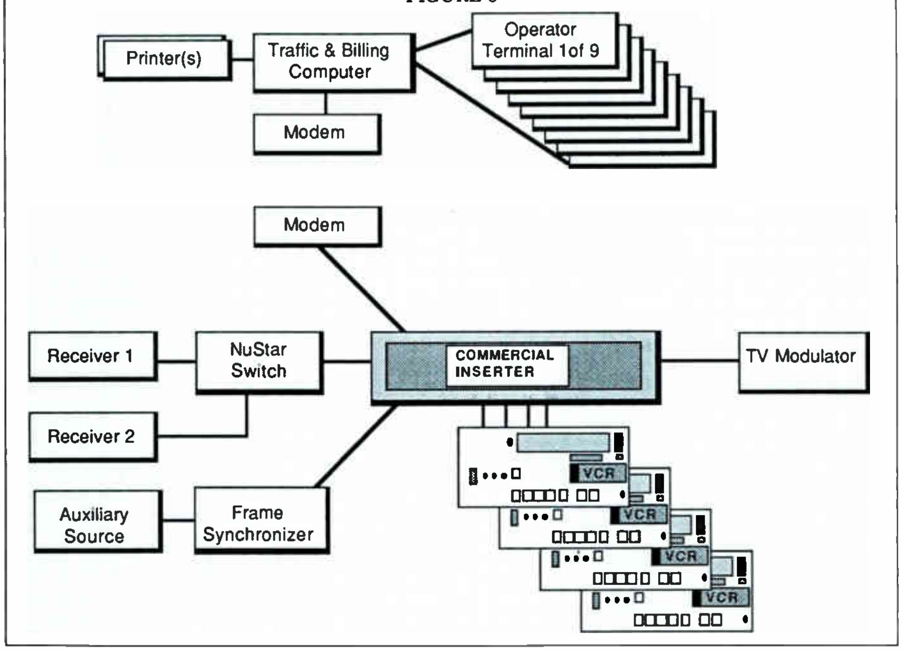
Long Systems, Inc.

9666 Businesspark Avenue
Suite 105
San Diego, CA 92131

Reader Service Number 43

Equipment once considered exotic and esoteric are finding their place in commercial insertion systems.

FIGURE 6

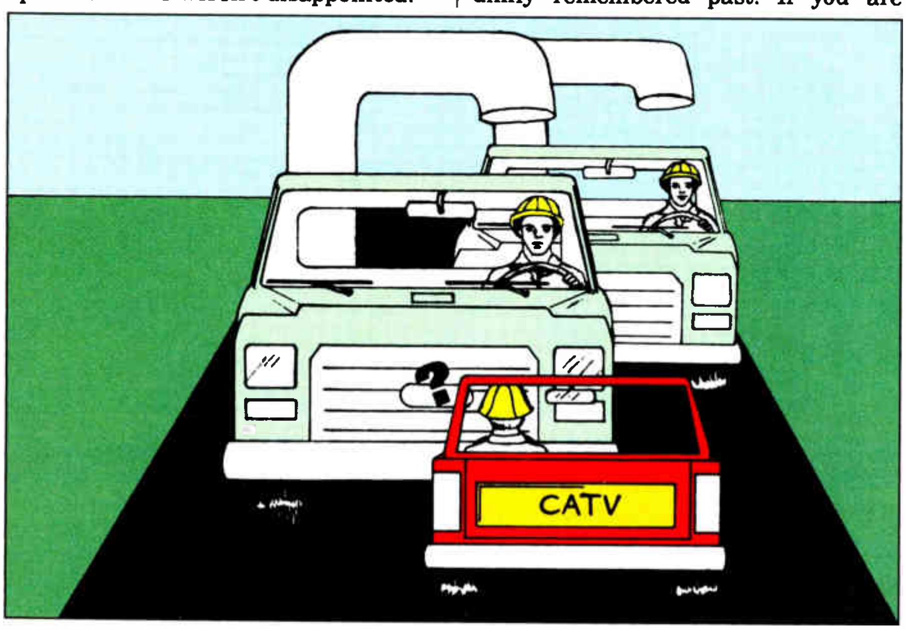


pare Figure 1 to Figure 8. Being at the center of the picture the largest percentage of the changes have occurred within the commercial insertion controller. In essence, the change has come from a simple tone-activated switch to a very powerful multifaceted microcontroller. Equipment once considered exotic and esoteric, such as frame synchronizers, TBCs and processing amplifiers, are finding their place with increasing frequency in commercial insertion systems. Most of these burdens were brought on by industry demands.

Some of the burden has been borne by cable operators. Rack space, always at a premium, is even more difficult to find. In this single channel scenario the equipment space increased from a skimpy five Rack Units (R.U. = 1.75") to a whopping 31 R.U.'s. That's a 520 percent increase in required space. If the headend was built in the late '70s chances are that the facility may not have anticipated adequate room, venti-

Rural cable system headends

During 1987, Hickory Mountain Associates Inc. conducted technical and operational inspections of many small and predominantly rural cable television systems in the Southeast and Midwest. These inspections were designed to provide potential purchasers with estimates of the technical and operational state of the systems, so that final purchase prices could be negotiated. In all, HMA visited approximately 120 cable systems in 10 states, serving a total of about 165,000 subscribers, or an average of about 1,400 per system. The smallest system we inspected included less than three plant miles and served about 50 subscribers. Since HMA's background was primarily in much larger urban and suburban cable systems, we were especially interested in these inspections and eager to learn what the would teach us about rural cable system operations. We weren't disappointed.



Rural system operators in general are past masters at getting the absolute most they can out of their systems, and at an absolutely minimal cost. Rural system service technicians routinely handle successive trouble calls over 20 miles apart, and often must deal with road conditions that are

By Alan Hahn, President,
Hickory Mountain Associates

First of a three-part series

"challenging," to say the least. Among the many lessons we learned while touring these systems was an unforgettable one about traveling at night on country roads during harvest time. That night, we found ourselves heading for a ditch when some dim, fluttering headlights coming toward us suddenly materialized into a convoy of harvest combine machines, taking up the full highway width, as they moved overnight from field to field. Manhattan was never like this!

Typical headend equipment

In rural systems, headend equipment covers the full gamut of manufacturer's offerings. Some of it is fairly modern, but much of it comes from a dimly remembered past. If you are wondering where all those old Jerrold "Starline 1" and Benco processors ended up, we can now tell you that many of them are still out there, earning a living every day. And they do it very well, too, since they were designed at a time when CATV was a much-less-glamorous and primarily rural basic reception service. The older hardware was designed to operate well for a very long time, and it has done so. In general, the older headend gear performs as well as would be expected, and probably much better.

In contrast, though, we found a lot of user dissatisfaction with some of the newer equipment; especially the newer low-cost equipment ostensibly designed for small system use. When we asked about this, we found that manufacturers had based the design of at least some of this lower-cost equipment on that of their "top-line" gear, but with many of the costlier features omitted. This type of cost reduction has indeed yielded a less-expensive product, but has also produced some dissatisfaction among system operators, particularly when the purchasers of this new equipment learn that the new gear may require modifications, or even auxiliary equipment, in order to meet operational needs or FCC standards.

