COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Ringing in the audio

Pay-per-view: Giving in to the impulse

October 1985

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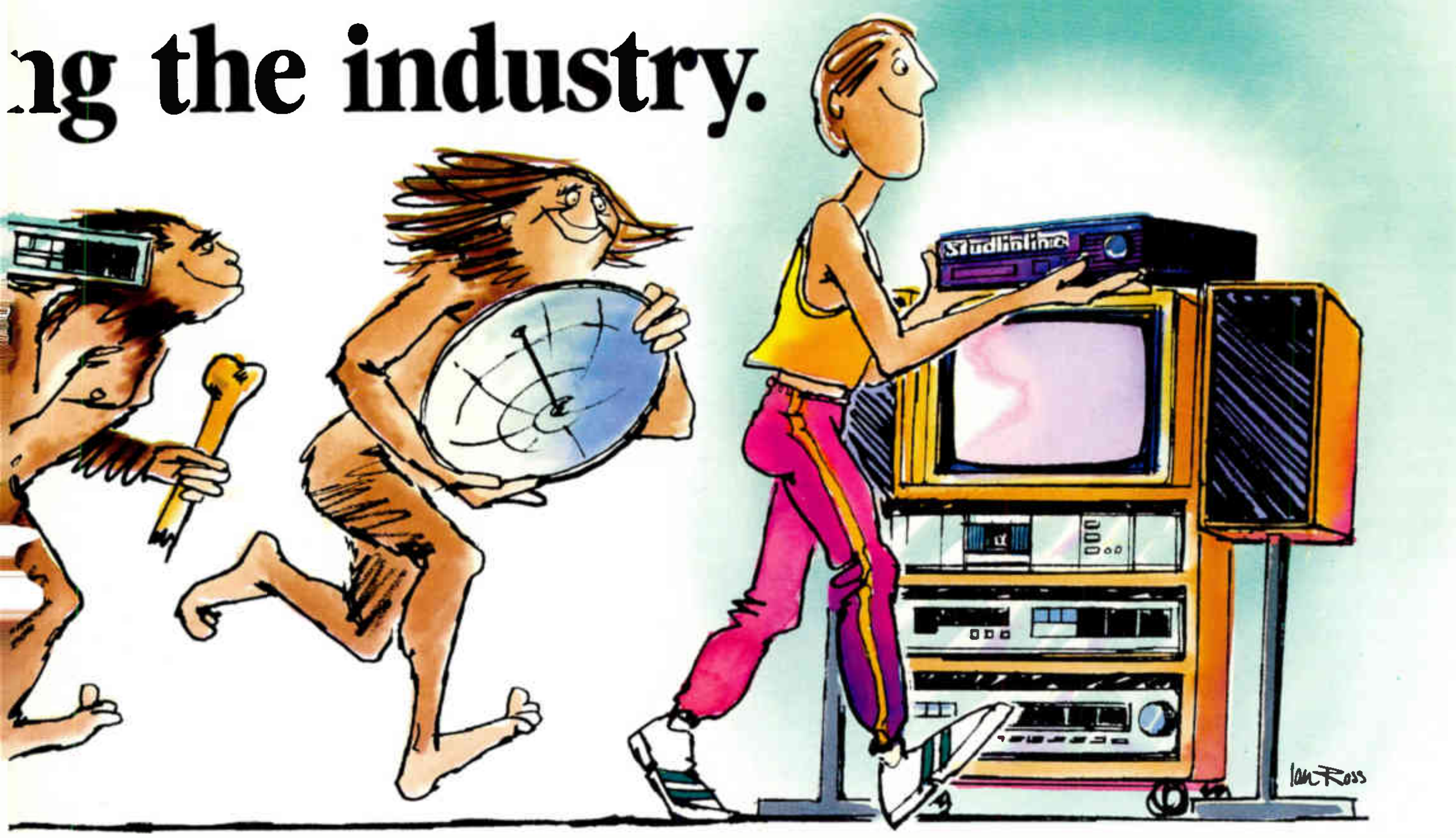

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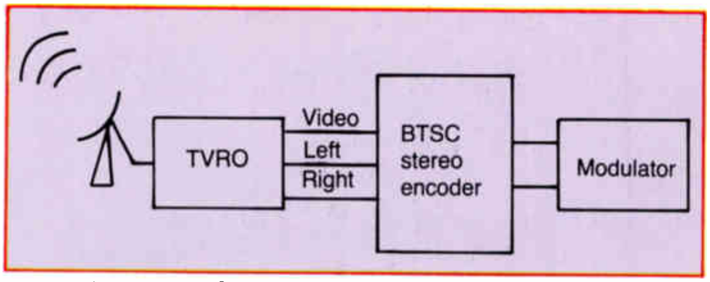
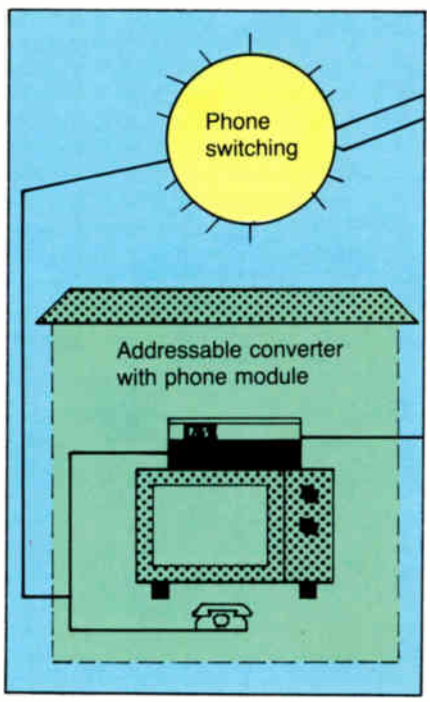
CONTENTS

Departments



BTSC stereo 19

ANI systems 55



Store and forward 60

Features

Cover
The development of audio through the eyes of Charles White III. PPV photo courtesy of Texscan Corp., Mike Zubeck, photographer.

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Remember when PPV required a large phone staff? Or two-way cable plant? Now...

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Remember...it was only yesterday when offering a PPV event in one-way cable systems usually meant mass confusion. Too many telephone operators to pay, but not enough to handle the last minute phone calls. In solving this problem, Jerrold drew on experience that dates back to 1956. That year, a two-channel device was developed and demonstrated at the Jerrold plant in Philadelphia. Known as the PBPB "program-by-program billing," it attracted much interest—and visitors—from all over the world. Although the PBPB was too far ahead of its time to be a financial success, it was one of cable's earliest demonstrations that pay-per-view technology was quite feasible.

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GENERAL INSTRUMENT

EDITOR'S LETTER

Overlooking the basics?

On Sept. 10 and 11, the Society of Cable Television Engineers and its Rocky Mountain Meeting Group co-sponsored an overwhelmingly successful national technical seminar on "Signal Leakage—CLI and the FCC" in Denver. Approximately 110 attendees were exposed to almost every aspect of signal leakage: its history, CLI measurements, effects of equipment, selecting the proper equipment, organizing a leakage program in a cable system, and dealing with the FCC.