One example of this occurs frequently in the selection of new processors or modulators for the rural system headend, when a newly upgraded system plans to activate a lower-end mid-band channel. Activation of these channels requires that aeronautical frequency protection be taken into account. But several of the lower-cost processors and modulators have output frequency stability standards which will not meet FCC requirements. The rural system technician should be especially wary in selecting new, low-cost headend components for use in channels where FAA interference protection is a factor.

Another potential problem area, and one which was addressed by Randy Karr in a *CED* article in July 1987, is the use of multiple frequency agile modulators in upgraded or rebuilt headends. These modulators do not include band-limiting filters in their output sections, and will therefore act as broadband noise sources in the system headend unless external filters are added. This means that some of the cost savings anticipated in the low-cost modulator disappear when the exteral filter must be added. And this is no small problem—we visited a newly rebuilt system which had installed more than 30 unfiltered, frequency agile modulators in a newly constructed headend, and which now found it necessary to rewire and re-rack this

In over 100 visits we found only two headends which had a headend block diagram or book containing this information.

brand new headend to add external filters.

Still another area where lower-cost or older headend equipment has created real problems is in its incompatibility with VideoCipher II technology. This problem is disappearing as improvements are made over time but it has been a major headache for many rural systems.

Upgrading opportunities

Rural system headends, like all others, are in a state of flux as the number of scrambled satellite signals grows and as the systems themselves are upgraded. In addition, rural cable systems are typically plagued with "old favorite" problems like co-channel and electrical interference. In many cases, improvements to the latter two problems are possible without major expenditures, although some planning and analytical homework is needed.

For example, a surprising number of the rural headends we visited had off-air reception antennas which were grouped closely at the extreme top of the tower, looking much like a lollipop on a stick. Therefore, the antenna reception patterns interfered with each other, so that signal strength and quality were well below what might have been achieved. Towers such as these should be analyzed to optimize antenna placement and spacing. In many cases, it may be expected that significant signal strength and quality improvements will be achieved without the need for antenna replacement.

A useful tool for optimizing antenna placements and configurations is the computer-aided reception analysis offered by CATV engineering firms, such as Biro Engineering. This form of analysis can be tailored to an individual system, and can be based on the present tower size, antenna types, etc. The computer algorithm will minimize antenna pattern interference and will optimize antenna configurations to reduce co-channel or adjacent channel interference effects. This sort of planning tool reduces upgrading costs by highlighting only the antenna or antennas which need replacement or redesign to solve particular problems. Another major benefit of computer-aided signal reception studies is the development of useful "benchmark" data giving predicted unfaded signal levels, so that future antenna related problems will become much simpler to identify.

We were surprised that so many rural headends need this kind of approach, but in over 100 visits we found only two headends which had a headend block diagram or book containing this kind of information. Many of the other technicians were forced to operate largely in the dark as far as headend performance was concerned.

Turning to electrical interference, we again encountered some old acquaintances. In many rural systems, headend antennas are placed atop municipal water towers, which invites electrical interference caused by sparking in water pumps and their controllers. Another even more common source of electrical interference is found in nearby electric power substations, and even in cracked insulators at nearby electric power weatherheads.

Satellite reception is also less-than-optimum in many rural systems. Often, we found that new, dual-feed kits have been installed without optimizing the antenna's boresight alignment. The dual-feed kits are then blamed, in many cases, if degraded TVRO performance results. This, too, is fairly simple to remedy, but TVRO alignment is often put off until a "better time." This causes needless system performance degradation.

Satellite receivers are another source of problems; and frequently because lower-cost units were used which lack some of the protective features of other equipment. For example, large numbers of tunable satellite receivers have no "memory" of transponder assignments. In the event of a power interruption—frequent in rural systems—the receivers lose their settings, necessitating a trip to the headend by the technician. This creates a needless cost to the operation, and a needless inconvenience to the subscribers. Part of the price eventually paid for inadequate satellite receivers will be the number of unnecessary truck rolls resulting from their shortcomings.

In many systems, popular off-air TV stations are remote from local subscribers, but are nevertheless desired because of local or statewide news content and other features. This is a frequent problem in CATV systems near state borders, where TV stations in the neighboring state are often closer to the headend than are those in its own state. In one case we encountered, about 10 small systems near one state border had erected tall towers and expensive antennas to receive a VHF station in their own state, notwithstanding the fact that it was located nearly 120 miles away.

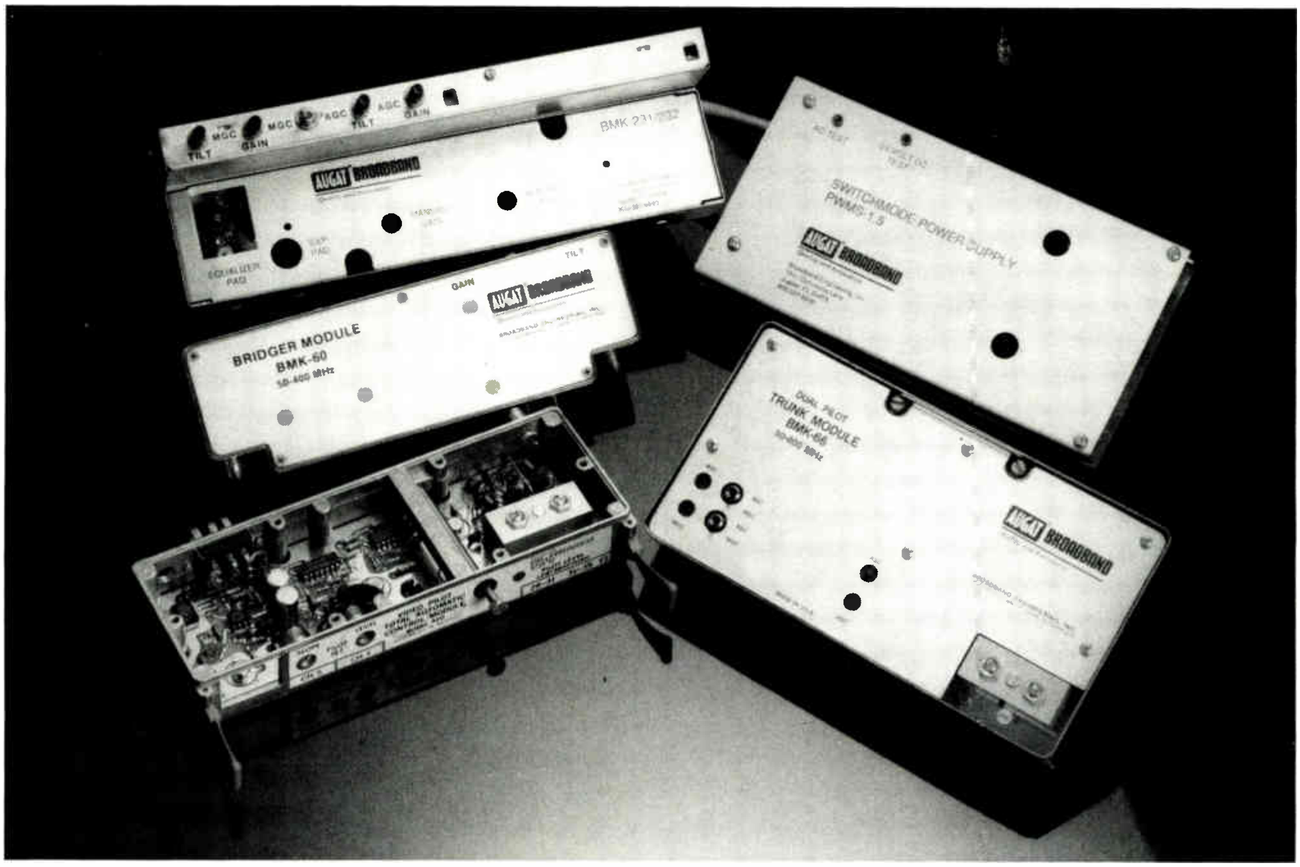
Even in minimum-fade conditions, signal reception was poor, but subscribers had resisted efforts to delete the channel since it carried home-state news and sports events. The solution here may be to resort to either a simple, privately owned CARS-band microwave relay, or to determine whether a local microwave common carrier could provide the signal importation.