The highlight of the two-day conference was a live two-hour video teleconference, complete with a distinguished panel of guests from Washington, D.C.: Wendell Bailey of the NCTA, Ralph Haller and John Wong of the FCC, Archer Taylor of Malarkey-Taylor, and Tom Polis (moderator) of RT/Katek. The moderator in Denver was Al Kernes of Jones Intercable.

Satellite transponder time for the live teleconference was donated by Showtime/The Movie Channel, and Dynavision (a subsidiary of Microdyne) provided the downlink.

Haller discussed the history and effects of leakage. Taylor gave a brief overview of CLI and emphasized, "The most important effort in the field is to eliminate signal leakage." Wong explained the new FCC rules, and Bailey commented on the NCTA's position regarding signal leakage.

Jones Intercable taped the seminar. Some time after Nov. 1 videotapes will be available through the SCTE's national office. Look for more coverage on this seminar in the November issue of *The Interval* here in *CT*.

The signal leakage seminar was one of the most professional and thorough sessions I've attended. A sincere "well done" and "thank you" to Bill Riker, Sally Kinsman and the multitude of SCTE personnel involved.

Speaking of signal leakage

In the cable industry, impulse pay-per-view, multichannel sound and satellite scrambling are among the topics drawing considerable interest, and rightly so. However, while these developing technologies are essential to cable's growth, we must not lose sight of the basics—the quality of signal received at the subscriber's TV set. This subject hits close to home—at least our circulation director, Greg Packer, is well aware of it. Packer lives in the mountains of Colorado and subscribes to the local cable system. He enjoys receiving cable except for the few hours of downtime a week when a technician has to go up to the area and dump water from several amplifiers to clear the signal. This situation inspired him to write the following fable.

'A cable fable'

"Once upon a time some very bright young men found a way to make moving pictures dance on little glass boxes anywhere in the land. Because of the extensive use of coaxial cable the process became known as 'cable.' It was a very good idea and people loved it.

"Then some men with money, called 'investors,' approached the bright young men, as men with money always do when they see a 'good idea.' With the help of their wise men, known as 'accountants,' they set up some ground rules and began building cable systems.

"Soon 'cable' companies sprang up all across the land. The investors made more money than even they imagined they would. And, the bright young men were very happy because they lived to see a dream come true: for the first time people throughout the land could watch a variety of moving pictures on a glass box in their own homes. It truly seemed to be a 'no-lose' situation.

"Then one day while the bright young men were graying and reminiscing about their accomplishments, and the investors were counting their profits in their respective moneyhouses, a strange thing began to happen. The moving pictures on the little glass boxes all across the land began fluttering, fading and stopping altogether. The viewers were sad and called the cable companies to ask that they make the pictures move again.

"When the slightly graying, bright, not-as-young-as-they-used-to-be men heard of this they agreed that there was probably nothing really wrong and certainly nothing to worry about; someone would fix it. None of them volunteered because for one thing, it wasn't their job. For another thing, none of them had lifted a screwdriver in years. Besides they were busy reminiscing. The investors were out of town and unavailable for comment. Tired and frustrated, the 'service' people took their telephones off the hook and went to lunch. To this day most of them are still there.

"In no time at all a new group of bright young men began to show the viewers how to get even more moving pictures without putting up with poor service and condescending, couldn't-care-less individuals; they called it 'home TVRO.'

"Moral: People who sell dreams on glass boxes can't afford to let the pictures stop moving."

Stay tuned

In last month's issue we ran an article by Lawrence Lockwood, of TeleResources, on determining antenna heights for line-of-sight microwave links. As a follow up for this article, our December issue will feature the computer program developed by Lockwood for doing path analysis calculations on your PC.

Toni I. Barnett

This is what your next signal level meter should look like

That is, if you're looking for a high-quality 600 MHz signal level meter for under $1200

Accuracy. Ease of use. Advanced features. Lasting value. Interested? You should be. Because these features, which you'd expect only from a high-priced signal level meter, are now available for much less. Presenting the Spectrum 700—Texscan's newest signal level meter.

Accuracy

Your system depends on it and the Spectrum 700 promises it. With ±0.75 dB (at ±68° f) over the entire range of 5 to 600 MHz. Dependable accuracy is maintained over the entire operating temperature range of 0° to +130° f—eliminating any need for recalibration. But that's only half of it. Accuracy is also important when it comes to taking level readings. That's why we've equipped the Spectrum 700 with a large easy-to-read meter.

Ease of Use

Besides the easy-to-read meter, and elimination of a recalibration function, the Spectrum 700 features a replaceable input connector. Each Spectrum 700 is supplied with a protective carrying bag, making transport easy and safe. The Spectrum 700's low profile means you can work with the meter right up front. Rather than off to the side.

Advanced Features

The Spectrum 700's most advanced feature is its 5 to 600 MHz accurate level measurement capability. In addition to signal level measurement, the meter measures hum. It has a built-in charger and an internal battery which provides five solid hours of operation between charges. And should you leave it on, Spectrum 700 lets you know with a "beep" every five minutes.

Lasting Value

Spectrum 700 has been designed to satisfy your measurement needs today and anticipate tomorrow's. It stands up against the environment with its waterproof carrying bag and waterproof mylar speaker. And withstands shock with its durable metal casing, protective rubber-ended handles, and padded bag. Durability under all of these conditions means longer life—and that's lasting value. Best of all, it's affordable. Which means you can afford to keep more around.

If you still aren't convinced—give us a call. Or better yet, request a demonstration. And see why Spectrum 700 should be your next signal level meter.

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BPA membership applied for November 1984.

Tribune/United and Jerrold do PPV test

OAKLAND COUNTY, Mich.—Tribune/United Cable Communications went into a pay-per-view experiment with the Jerrold Division of General Instrument Corp. in April 1985. Reports indicate that the test is operating smoothly. The pay-per-view field trial, scheduled to run for six months, is designed to test the technical aspects of one-way and two-way PPV operations as well as determine whether the service is a potential source of new revenue for the cable system, according to Tribune/United.

Oakland County is a two-way system and it is using Jerrold's Starcom V converter for the PPV test. In order to measure the effect of one-way call-in PPV versus two-way impulse technology on purchase patterns, Tribune/United has split the 4,800-subscriber test base into two groups of 2,400.

Terry Wolf, director of system software for United Cable in Denver, says that the total number represents a statistically significant sample for purposes of the field trial, "but it's small enough to allow for evaluation of subscriber price sensitivity and use of special advertising techniques," he says.

According to the pre-trial survey results, there's a high level of awareness of cable television and an interest in PPV programming. David Skinner, marketing manager for Tribune/United Cable, said, "The demographics are good here in Oakland County. There's a lot of disposable income for entertainment sources like cable television."

During the test Tribune/United subscribers will be able to choose from two channels of pay-per-view programming. In addition, participating subscribers receive a special monthly PPV channel programming guide.

Success with pay-per-view in Tribune/United's Oakland County cable system could lead to similar experiments in other United systems, according to United's Terry Wolf. The MSO counts almost 680,000 subscribers across the country, approximately 100,000 of which are addressable.

Terry Wolf, United Cable TV's system software director, makes last minute checks on Oakland County's computer billing system, while Dave Skinner (left), Sheri Herman and John Hartnett (foreground) look on.

Nemal's new division

NORTH MIAMI, Fla.—Nemal Electronics International has opened a new division specializing in cable assemblies for the aerospace, data processing and commercial markets. The new facility is capable of producing in excess of 1,000 assemblies daily. Nemal also maintains an inventory of component parts and cables allowing for quick delivery on a variety of RF and data cables.

SCTE call for nominations to fill six board positions

WEST CHESTER, Pa.—The Society of Cable Television Engineers is inviting interested members to run for election to its board of directors. Six openings will become available when the current term expires: three at-large directors and one regional director for each of three regions. Regional directors must live within their regions; at-large directors are not geographically restricted.

The regions and their respective states are: Region 4—Minnesota, Wisconsin, Michigan, Indiana, Kentucky, Tennessee and Illinois; Region 6—Virginia, West Virginia, Maryland, Delaware, Pennsylvania and Ohio; and Region 7—New Jersey, New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire and Maine.

Nominations for candidates to be placed on the 1986 ballot should be submitted to SCTE Election Committee Chairman Rex Porter, (602) 245-1050, or to the SCTE national headquarters, (215) 363-6888, no later than Nov. 1, 1985. (See *The Interval* for more on this.)

In other Society news, the SCTE is still accepting proposals for papers and technical programs to be presented at Cable-Tec Expo '86 and the Spring Engineering Conference, which precedes the expo. Proposals should be directed to: Bill Riker at the national SCTE office. For more information on Cable-Tec Expo '86, just circle #1 on the reader service card and drop it in the mail.

NCTA call for technical papers

WASHINGTON—Proposals for technical papers to be presented during the 1986 National Cable Television Association convention, March 15-18 in Dallas, are due the middle of this month at the association's headquarters. Persons interested in presenting original, noncommercial papers on communications engineering topics of interest to the cable television industry should submit 250-word summaries to Wendell Bailey, vice president for science and technology, NCTA, 1724 Massachusetts Ave. NW, Washington, D.C. 20036.

The papers will be presented during the technical program, which will include 10 to 14 sessions, and published in the conference proceedings text. A subcommittee of the NCTA's Engineering Committee will judge the summaries on reference value, originality and absence of commercial intent. Completed papers will be due in December for publication in the 1986 edition of the *NCTA Technical Papers*. Additional information is available from Katherine Rutkowski at (202) 775-3637.

S-A announces orders

ATLANTA—Two major oil companies have installed Scientific-Atlanta private cable systems on their Gulf coast off-shore oil drilling platforms to provide entertainment for company employees. A total of 53 systems, valued at over $150,000, were purchased from Auto-Comm Engineering Corp., a Lafayette, La., Scientific-Atlanta dealer. Included in each system were the Series 9000 2.8-meter antenna, Model 9530 video receiver with plug-in modulator and Model 362 low-noise converter. The single-channel systems will provide entertainment for workers, some of whom are stationed on the oil rigs for up to two weeks at a time. Auto-Comm has installed over 145 such off-shore earth stations for 20 major oil companies.

Continental Cablevision has given Scientific-Atlanta a $5 million order for addressable CATV products to be installed in Continental's new St. Paul, Minn., system. The new system, which has the potential for 140,000 homes, will feature S-A Series 8500 products, including Model 8550 addressable set-top terminals and remote controls, Model 8553 addressable transmitters, Model 8556 scramblers and a System Manager IV computer control system.

The Sanibel Harbor Resort Spa & Racquet Club has installed a Scientific-Atlanta private cable system to provide entertainment for resort guests. The system was sold by Cable Systems International, a Sarasota, Fla., dealer for Scientific-Atlanta and includes a 5-meter dual-beam feed antenna, Model 9530 receivers, Model 6130 signal processors, Model 6330 modulators, Model 362 low-noise converters, 300 MHz distribution electronics and coaxial cable. A Scientific-Atlanta 3.2-meter antenna has been added to the system to provide teleconferencing capabilities for the resort. The 12-channel system offers six off-air channels and an in-house channel.

Lastly, HI-NET Communications of Memphis, Tenn., has awarded a $2.9 million contract to Scientific-Atlanta for the purchase of a B-MAC encryption system for its new satellite-transmitted television network. The network will carry news and entertainment programming and videoconferencing services to hotels throughout the United States. The contract calls for Scientific-Atlanta to install satellite uplink encryption equipment at HI-NET broadcast studios. S-A also will install decoders at network affiliate hotels to allow receipt of secure business conferences and four channels of programming from HI-NET.

Telecommunications export firm established

PHILADELPHIA—Ballagh & Thrall Inc., an international trade company, announced the establishment of a new division devoted exclusively to telecommunications and data transmission equipment. According to Geoff Carroll, marketing manager of the new division: "We felt there was a need for an established export company, with full back-up services, to bring together some of the newer and more exciting U.S. products to overseas markets."

The company has no plans to enter the general telephone equipment markets, which they feel are fully covered at present. They have designed their line around system enhancement products. Most of the products, while fully compatible with the European networks, offer features that are not yet available off-the-shelf outside of the United States.

"Local technical support," Carrol went on to say, "was one of the first areas we addressed. We established a service facility equipped to provide service out of London." The company sells to distributors, PTTs and has some private label distribution.

GTE satellite launched

McLEAN, Va.—Spacenet III, the fourth GTE communications satellite, was launched Sept. 12, 1985, from Kourou, French Guiana. Spacenet III was launched aboard a three-stage Ariane 3 expendable launch vehicle at 7:26 p.m. EDT with the launch window extending until 8:30 p.m. Spacenet III was one of two satellites launched on this vehicle. The other satellite is the European communications satellite ECT-3.

The Spacenet satellites provide the United States with both C- (4/6 GHz) and Ku-band (12/14 GHz) service. This dual frequency capability enables the satellites to support existing networks that utilize the lower C-band frequency, as well as new systems operating in the higher Ku-band frequency range.

The Ku-band transponders have been modified to provide East and West regional coverage beams. The C-band communications subsystem of the satellite is the same as the earlier Spacenet satellites with 12 36 MHz and six 72 MHz transponders.

Spacenet III will be located at 87 degrees West Longitude and will provide C-band coverage of the United States and Puerto Rico, and Ku-band East and West regional coverage beams.

GTE also has been authorized by the Federal Communications Commission to launch three additional satellites—Spacenet IV, and Gstar II and Gstar III. The GTE Spacenet satellites are manufactured by RCA Astro-Electronics. Each satellite is nearly 10 feet high and has a solar panel wingspread of 47 feet. Launch weight is 2,634 pounds, and in-orbit weight is 1,551 pounds.

Spacenet III will provide satellite communications transmission services to a variety of voice, video and data customers.

Grand opening of shared tenant system

BETHESDA, Md.—The Air Rights Communications Center (ARCC), the Washington metropolitan area's integrated communications system for office buildings, recently opened for business. The ARCC, located in the Air Rights office complex at 7315 Wisconsin Ave. in Bethesda, is a joint venture of TDX Systems, the Vienna, Va.-based long distance company, and Eisinger Kilbane & Associates, the Washington area commercial real estate development and management firm that owns the Air Rights complex.