Auxiliary features

No discussion of rural system headends would be complete without considering the headend buildings themselves. In most cases, these are of frame, masonry or metallic construction. The first two types are generally erected on-site, rather than prefabricated, as are many of the metallic buildings. Wood frame headend buildings are simple to construct but require painting and are subject to damage from termites, rot, etc. Frame walls will seldom stop a determined snake or rodent, so that the warm, remote headend can become a winter wildlife sanctuary if precautions are not taken.

Masonry (usually concrete block) headend buildings are often a better bet, since they are fairly impervious to rodents and snakes and exterior upkeep is cheaper. Concrete block construction is relatively simple and the building has the advantage of being wildlife-resistant.

Prefabricated metallic headend structures can be a major aid in rapid system startups or headend rebuilds, but they are lightweight and must be "tied down," especially in tornado- or hurricane-prone regions. One major problem we have seen with prefabricated buildings is their inflexibility to changing



Broadband:
The leader in upgrade electronics

Upgrading rather than rebuilding has been the cost effective way of extending the life of cable systems by many years thus adding profits to the bottom line.

Broadband originated the concept of upgrading almost 9 years ago and we have continued our leadership ever since.

You can feel confident with the technical superiority and reliability that we have always been known for.

We don't look for quick fixes, we engineer long term solutions to your upgrading problems.

The result is electronics better than the original equipment that you are upgrading.

We stand behind our product too. Our upgrades have a one-year warranty and we are always there to discuss any immediate problems by phone.

For more information call Broadband Engineering at 800-327-6690 (in Florida 305-747-5000) or write us at 1311 Commerce Ln., Jupiter, Florida 33458.

For quality, performance and service, call Broadband

AUGAT® BROADBAND

Quality and Innovation

Reader Service Number 51

headend configurations. For example, nearly all "pre-VideoCipher" prefabs are now overcrowded, and expansion is typically impractical. Frame and masonry structures can accommodate expansion more easily.

Standby power generators are certainly logical additions to the remote headends found in rural systems but were seldom in evidence. Those that were available were often at the system office, instead of being in place at the headend and ready for use. In practice, this means that the system technician often has to hand-carry a portable generator, along with its fuel, up a snow-covered mountain during the worst weather of the year, in order to restore headend operation. There has to be a better way.

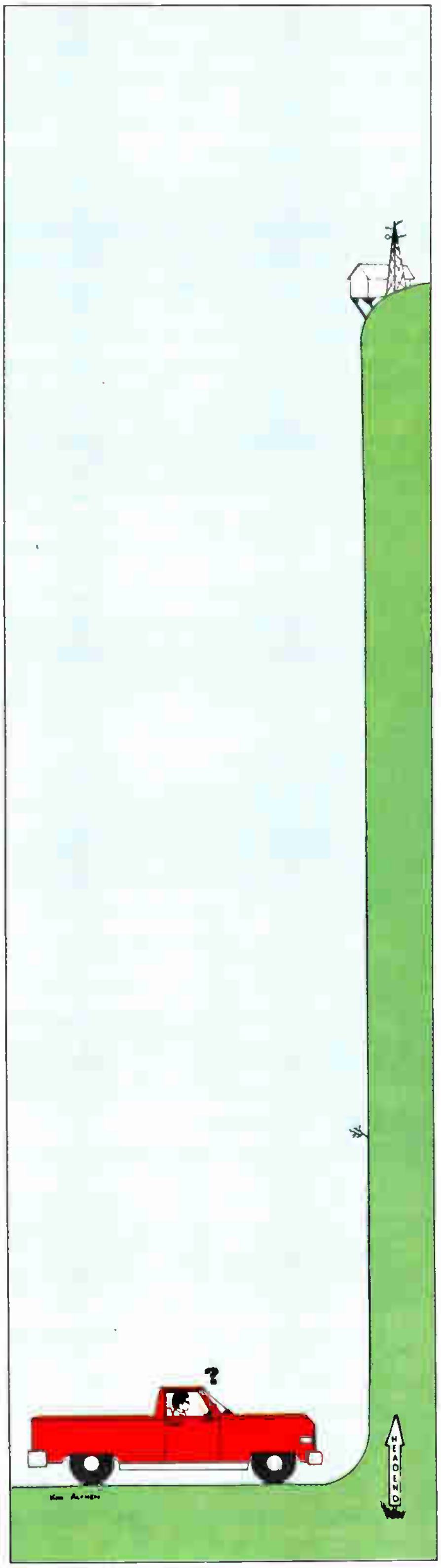
Another area of auxiliary headend features is the use of air conditioning, heating and ventilation. All headends we visited were air conditioned (including two whose A/C units were churning away during a snowstorm!) but very few were heated. The need for heating was typically assumed to be met by the headend electronics themselves, but near-zero temperatures outside will usually mean sub-freezing conditions inside the headend, with major frequency shifts likely in unstable electronics. This can cause FAA interference problems. A heater is also useful should the headend technician become marooned there in stormy weather.

Moving from winter cold to summer heat, we found that several remote headends had sustained significant equipment damage due to temperature overruns when air conditioners failed. One way to reduce this problem would be to install a thermostatically-controlled exhaust fan, which could turn itself on if the interior temperature climbed to, say, more than 100°F.

Locations and access

We thought of calling this section "Getting There is Half the Fun" as we recalled some of our recent trips through swamps, forests and up steep mountainsides. Rural system headend access roads range from the well-graded and graveled all-weather kind to the "pass-at-your-own-peril" kind. We noted many curious access roads

Sometimes just a small improvement can make a real difference in headend accessability.



in our travels, including a memorable one with a fork in it. The left fork had a large hump in it, and the right one had a water-filled hole in it, about 30 feet to the right of the hump. Beyond this point, the road came together again a short distance ahead. Now if someone would just dig up the hump, and dump it into the hole, he might have two good roads....

You get the picture. There is a lot of this kind of thing in rural systems. Often, mountain headend access roads are cut straight up the side of the hill, instead of making "switchbacks" across its face, so that water from rainstorms simply flows downhill and rapidly turns roadways into sluiceways. Loads of gravel will be little help because of the fast-rushing rainwater. But help isn't necessarily far away. In mountainous areas the U.S. Forest Service may be able to assist, since they must lay out and maintain "primitive roads" all the time. Sometimes just a small improvement can make a real difference in headend accessability, and in truck wear and tear.

Looking at the brighter side, though, we found that mountaintop headend height and remoteness can also be an asset, as one technician told us. He was approached by a local fire department which found itself required to cover a new area, at a considerable distance from its existing two-way radio transmitter, and shadowed from its antenna pattern by a large mountain. Our entrepreneurial technician told the firemen that he and his crew would relocate the transmitter onto their tower, solving the coverage problem, if they could then have first crack at deer hunting on the fire department's land!

Anyone who could come up with an idea as good as that could ultimately even better it, as our technician did. After the fire department's transmitter and antenna were relocated (and a letter of commendation was sent to the system office by grateful county officials) our man carefully placed salt blocks around his new "hunting preserve." He and his crew were rewarded with two does and a fine buck on the very first day of deer season.

Future article topics will explore rural system design and construction as well as technical operations.

The growth of BTSC stereo

Stereo, stereo and stereo. We've been reading and hearing a lot about it lately. Also, your customers have been hit by a major stereo campaign from the networks, cable service programmers and electronics manufacturers. In fact, the American public has been conditioned to expect high fidelity and stereo sound from movies, compact discs, car stereos and even portable "boom boxes". Stereo for television audio is a natural progression they expect, even insist upon. Stereo television dramatically changes the role of the viewer from that of an observer to that of a participant. With strategically placed speakers, the stereo television sound will fill the room with ambience and special sound effects, thereby drawing the audience into the on-screen action.

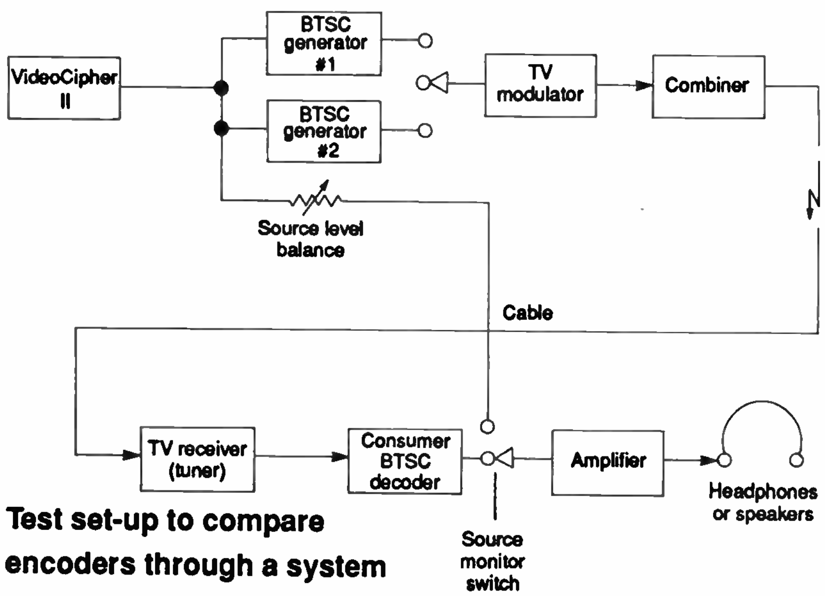
Much has been written concerning the technical aspects of BTSC (Broadcast Television Systems Committee) stereo. This paper will take a different viewpoint and concentrate more on what BTSC will do for you and your system, how to properly evaluate a BTSC stereo generator, and then give a brief technical description of the interconnections of BTSC with the existing components in your system.

The BTSC format for stereo television sound was accepted by the FCC in February 1986 (OET Bulletin #60). Since then, broadcasters have been adding stereo capability to their TV stations. In fact, CBS Television has just announced that starting in the fall of this year it will broadcast all of its programming in stereo. NBC currently transmits about 30 hours of stereo per week. As of February 8, 1988, 139 of NBC's 207 affiliates, covering 87.9 percent of the U.S., were equipped to broadcast stereo. And NBC expects its coverage to exceed 90 percent by the end of 1988. ABC is also currently broadcasting stereo programming during the prime time hours. All of the networks market stereo heavily both before the program begins and during their advertisements.

By Kim Litchfield, Leaming Industries

Consumer demand for quality stereo sound from the television is on the increase. Is your cable system ready to cash in on the demand?

FIGURE 1



Test set-up to compare encoders through a system

Satellite services also boast of their stereo capability. Many of the pay-per-view and premium services announce that the following movie is "In Stereo Where Available" at the onset of the program. This statement generates a smile on the faces of subscribers in stereo-capable systems. This same statement, on the other hand, creates confusion and discontent for stereo-capable viewers in a non-stereo system. These same subscribers may voice their discontent in the form of a service call to their local cable system, or they may just go elsewhere for their stereo programming (e.g.: videocassettes, videodiscs, movie theaters, off-air broadcast programming and direct satellite reception).

Advantages of BTSC

The predecessor to stereo television was FM simulcasting of television program audio. BTSC stereo made FM stereo simulcasting obsolete. With the FM method, the consumer has to retune his FM receiver to the proper frequency every time he changes the channel on his television. With BTSC stereo, the audio tracks with the video each time the viewer changes channels. This is considerably more convenient as the BTSC stereo is present each time the television is turned on; that is, no extra effort is necessary to receive the benefits of the stereo effect.

According to figures from the Electronic Industries Association, stereo penetration in U.S. homes has reached 10 percent. It is projected that this stereo TV penetration will be no less than 20 percent by the end of 1988. Also, estimated sales of stereo TV sets for 1987 totaled 5,300,000—up from 4,350,000 in 1986. Keep in mind that these numbers do not include consumers with either side-car stereo decoders or VCRs with built-in stereo decoders, of which both are capable of receiving a stereo signal.

Stereo is valuable not only for its obvious benefits of improving audio perception, but also because of the overall positive effect stereo has on the

It is also useful to synthesize VideoCipher II backup audio to avoid unnecessary service calls.