The ARCC, which is a shared tenant system (STS), can provide tenants of the complex and surrounding office buildings with a variety of services ranging from the installation of basic telephones and service to state-of-the-art data transmission. The STS concept is based on the idea that certain telecommunications services that are too expensive for one tenant to obtain become more affordable when the cost can be shared by several users.

Working with a telecommunications consultant from the ARCC, tenants can select from the center's menu of services, which can be custom packaged to meet their needs and requirements.

TFC's new office, orders and division

WALLINGFORD, Conn.—Times Fiber Communications recently announced the establishment of a Far Eastern Office in Hong Kong to be headed up by Mr. Benny Chee-Hon Chan. The office was created to represent the company in its dealings with the Taiwanese and Hong Kong vendors who manufacture TFC's Mini-Hub II star-switched video distribution system.

The Government Systems Division of Times Fiber announced the receipt of an order to supply cable assemblies to the McDonnell Douglas Corp. for use in their F-18 aircraft. The order is valued at more than half a million dollars.

Times Fiber also announced the creation of a special business unit designed to exploit its technological expertise in the field of fiber optics. Specifically, the business unit will work on developing analog, digital and hybrid fiber-optic links and equipment for the video and computer-interconnect markets.

Governor salutes Raydx

OCALA, Fla.—Raydx Satellite Systems has been awarded the Florida Governor's "New Product Award" for medium size businesses and has been nominated for the national competition. The 10.5-foot Raydish satellite receiving antenna was chosen for innovative use of engineering principles and materials in the design. The antenna was built with high-strength aluminum extrusions to produce a high-performance antenna with a look that blends well into any background.

The award is sponsored annually by the Florida Professional Engineers in Industry and the Florida Department of Commerce. The plaque commemorating the award was presented in a ceremony in the Governor's room at the State Capitol. As the winner in its category Raydx is nominated for the National Society of Professional Engineers and the Professional Engineers in Industry national level competition.

Avantek's contracts worth $5.5 million

MILPITAS, Calif.—Avantek Inc. announced that it has received contracts from AT&T Communications and Western Tele-Communications Inc. totaling $5.5 million. The two contracts are for delivery of solid-state power amplifiers used to retrofit traveling-wave tubes in analog and digital radios for heavy-density microwave communications routes. This brings to $15 million the total orders received from various customers for products of this type so far in 1985 by the company's Telecommunications Group's telecom microwave assemblies product center.

BellSouth contracts new voice, data system

ANAHEIM Calif.—BellSouth Services Inc. has awarded Lear Siegler Inc./Electronic Instrumentation Division the development contract for a new system that will provide digital voice and data service over non-loaded, two-wire subscriber lines or through SLC-96 systems. The simultaneous digital voice and data system that Lear Siegler is developing will provide a voice channel and two data channels over two-wire loops, either directly from the central office or via 96-channel subscriber loop carrier, to subscribers. The system will allow the telco to offer efficient simultaneous voice and data services over its existing loop plant.

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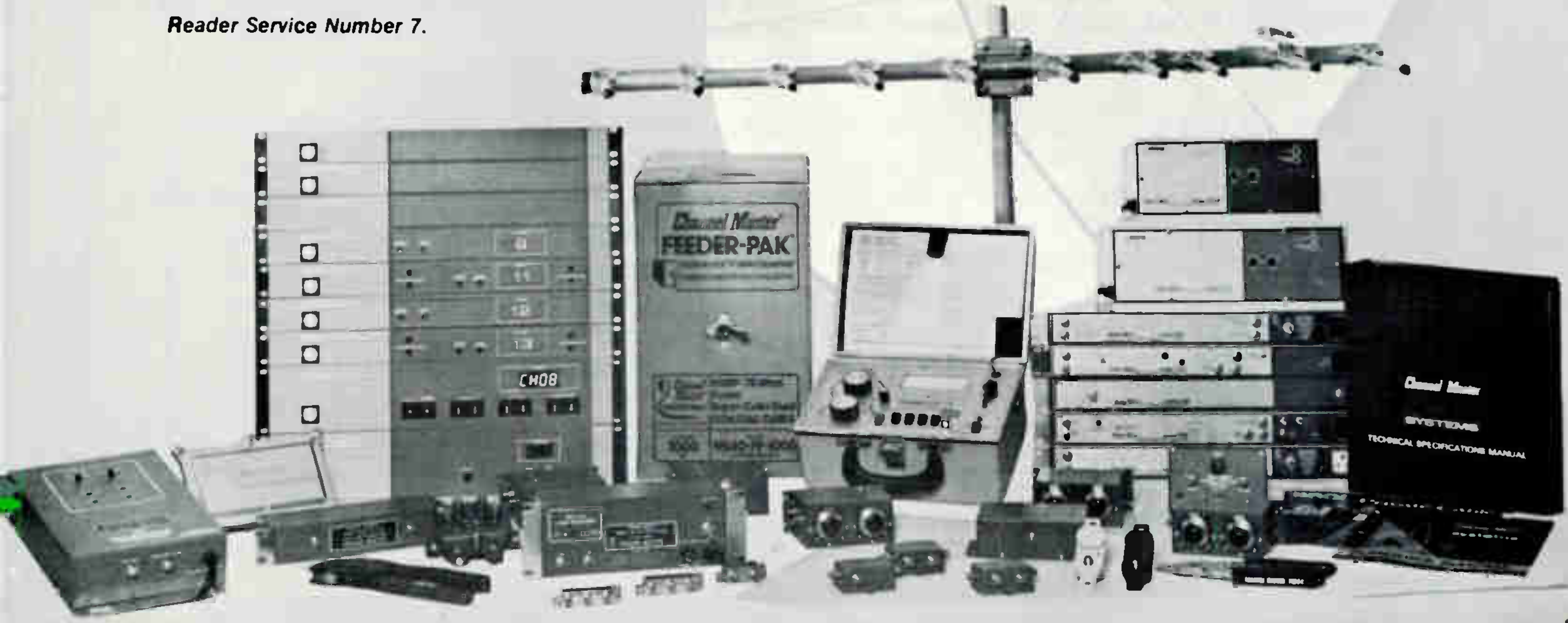

Growing old gracefully

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories Inc.

To quote from the seventh edition of *Psychology in Life* by Floyd Ruch, a commonly used college psychology textbook, on page 248: "Although our society is rapidly changing both in technology and prevailing economic philosophy, requiring new attitudes and skills, it can be predicted that an aging businessman will come more and more to react to new problems on the basis of knowledge, skills and attitudes learned in his youth. Thus, a certain degree of conservatism would appear to be part of the biological and social heritage of mankind."

Additionally, to quote a medical authority, "Aging is a gentle decline that begins around the 30th birthday. The output of the heart and the speed of nerve impulses diminish by the same amount between the ages of 60 and 70 as they do between 30 and 40."

There are two basic kinds of damage that befall the aging body. One is a gradual loss of cells where, even in the human brain, they do not reproduce themselves. Muscles may actually shrink, connective tissues become stiff, bones brittle. These aging processes seem to be a matter of heredity and degree of physical activity. The better the heredity, the less the aging; the more the physical activity, apparently also the less the aging.