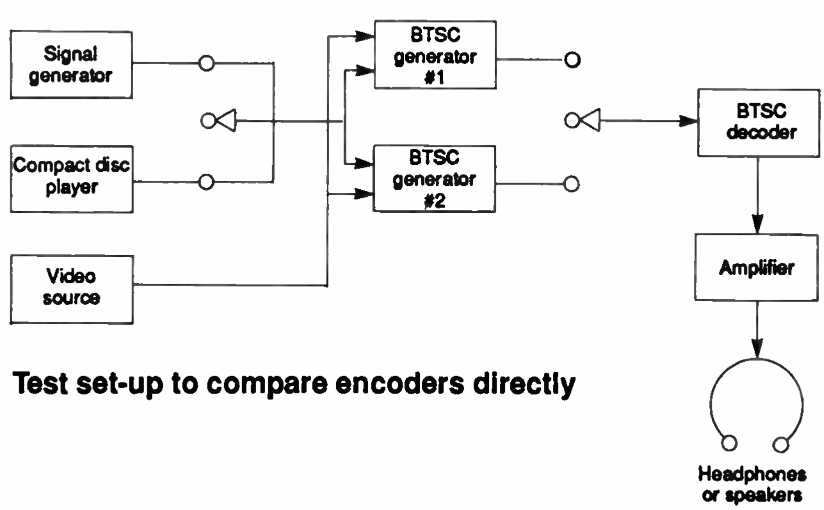
TV viewer: Studies have shown that stereo improves the viewer's perception of *picture* quality. Consumers who viewed the same television program twice (once with stereo audio and once with monaural audio) believed the stereo television had a better picture. This research was performed by the Advanced Television Research Program at the Massachusetts Institute of Technology. Moreoever, during a recent survey announced at the last Winter Consumer Electronics Show, Zenith Electronics Corp. found that 93 percent of the consumers with stereo televisions surveyed said that they were "very satisfied" with the set's picture quality. As consumers are exposed to improved video sources, stereo-enhanced NTSC is a good way to keep cable's competitive edge. And, as video continues to improve with wide screen television, Super-VHS, and eventually high definition TV, viewers will expect audio to improve and become more stimulating as well.

In fact, Dolby Surround Sound is a step in this direction. Over 1,000 films have been released in Dolby Stereo. These same films, which are part of the cable programmer's library, automatically contain the encoded information. And, using the proper decoding equipment, your customers can decode the soundtrack into four channels—left, center, right and Surround—and take advantage of the multi-dimensional sounds. Consider, however, that the audio must be transmitted in the BTSC stereo format, as opposed to monaural audio, for the Surround Sound information to be present at the subscriber's premises.

Stereo in your cable system can be promoted through bill stuffers, mailers as well as through local television wholesalers. By working together, both your cable system and local wholesalers will profit. A typical relationship would involve a cable drop with a stereo service demonstrating BTSC through one of the dealer's stereo-equipped televisions. Consumers will be impressed by the stereo they can receiver thorugh their cable system and will be encouraged to upgrade to stereo television sound.

Recently, a cable system upgraded eight channels with BTSC stereo and demonstrated VH-1 with BTSC at a local consumer-electronics store. The result: the store sold $40,000 worth of stereo televisions in the first two weeks.[1]

FIGURE 2



Test set-up to compare encoders directly

Equipment evaluation

Once your system has made the commitment to stereo TV audio, the next step is to evaluate which type of equipment to install into the headend. There are many factors to consider. The features offered with each BTSC generator, its specifications, ease of installation, compatibility with ad-inserted services, true BTSC stereo generation, and, of course, price are all considerations.

A BTSC stereo generator accepts a left and a right channel of audio information and encodes the signal into the BTSC format, which can then be distributed throughout the cable system. Some generator manufacturers provide a second input to be used as backup audio or for local ad insertion. A few generators have this second input available in stereo (left and right inputs) rather than monaural. But since the industry is moving toward stereo, the capability to meet future ad insertion stereo needs should be considered when choosing a generator. Dual stereo inputs also provide the capability to toggle between two different stereo program inputs.

Another feature which proves to be useful is a built-in stereo synthesizer. With this feature, you can run your program in true stereo, while synthesizing your local ad insertion. It is also useful to synthesize VideoCipher II backup audio to avoid unnecessary service calls. When the VideoCipher switches into the bypass mode, it provides mono backup audio. Your customer's stereo lights may go out and their separation will disappear. With a built-in stereo synthesizer, the backup audio can by synthesized into stereo. Your customer's stereo lights will then continue to be lit and ambience will still be present. Although synthesized stereo is convenient when used in conjunction with the second input, we suggest that the primary program input be used in the true stereo mode, as nothing can replace the effect of a horse trotting from one side of the screen to the other.

Features, although an important consideration, are relatively simple to list and compare. However, in order to properly measure the important technical performance specifications (i.e.: separation, frequency response, distortion and signal-to-noise ratios), an array of costly test equipment is necessary: a precision stereo decoder should be used (such as Modulation Sciences

When performing comparative listening tests, one should be sure that an actual A/B comparison is made.

SRD-1 Stereo Reference Decoder) along with an audio oscillator, an AC voltmeter/distortion analyzer, an oscilloscope and a high-quality amplifier with speakers and/or headphones to monitor the audio performance.

To perform these same measurements on a signal through your system, a demodulator (such as the Tektronix 1450-1) could be used to demodulate the signal to baseband for input to the precision stereo decoder. It may seem logical to use a consumer decoder to perform the measurements since that is precisely what your customers will be using. But, if a consumer-grade decoder is used, it will probably become the limiting factor; the results obtained would then be those of the decoder rather than the encoder. One might ask, "How can my system perform a valid evaluation without all the necessary and expensive test equipment?" Essentially, your ears become the judge. If, as in most cases, this elaborate test equipment is not available, common sense must be used in evaluating the manufacturer's published specifications, the manufacturer's reputation, the features and how the unit sounds in a real-world environment—namely, your system using real-world consumer decoding equipment.

When performing comparative listening tests, one should be sure that an actual A/B comparison is made between the "original" audio source and the encoders in question. In other words, the input material, the level and other factors should be identical for each encoder and a switch should be used to bypass the encoder(s) and listen directly to the source. Ideally, the same source material should be supplied to each encoder simultaneously. If the tests are to be run through the system and extra channel space is available, running each generator with the same service on adjacent channels, with all other factors equal, can provide a good comparison. A compact disc with good dynamic range and frequency response could be used for the audio source; color bars, or any other video, could be used as the video source, again with each encoder on adjacent channels to facilitate an easy A/B comparison. Or, a single satellite-delivered service may be supplied to each encoder simultaneously (e.g.: HBO to each encoder, rather than HBO to one and Cinemax to another). In any case, a bypass switch should be used to verify that the encoders are accurately reproducing the source. Typical evaluation set-up configurations are shown in Figures 1 and 2.

Installation considerations

A further consideration in the world of BTSC stereo is the generator/TV modulator interface. A variety of interconnections are possible. The generator may be interfaced with the TV modulator as BTSC composite baseband and video, as a video plus 4.5 MHz aural subcarrier, as a 4.5 MHz aural subcarrier separate from video, or as a 41.25 MHz intermediate frequency carrier. The specific interface chosen will depend on the individual components in the headend as well as personal preferences. Much has been written on this subject. Therefore, this paper will not reiterate the details of each interface, but rather state an order of preference, judged on the technical merits of each interface as well as proven field results:

BTSC composite baseband. This method is technically sound and appears to be the most compatible with scrambling systems. When interfacing at baseband, the modulator's audio pre-emphasis network must be disabled and the audio bandwidth and deviation capability must be compatible with BTSC (i.e.: 100 kHz bandwidth and ±73 kHz deviation). This interface also requires that the headend operator set and maintain the correct deviation level. Since this level cannot be accurately set with program audio, worry exists as to how accurate the setup will be. But if done properly, the deviation level may be set very precisely. The recommended procedure for deviation adjustment is to apply a Bessel null tone (10.396 kHz) at a level that is to produce 100 percent modulation, monitor the output using a spectrum analyzer and null the carrier. This procedure yields precise audio deviation levels. This may sound complicated, but since a built-in Bessel null test tone is available, setting and maintaining accurate deviation levels is actually a simple process. If a spectrum analyzer is not available, the channel modulator's over-deviation light or deviation meter may be used, although this method is not as accurate.

A 4.5 MHz subcarrier separate from video. This method of interface offers the advantage that the channel modulator's pre-emphasis circuit and audio module do not need to be modified. However, the channel modulator's internal 4.5 MHz modulator must be disabled. If it is not, two 4.5 MHz subcarriers will be present, interfering with one another in your system. Most TV modulators can be modified to accept the video separate from the 4.5 MHz aural subcarrier.

Video and the 4.5 MHz subcarrier combined. This is the simplest and most convenient interface. However, with this method there is a risk that the video might bleed into the audio when combined as a composite subcarrier, creating unwanted buzz. Therefore, the video source should be bandlimited to 4.2 MHz. For this reason the method of interfacing with 4.5 MHz separate from video is preferred.

A 41.25 MHz subcarrier combined with video. This interconnection is recommended only when using a modulator that cannot accept a 4.5 MHz subcarrier or a baseband input.

At the onset of BTSC, concern existed as to whether or not the BTSC signal would survive scrambling. This concern has, in most cases, been put to rest. Field studies have shown that BTSC is compatible with most scrambling schemes.

Conclusion

BTSC has not only been accepted, but is also in widespread use (in excess of 4,000 encoders) throughout the United States, which confirms that the time for BTSC is now. Cable systems are always developing competitive strategies for the future. And ideally, decisions regarding upgrades should be made in anticipation of, rather than in reaction to, consumer demand for new technologies. So why wait to add stereo?

VideoCipher II is a registered trademark of General Instrument. Dolby Surround is a registered trademark of Dolby Laboratories Inc.

[1]Harold's Electronics, Midland, Texas.

The VCR Filter only relies on controls already existing on the VCR and television.

channel on the converter and finds out the necessary information: Is the channel I wish to watch "CONV" or Basic? Is the channel I wish to tape "CONV" or Basic? Armed with this information, the subscriber now refers to a table of equipment settings necessary to get the job accomplished.

Each subscriber is provided with either Table 1—for use in systems with converter output channel 3—or Table 2—for use in systems with converter output channel 2. The tables describe the appropriate action taken to achieve the desired results, such as viewing one channel while taping a different channel. For each desired result, the table lists the channel to be tuned on the converter, on the VCR and on the television receiver. It also provides the selection for the VCR/TV switch on the VCR.

The VCR/TV switch, sometimes labeled as Video/TV, causes the output of the VCR to be either the one channel tuned by the VCR, appearing as either channel 3 or channel 4 in the VCR or Video position, or a broadband bypass of the full cable spectrum in the TV position.

Because of the flexibility of the VCR Filter, VCR and television receiver, there are actually many other possible settings to achieve the results listed in the table. For simplicity, only one group of settings are provided. The more savvy subscriber will likely "wing it" and use variations on the table's recommended approaches.

Use with built-in VCR timers

Addressable converters that have built-in VCR timers usually are programmed by the subscriber so each timer on the VCR is essentially duplicated by a timer on the converter. Because the VCR Filter provides a broadband signal with many unscrambled channels, this duplication is not always necessary.

Only taping of "CONV" channels requires the BA-6000's VCR timer be set to match the desired program. A subscriber with eight or more timers in his VCR achieves maximum usage of the timers by *not* duplicating timers on the converter for taping of Basic channels.

Remote control capabilities restored

Unlike the manual swtiches used in other approaches to VCR cable compatibility, the VCR Filter only relies on controls already existing on the VCR and television receiver. Those existing controls are often already operable from the subscriber's infrared remote control units. In addition, when using programmable remotes, total control may then be possible from a single remote.

The never ending battle to attract and retain cable subscribers is fought on many fronts. Consumer friendliness quickly is becoming a critical factor in this effort.

The VCR Filter provides a broadband cable signal directly to the subscriber's VCR and television receiver. This approach restores many of the consumer features that prompted the subscriber to purchase his VCR and TV in the first place.

TABLE 1

Subscriber operation of VCR Filter

Converter output channel = 3 — VCR output channel = 3

To tape this channel	While viewing this channel	SET EQUIPMENT TO: Converter Tune channel	VCR Tune channel	VCR TV/VCR switch	TV Tune channel
Basic or CONV	Same channel	Basic or CONV	3	VCR	3
Basic (A)	Different Basic (B)	Basic (B)	Basic (A)	TV	3
Basic	CONV	CONV	Basic	TV	3
CONV	Basic	CONV	3	TV	Basic
CONV	Different CONV	—	Not possible		—
To watch a tape*		Any	Any	VCR	3

TABLE 2

Subscriber operation of VCR Filter

Converter output channel = 2 — VCR output channel = 4

To tape this channel	While viewing this channel	SET EQUIPMENT TO: Converter Tune channel	VCR Tune channel	VCR TV/VCR switch	TV Tune channel
Basic or CONV	Same channel	Basic or CONV	2	VCR	4
Basic (A)	Different Basic (B)	Basic (B)	Basic (A)	TV	2
Basic	CONV	CONV	Basic	TV	2
CONV	Basic	CONV	2	TV	Basic
CONV	Different CONV	—	Not possible		—
To watch a tape*		Any	Any	VCR	4

Track Down Tough To Find CATV, MATV And RF Distribution Troubles?
• All Channel (Cable, HRC, ICC, VHF, UHF, FM) Digital Tuner And LCD Channel Readout
• Exclusive 5 Microvolt Sensitivity On All Channels With Autoranged Attenuator
• Exclusive, Automatic Or Manual Fine Tuning With Off-channel Frequency Readout
• Exclusive, Automatic Hum And (Patented) Signal-to-Noise Tests On Any In-Use Channel
• Exclusive Picture Quality Check With Integrated Wide Band Monitor
• Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input
New
100% American Made and backed by Sencore's 100% "Made Right" Lifetime Guarantee.
With The . . .
FS74 CHANNELIZER SR.™
TV-RF Signal Analyzer
$3495 Patented
SENCORE
MODEL FS74
CHANNELIZER SR
TV-RF SIGNAL ANALYZER
Call 1-800-843-3338
In Canada 1-800-851-8866
Reader Service Number 67
SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107

in the news

S-A prepares to introduce series of new products at National Show

Scientific-Atlanta engineers have been so busy that no fewer than six new products will make their debut at the 1988 National Cable Show in Los Angeles. With a focus toward both user and operator friendliness, S-A will show two new addressable set-top converters, and integrated receiver/descrambler, a frequency agile drawer, an enhanced stereo encoder and new taps.