Some years ago, I had the occasion to question an insurance doctor as to some of the peculiar physical problems he had seen in the course of examining people for insurance. He described the case of a subway motorman who for many years had sat on a little stool, one foot pushing a floor button and the other doing nothing. Now one leg has varicose veins and the other did not. Which leg had the varicose veins? I'm sure you know the answer—the one that did nothing.

A very interesting statistic I ran across shows that the average brain shrinks in weight from 3.03 pounds at the age of 30 to only 2.72 pounds at the age of 90. An individual's reaction time drops by 25 percent from age 20 to 70. One's powers of inductive reasoning begin to decline at 23, one's ability to recognize numbers at 27, recognize designs at 32, and recognize tones at 45.

Now, to look at the individual as a learning machine. One year after the conclusion of a course of study, he can only recall 5 percent of the memorized material. Typically, those of us who have left school and return to take the identical examinations that we took in our senior year, would probably find that by the first year out of school, we would have reduced our grades at least two levels, and by the third year, we would have scored below the passing level.

One's learning capability decreases with age, starting somewhere around the age of 30. The time required to inject the knowledge into the individual brain is something that age and cleverness and skill cannot change. This is a constant up to the age of 30 and gradually increases thereafter.

If you examine any individual, you will find, I think, that the quantity of knowledge input to the brain is probably at his highest level in his last year in college, based strictly upon the number of hours that he spends in study. Probably at no subsequent period of his career does he truly have the freedom from distraction and the economic capability to spend his time singly and solely devoted to piling knowledge into the mind. From this point on, the total knowledge content in the brain can only go down. The most annoying aspect of this analysis is that the retained knowledge is also getting obsolete every day. It seems as if there is an exponential increase of subject content with time. Probably every 10 years the knowledge in any field is multiplied by 100.

Not only does one's knowledge become obsolete with time, but an entirely new field may arise with techniques so unique that even the basics have to be relearned. No one is going to learn a new mathematical skill quickly and painlessly. Indeed, as you get older, the hours required to acquire this information become longer not shorter, and yet as you get older, the hours available for the acquisition of such knowledge shrink due to social pressures.

Before we all sink in a sea of sorrow and drown in our own tears, what can be done to survive? Indeed, how does one grow old gracefully?

How to do it

The first and most important ray of sunshine in the gloom is the basic individual differences that exist between all of us. The kind of abilities that have been mentioned are happily reduced by comparatively minor percentages over an individual's lifetime, amounting to no more than a 25 percent reduction in anyone's skill, while the differences between individuals are far greater. The engineer or businessman who has emerged to survive for many years in a competitive environment, who did well in school when he was there, who possesses a drive and creativity to rise to the top of his profession, still will survive very well indeed if he understands who he is and what he has to do. The following suggestions may be helpful in growing old gracefully.

To begin with, attempt less than you did before. Reduce the effort required by reducing the goals. Perhaps there may even be a deliberate reduction to the extent that you think your own abilities have declined.

Next, specialize more in a particular field. Be less of a generalist. If in any one field you concentrate your time, you may actually be able to catch up or stay with the expert in that field, providing it is narrow enough.

Call on experts and consultants. They may be available at reasonable enough fees to provide you the knowledge that you haven't the time to gain.

You may not be able to replace yourself, but you certainly can replace your associates and subordinates. Don't be satisfied with a business that has grown old with you. The more capable assistants you surround yourself with, the less likely anyone is to notice that you have declined in your own ability.

Reduce the time needed for study by concentrating on the very latest magazine articles and books in which the information has been digested and regurgitated, so that you don't have to do the job the author has done.

Probably the most significant area in the struggle to remain competitive is to watch your competitor closely. He is in the same bind. He is working as hard as he can to survive, and generally, his designs and his techniques reflect the latest state of the art. Build your designs and your capabilities upon the latest industry practices rather than in a serial fashion from your own laboratory and your own concepts.

Whatever you do in design, don't get too close to a marginal design. Leave room for error, don't push the state of the art. Derate that transistor output stage, lower the working voltage stresses, reduce the possibility of mechanical fatigue with extra metal, add to the strength of the packaging, double the pages of instruction that go with your product. Admittedly, up goes the cost but down goes the knowledge level required, and the risk.

Rest a little more. Don't run up four flights of stairs at once. Admire the view at each landing, and then make the fourth one.

Along with the hardening of the arteries, it is obvious that you no longer work at the same speed as when you were younger. Better raise those costs estimates and time schedules.

If the picture seems bleak, fortunately, experience usually means more efficiency. It is probably going to be true that if you maintain your company's efficiency level at the average of the industry, and you mix in a little of your own experience, to counteract your own lower efficiency level, the chances are that you will probably do as well as you used to when you had more energy and stored knowledge.

Generally, in most fields, the rich become richer, not poorer. The new firms have the usual problems of breaking in and the fact that they are staffed by vigorous and young and hungry executives, doesn't mean that they are naturally going to push out the older and tired companies. Older and tired companies have learned how to live with their oldness and tiredness, and they survive very well indeed. All you have to do is make sure that you are one of the survivors.

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Reader Service Number 10.

Considerations in the operation of headends carrying BTSC stereo

This article addresses some of the important issues in operating a system that carries a BTSC stereo signal. It will be assumed that the CATV system operator has studied the technical issues involved in selecting a stereo transmission method (i.e., set-top converter compatibility, scrambling, etc.) and has determined that the BTSC format is suitable for his system.

By Alex Best and William Woodward
Video Communications Division, Scientific-Atlanta Inc.

In order to help understand the problems associated with the BTSC signal, a cursory review of the system is in order. The system is conceptually similar to commercial broadcast FM stereo. As with commercial FM stereo, the BTSC stereo signal consists of a baseband signal that is the sum of the right and left audio channels and a double sideband suppressed carrier (DSB-SC) subcarrier, which is modulated by a signal that is the difference between the left and right audio channels. The carrier frequency of the DSB-SC signal is twice the horizontal scan frequency of the video signal. A pilot carrier, used to demodulate the DSB-SC subcarrier and to indicate the presence of a stereo signal, is transmitted at a frequency equal to the horizontal scan frequency. Figure 1 shows a basic block diagram of the system and an illustration of the baseband spectrum of the encoded signal. Note that an additional subcarrier is shown. This is the second audio program (SAP) subcarrier, which is used for bilingual broadcasts. This subcarrier is FM modulated. The maximum deviation of the main carrier by each component is indicated in the figure. Because of the wider baseband width (100 kHz) and the higher peak deviation ($\pm$73 kHz) of the aural carrier, the stereo compatibile CATV headend must have wider baseband and RF aural carrier bandwidths than those required for monaural operation.

In order to achieve a good signal-to-noise ratio in areas of poor signal quality, it was determined that some noise reduction method was required for the difference subcarrier and the SAP subcarrier. The noise reduction system chosen was the DBX companding system, which consists of wideband compression and variable pre-emphasis in the encoding process, and a complementary wideband expansion and variable de-emphasis in the receiver.

It is important to note that for good stereo separation the gain in the sum signal path must be the same as the gain of the difference signal path. Note that ideally the DBX encoder at the modulator (transmitter or headend) and the DBX decoder in the television receiver are totally complementary and have no overall effect on the difference signal level and frequency response.

In order for the DBX decoder in the television receiver to properly track the DBX encoder at the transmitter (or CATV headend), the deviation of the aural carrier must be accurately set to the levels specified for the BTSC system. If the proper deviation levels are not maintained, then the stereo separation of the system will be reduced. If the deviation is being set, then there must be some reference signal from the BTSC encoder that corresponds to a specific deviation. Since there is no reference signal when the input to the encoder is a program audio signal, there is no way to correctly adjust the aural modulator deviation when the modulator input is program audio in the BTSC stereo format.

Signal processors

As television stations start to broadcast BTSC signals, CATV signal processors will be required to process the BTSC signal. Signal processors fall into one of the following categories: heterodyne processors, strip amplifiers, and demodulator/modulator combinations. Of these, strip amplifiers and heterodyne processors are the simplest to use with a stereo signal. As determined by National Cable Television Association (NCTA) studies and subsequent studies, these types of signal processors typically have few deleterious effects on the stereo signal. Since the audio signal is never demodulated, they require little attention in operation.

This is not to say that these types of processors will not require modification or realignment to operate with BTSC stereo signals (although many units will have sufficient bandwidth and passband amplitude flatness to operate satisfactorily with a BTSC signal). However, once these changes have been made, processing a BTSC stereo signal requires no more attention than processing a monaural signal.

If processing is performed with a demodulator/modulator combination, then the manner in which the aural signal is connected between the two units is critical. If the BTSC stereo signal is demodulated to a broadband baseband signal, it must be remodulated in the modulator to the modulation levels of the original signal. Any errors in this modulation level will be detrimental to the stereo separation. In an attempt to determine how critical the modulation level is to system performance, a computer program was written to simulate the BTSC encoder, the FM modulator and the television receiver. The results from this program are shown in Figure 2. As can be seen from the figure, in order to maintain a stereo separation of at least 30 dB in an otherwise perfect system, it is necessary to maintain the modulation level at $\pm$5 percent of the correct level.

For these reasons it is preferable to interconnect the demodulator and the modulator audio path with a 4.5 MHz link. This eliminates the problems associated with adjusting the modulation level since the signal is never demodulated. It is important to note that certain demodulators and modulators can be connected in this manner and provide satisfactory results with BTSC signals, provided that the 4.5 MHz path has sufficient bandwidth. There is much standard monaural equipment connected in this manner that, when properly aligned, works well with a BTSC stereo signal.

If for some reason it is essential to demodulate a BTSC signal to broadband baseband, it is recommended that the demodulator/modulator combination be aligned in the following manner. Apply an FM carrier, which is modulated by a tone, to the RF input of the demodulator. Using a spectrum analyzer, adjust the tone to the correct frequency and level to produce a Bessel carrier null (i.e., a 10 kHz tone modulating the carrier to ±25 kHz deviation). Set the demodulator

Figure 1: The basic BTSC system

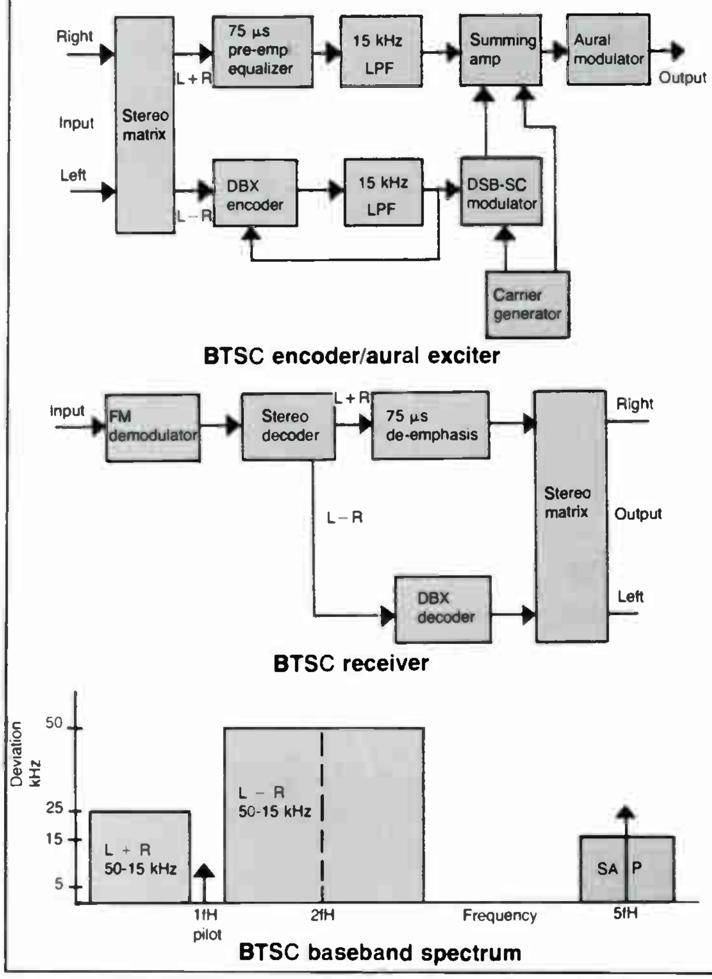
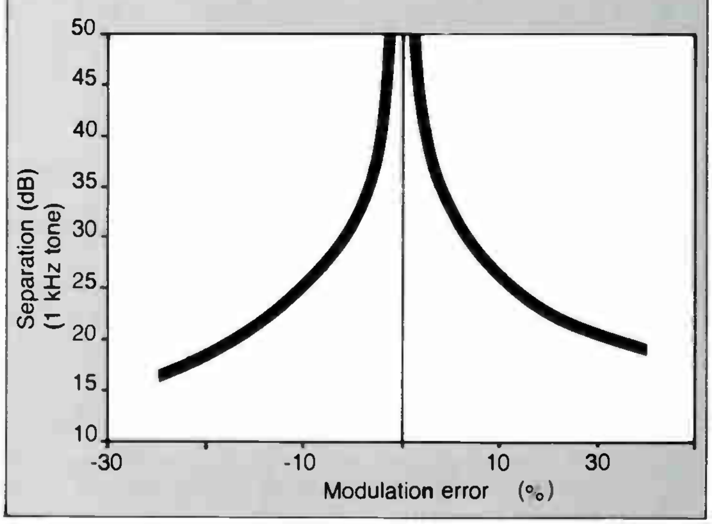


Figure 2



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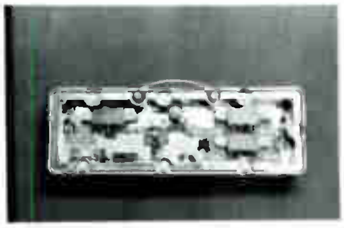
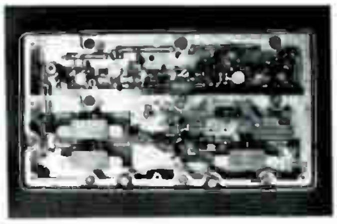
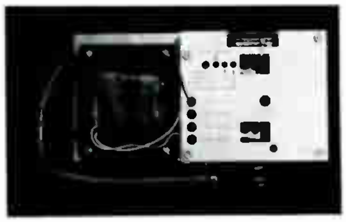
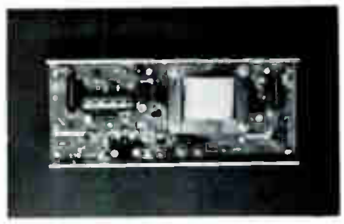