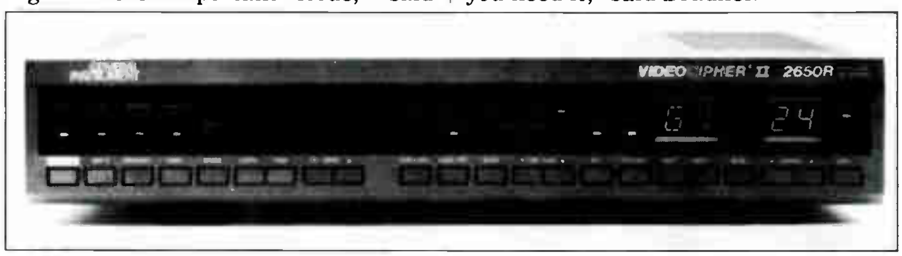
Top company officials are calling this year's product introduction the company's "most significant ever," because each product represents a breakthrough in compatibility, convenience and/or signal quality.

The flagship product announcement has to be the new 8590 converter with volume control that features visual sound level indicators, one-touch impulse pay-per-view ordering capability, a, eight-event, 14-day timer and a high level of security. The unique LED volume level display provides proof of "optimum" stereo separation for recording and playback of stereo programming and also allows the VCR timing function of the converter guide subscribers through the programming process.

S-A's 8570 addressable set-top

"We've gone to the extent that a subscriber can pre-program an IPPV purchase for a week or 10 days later and set the volume level at the proper setting for optimum stereo separation," said J. Larry Bradner, president of S-A's Broadband Communications Business Division.

In addition, baseband and RF circuitry has been combined to offer three levels of security (dynamic sync suppression, dropped field, and sync and video inversion), allowing operators to choose and rotate through 50 different scrambling modes. The unit is compatible with Oak scrambling methods. "We think security is clearly becoming a more important issue," said William Johnson, vice chairman and chief executive officer at S-A.



GI's 265OR IRD

Another unique feature of the converter is the ability to adjust the volume level while the unit is turned off. That feature is not currently available on any consumer electronics. The new 8570 set-top also allows one-touch IPPV ordering from both the keypad and remote control, but does not feature built-in volume control. Instead, the 8570 is designed to be paired with S-A's Complete Remote Control to provide single-remote volume control to remote controllable TV sets. The 8570 also features a plug-in IPPV module for easy upgrading and dynamic sync suppression and dropped field security.

From the headend product department come a new IRD, an enhanced stereo encoder and a frequency agile "drawer" that allows easy slide-in back-up to a lost modulator or signal processor.

The 550 MHz drawer is frequency agile and can be used to back up existing 6350 modulators and 6150 processors. By keeping one or two drawers on hand, operators don't need to stock a full complement of back-up modulators and can complete the retrofit quickly. "The drawer gives you agility when you need it and only when you need it," said Bradner.

The 6380A stereo encoder now features a peak limiter to maintain consistent audio levels, a choice of audio outputs from encoder to modulator and allows local insertion of stereo ads by accepting stereo input through the alternate audio input.

The Model 9650 IRD puts a satellite receiver and descrambler in a single chassis. That eliminates the need for a separate descrambler in the headend, thereby doubling headend rack capacity, an important consideration in this day of expanding channel capacities.

Finally, a series of new taps provide better corrosion resistance in any environment through coated housings and brass ports, S-A officials said. By making them all one size, the taps are easier to install with a single tool. And printed wire board design makes them stronger and more resistant to shock.

"We've spent a lot of time with the operators and we're trying to give them what they need," said Johnson. "We're making a major investment to improve and enhance our products to help support" new revenue generating opportunities. When you take this new product line and look at it as a whole, it allows the operator to tailor the most consumer- and cost-effective solution to each subscriber," added Johnson.

In other news, the **VideoCipher Division** of General Instrument has

The Sound Of Your Future. It's Hear Today!

The Leaming MTS-2B BTSC Stereo Generator

Simply The Best Value In Stereo TV Audio:

More Standard Features!

- Typical frequency response flat out to 15 KHz
- True Automatic Gain Control (AGC) eliminates routine level adjustments
- Stereo synthesizer for ad insertion or mono services
- Your choice of VU-type or LED metering
- Bessel-null test-tone for simple, accurate installation
- Baseband & 4.5 MHz outputs standard (41.25 MHz available)
- Typical stereo separation greater than 30 dB
- Compact, rack-mount design—Just 1.75 inches high
- dbx® licensed companding (true BTSC format)

Leaming: Cable Audio Specialists Since 1970.

Eighteen years of revolutionary advances, technological innovations, and superior craftsmanship have made Leaming the most respected name in cable audio.

Representing nearly two decades of research,development,and hands-on practical experience,the Leaming MTS-2B embodies our traditional dedication to electronic excellence.

Dollar for Dollar, Your Best Buy!

Compare our sound performance, features, and price. We think you'll agree. Nothing else comes close.

For The Sound of the Future—Call (714) 979-4511 Today!

LEAMING INDUSTRIES

180 McCormick Avenue, Costa Mesa, CA 92626
Also Available Through Major Cable Distributors
dbx® is a registered trademark of dbx.

Reader Service Number 68

the last word

How will you answer this question to your management:

$$\frac{\text{FIBER}}{\text{COAX}} = ????$$

Today the CATV system engineer is finding himself more in the position of a futures broker than the position of traditional system designer. Where is technology today? Where is it going? What can we bank on in 24 months? The biggest question from management many CATV engineers are facing is whether fiber should be a part of the system rebuild equation.

There is talk of amazing if not downright revolutionary advances in fiber optic systems. We read of lab tests that have demonstrated 60 FM video channels per fiber. Others with 40 VSB-AM video channels per fiber! And new, low cost devices that will drop system costs to one-tenth of their current per channel price. The list goes on.

Until 12 months ago, the answer to the fiber/coax question was straightforward and relatively easy to quantify. Namely, faced with a rebuild, if you were consolidating headends or extending a system to include a new headend, then a technical and economic analysis of fiber optics was appropriate. A comparison of the proven technology of a 16-channel per fiber optic FM supertrunk system to standard alternatives such as AM coaxial supertrunk, FM over coax and AM microwave systems was made to find the best solution matching the particulars of the application. Fiber optic FM supertrunks win these classic analyses with increasing frequency.

Here is the real dilemma. If the time to do a complete system rebuild is now, a decision has to be made: If the existing coaxial cable has two to three years of life remaining, do you rebuild it with coax today knowing that you will stay with the new coax-based system for 10 to 15 years? Or do you overlash fiber to the existing coax, knowing that you can squeak by for a couple more years, betting that fiber technology will catch up to provide the capability you need before the existing plant simply becomes too burdensome? If you bet on your current system, just where do you install fiber? Everywhere, and eat the cost? Just on the main trunks? How many fibers at each location?

John Holobinko is vice president of marketing and sales at American Lightwave Systems.

To answer this requires an examination of the technological considerations of extending fiber deeper into the system: How do you think fiber systems of the future will handle RF scrambling? HDTV? Channel locking to local off-airs? HRC? How much will they cost per channel? How much will fiber cable cost two years from now given that last year prices dropped by almost 50 percent only to increase somewhat again in 1988? And about your current system: Can the amp electronics and/or spacings be changed to provide additional channel capacity today? What will happen to signal quality if the trunk is marginal? What about signal ingress and egress?

There are some of the questions. Now, where does the engineer look for answers? One of the best places to look is where technology stands today—not by product announcements and press releases—but by what is operating in the field, in any shape or form. With fiber optics you come to a startling revelation:

> There are no CATV fiber systems field installed today (as of the publisher's deadline) serving CATV subscribers, not even as *field trial* systems, that are utilizing any technology other than standard FM and digital multichannel supertrunking systems.

We know it usually takes close to a year or even more to go from a *successful* field trial to standard product. So, even if some new fiber system is installed in a field trial tomorrow (assuming that it is 100 percent successful from the start), it would be about a year from now before the first systems would be available as a standard product. But the new fiber systems that are being discussed today are a radical departure from current fiber trunking technology. They will not be evolutionary systems, but revolutionary departures from existing systems. The probability that the problems these technologies face today will be overcome in the near term is small, given the orders of magnitude of performance improvements that will be required. A lab system is a far cry from a field situation with -40°C to +70°C, high humidity, salt spray, power spikes, (i.e. real-world CATV conditions).

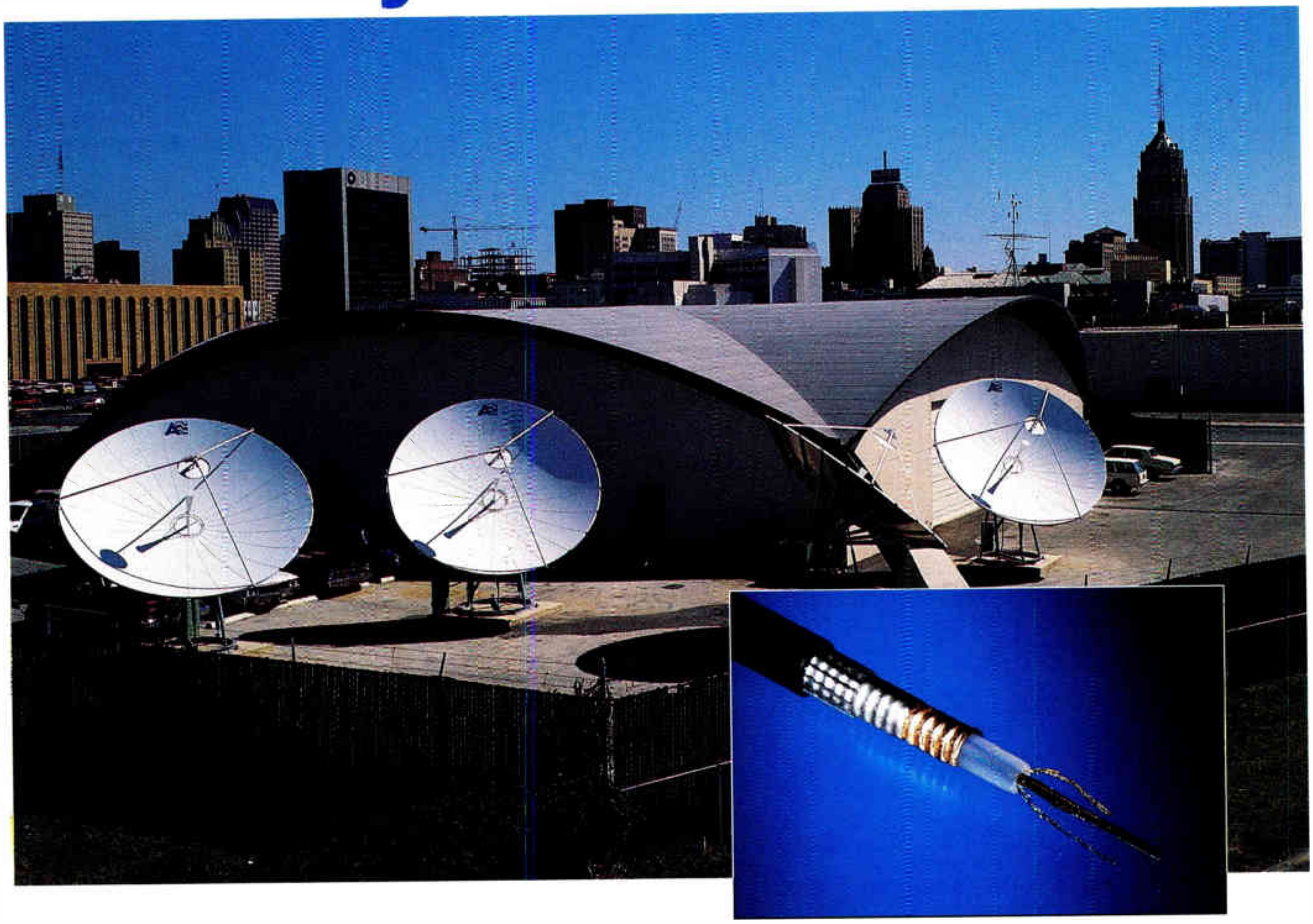
That's not to say that new technology and change are bad. American Lightwave Systems, for example, continues to advance fiber systems performance. Kudos to those in our CATV industry who have taken the lead to try to stimulate improvements in technology. Change forces us to constantly re-evaluate the way we do things, and ultimately do them better and more efficiently. However, change, especially revolutionary change in technology, does not happen overnight. And adapting new technology too soon is not without significant business risk.

So how do you answer management's question? If you are going to be asked to be a futures broker, then perhaps you should follow the advice of the late Ben Graham, arguably the best Wall Street stock analyst ever. Ben had an uncanny knack of beating the market consistently with his investment returns. His philosophy was: Go with the proven, that which provides good value and consistent performance, and in the long term you will always beat out the fad followers and speculators.

If Ben Graham had been a CATV engineer, I bet I know the answer he would have given to his management.

—John Holobinko

Is a Fiber Optic System in your future?...



... ANIXTER + AT&T is the answer.

Anixter can make your fiber optic system a reality. We stock all the AT&T products that you need, including Supertrunk and distribution fiber optic cables, connectors, closures, cabinets, tools and test equipment. You can have the best of both worlds – Anixter and AT&T.

Call an Anixter Fiber Optic Specialist:

CATV Fiber Optic Hotline:

1-800-647-7427

ANIXTER

DEPT. CATVFO
4711 Golf Rd., Skokie, IL 60076

☐ Please send me more information on AT&T's Fiber Optic Products.

Name ____________________

Title ____________________

Company ____________________

Address ____________________

City ____________ State ______ Zip ______

Telephone ____________________ CED588

ANIXTER® COMMUNICATIONS

CORPORATE HEADQUARTERS:
ANIXTER BROS., INC., 4711 Golf Road, Skokie, IL 60076 (312) 677-2600 — Telex 289464

Reader Service Number 59