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STATION MODEL NUMBER AVAILABLE in P^2 OR PUSH PULL ONLY						
PASSBAND	50 to 330 MHz			50 to 400 MHz		
RESPONSE FLATNESS (See Note 1) Trunk Amplifier	±.2dB	±.2dB	±.2dB	±.2dB		
Bridger or Distribution Amplifier	±.5dB	±.5dB			±.5dB	±.5dB
MINIMUM FULL GAIN (See Note 2) Trunk Amplifier	29 or 31dB	30 or 32dB	29 or 31dB	30 or 32dB		
Bridger or Distribution Amplifier	30dB	30dB			[illegible]	28dB
RECOMMENDED OPERATING GAIN at 330 MHz, without equalizer Trunk IN to Trunk Out	26/22dB	26/22dB	26/22dB	[illegible]		
Trunk IN to Bridger (Distribution) OUT	40/34dB	40/34dB			38/32dB	26dB
TYPICAL OPERATING LEVELS for 40 channels, with equalizers IN	9dBmV	[illegible]	[illegible]	9dBmV	10dBmV	
Trunk OUT 330 MHz Linear TILT	34/30dBmV	34/30dBmV	34/30dBmV	34/30dBmV		
Trunk OUT 400 MHz Linear TILT	34/29dBmV	34/29dBmV	34/29dBmV	34/29dBmV		
Bridger (Distribution) OUT	49/42dBmV	49/42dBmV			49/42dBmV	48/42dBmV
DISTORTION CHARACTERISTICS [illegible]						
2nd Order Beats [illegible] Trunk Amplifier	[illegible]	[illegible]	-84dB	-85dB		
Bridger or Distribution Amplifier	[illegible]	-72dB			-70dB	-71dB
Composite Triple [illegible] Trunk 330 MHz	-90dB	-91dB	[illegible]	-91dB		
Trunk Amplifier Trunk 400 MHz	[illegible]	[illegible]	-87dB	-88dB		
Bridger or Distribution Amplifier 330 MHz	[illegible]	[illegible]			-67dB	-69dB
Cross Modulation 400 MHz	-64dB	-64dB			-62dB	-65dB
HUM MODULATION (by 60 Hz line)	70dB ALL STATIONS					
MAXIMUM NOISE FIGURE, without equalizers 330 MHz	7.0dB	7.0dB	7.0dB	7.0dB	8.0dB	9.0dB
400 MHz	7.5dB	7.5dB	7.5dB	7.5dB	9.0dB	9.5dB
MANUAL GAIN CONTROL RANGE, mimimum Trunk Amplifier	8dB	9dB	8dB	9dB		
Bridger or Distribution Amplifier	9dB	9dB			9dB	9dB
OPTIONAL INPUT LEVEL PADDING	AVAILABLE PLUG IN PADS S X P'S					
MANUAL SLOPE CONTROL RANGE, minimum In Bridger or Distribution Amplifier (Ch. 2/36)	8dB	8dB			9dB	7dB
AUTOMATIC SLOPE AND GAIN CONTROL For changes in cable (ref. to 330 MHz)	+3/-3dB		+3/-3dB			
Amplifier output at pilot frequency holds at	±.5dB		±.5dB			
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Operating Level, minimum/maximum dBmV	SELECTABLE PLUG IN PAD S X P's					
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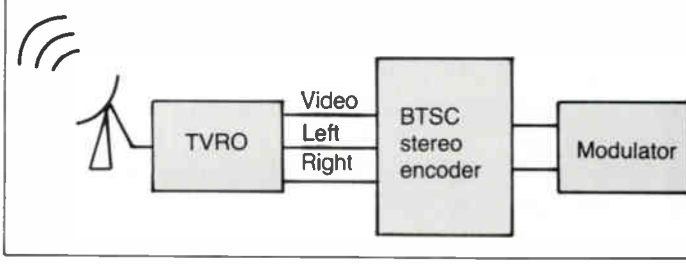
audio output to a convenient level or to the level recommended by the manufacturer. The modulator aural modulation level should then be adjusted until the same carrier null is present in the spectrum of the RF output of the modulator. This process will require that the demodulator/modulator be taken out of service while the adjustment is being made. Once the modulation has been set in this manner, it should not be necessary to adjust the demodulator output level or the modulator deviation.

It has been proposed that one way of setting modulation levels in a demodulator/modulator signal processing scheme would be to design a more complex modulation indicator that would have a narrow bandpass filter centered at the pilot carrier frequency. Since the pilot carrier always deviates the main carrier 5 kHz, it is conceivable that some modulation indicator—either a peak deviation indicator light or meter—could then be used to measure the deviation due to the pilot. To set the overall modulation to the correct level, the pilot deviation would be set to 5 kHz. Although this idea has some merit (and it is the only method which allows the modulation to be adjusted with an active signal), the standards for the BTSC stereo signal as they now exist allow for an error of ±500 Hz in the pilot deviation. If the pilot were used to adjust the modulation level, there could be as much as a 10 percent error in the modulation level. As can be seen from Figure 2, this would give marginal stereo separation performance.

Modulators

Undoubtedly, as the popularity of stereo television grows, many cable system operators will desire to produce a BTSC stereo signal for their pay channels. It will be assumed that left and right audio signals are available from a satellite earth station or other suitable source. Figure 3 illustrates how such a system might be configured. As can be seen, some form of BTSC encoder will be required. It will be necessary to decide whether the audio modulator portion of the video modulator will be replaced with a stereo-compatible unit or if the encoder will be purchased with an audio modulator. If the encoder is purchased with an audio modulator, then adjusting the system should be relatively simple because the modulation level will have been preset at the factory. It is only necessary to apply the proper left and right input levels to the encoder (these levels are not that critical). It might be pointed out that the level adjustments on the encoder audio inputs serve essentially the same function that the modulation control performed on the monaural system.

Figure 3



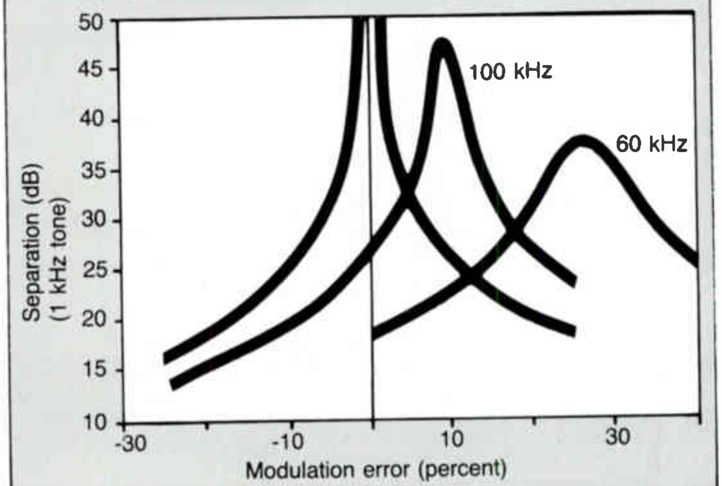
If the encoder that is purchased does not contain an audio modulator, then it will be necessary to have an aural modulator that is compatible with the BTSC stereo signal. Once this is obtained it will be necessary to set the modulation level of the modulator. This presents a problem similar to that of setting the modulation level in the demodulator/modulator combination. One solution to the problem of adjusting the modulation level is for the BTSC encoder to provide a test tone to the modulator, which produces a specified deviation. When the test tone is switched on, the aural modulator modulation level is adjusted until the overdeviation indicator on the aural modulator is just flickering on. It has been found that with a properly designed overdeviation light, this method gives excellent results in setting deviation levels. This method also allows the encoder to be aligned with the modulator with no test equipment.

Demodulators

This leaves only the demodulator to be considered. If it is desired to demodulate a BTSC signal to left and right audio (perhaps for simulcast into the FM band), it is important to choose a BTSC decoder that can demodulate the 4.5 MHz output of the demodulator instead of decoding the broadband audio output of the demodulator. This will eliminate the problem of having to adjust the baseband level into the decoder. There are several consumer decoders that are designed to use baseband inputs. Although these could theoretically be used on the output of the demodulator, there is no way to properly set the signal level going into the decoder. This would present a problem similar to the problem of adjusting the modulation level of the modulator. (An error in the baseband level going into the decoder would have the same effect as an error in the modulator modulation level.) For this reason, it is recommended to use a decoder that will accept a 4.5 MHz input.

As can be seen from the information presented here, accurate adjustment of modulation at the headend is important in order to achieve the maximum amount of separation. This might suggest to some that the best way to adjust the modulation of a BTSC signal is to maximize the separation by driving one audio input to the BTSC encoder and adjusting the modulation level for a null in the undriven channel when the signal is monitored with a stereo television. Although this can be done to produce the maximum amount of separation, it is not a recommended method to adjust the modulation level. It was found (as shown in Figure 4), that it is possible to correct for imperfections in the television or in the aural modulator (such as inadequate bandwidth of the television receiver) by allowing errors in the modulation level. This indicates that it is possible to maximize the stereo separation of the system by overmodulating the system! This is undesirable, and indicates that stereo separation is not the criterion that should be used to adjust modulation levels in a headend.

Figure 4: Separation of system with different baseband bandwidths



Achieving optimum performance

Some of the major headend operating problems that operators will face if they decide to carry BTSC stereo in their cable systems have been pointed out here. The most important point made is that the modulation level of a BTSC signal cannot be adjusted accurately with a program audio signal. For each combination of headend equipment there is an accurate method for adjusting the modulation level. All of these require the use of a test tone or external source. Although these procedures may seem overly complicated, they are required to obtain optimum performance from the headend when processing a BTSC stereo signal.

This article was reprinted from the "1985 NCTA Technical Papers," courtesy of The National Cable Television Association.

CATV audio program distribution

By Israel Switzer
Consulting Engineer, Cable Television & Telecommunications Engineering

Present audio program services on cable systems consist mainly of:

- FM radio stations (stereo) received off-air and redistributed in the cable system in the 88-108 MHz band.
- FM radio stereo services, 88-108 MHz band, which are generated at the headend as simulcasts of the audio program of certain TV program services. These simulcasts might be intended as substitutes for the BTS stereo audio originally provided with the television program or might be hi-fi stereo augmentation of television programs that otherwise have mono audio only.
- New pay cable audio services that are generated at the headend as a premium audio service offering commercial-free music on a subscription basis. These pay cable audio services should, for the time being, be considered experimental since their commercial success is not yet established nor is there any concensus yet on the transmission technology.

Most of these services use the conventional FM stereo signal format so as to be receivable by subscribers on ubiquitous FM stereo radio receivers. Pay cable audio services use a variety of transmission techniques. Some use conventional FM stereo format but transmit in a band other than the usual 88-108 MHz band. This system counts on the use of non-standard spectrum as a service security technique. Some pay cable audio systems use other analog transmission technologies such as use of discrete L and R carriers.

Problems of FM stereo transmission systems

Cable audio services that use conventional FM stereo transmission, as presently distributed on cable systems, provide mediocre service as measured by professional or audiophile standards, principally because of inadequate carrier levels in the cable distribution system, and inadequate headend processing and modulation equipment.

The low carrier levels make it impossible to provide an adequate demodulated audio signal-to-noise ratio (S/N), in stereo, from cable stereo FM transmissions. Inadequate headend equipment compromises stereo separation and audio distortion characteristics.

Conventional FM stereo transmission provides stereo by means of an L-R subcarrier. Since the L-R subcarrier gets only a small proportion of the available FM deviation, it effectively has only a small proportion of the available signal power. In marginal carrier-to-noise ratio (C/N) situations the stereo L-R subcarrier suffers significant quality degradation. The demodulated L-R baseband has poor S/N. When matrixed with the main channel L + R baseband to produce separate L and R basebands, the noisy L-R baseband introduces excessive noise. This is a well known effect in FM stereo radio broadcasting. The effective reach of an FM radio broadcast station is substantially reduced when it broadcasts in stereo, compared to mono. Stereo transmission suffers a penalty of approximately 20 dB compared to mono FM radio transmission. Cable transmission of FM stereo suffers from the same effects.

Effect of cable system noise on FM stereo transmission

The carrier-to-noise ratio for FM signals in a CATV system can be calculated as:

$$C/N_{FM} = C/N_{TV} + 10 \log \frac{BW_{TV}}{BW_{FM}} - (L_{TV} - L_{FM})$$

where:
BW_{TV} = noise bandwidth of TV signal.
BW_{FM} = noise bandwidth of FM signal.
C/N_{FM} = carrier-to-noise ratio for FM signals in cable system.
C/N_{TV} = carrier-to-noise ratio for TV signals in cable system.
L_{TV} = carrier level (dBmV) of TV visual carrier.
L_{FM} = carrier level (dBmV) of FM carrier.
S/N_{FM} = signal-to-noise ratio at output of FM receiver.

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A cable system operating to minimum FCC specification could have a visual carrier-to-noise ratio as low as 36 dB in a 4 MHz bandwidth. It is the usual American cable system practice to transmit FM stereo services 15 dB below TV visual carrier levels. If we consider an FM radio receiver to have a 180 kHz bandwidth, the C/N for the FM stereo signal would be:

$$C/N_{FM} = 36 + 10 \log 4{,}000/180 - 15 = 34.5 \text{ dB.}$$

Is this an adequate C/N for satisfactory FM stereo transmission? No! Generally accepted relationships (for 180 kHz noise bandwidth) between FM C/N and demodulated baseband S/N ($S/N_{FM} = C/N_{FM} + 15$ dB) indicate that this 34.5 dB C/N would provide only 49.5 dB baseband audio S/N. A 67 dB S/N would be a desirable objective for imperceptible noise. A more typical cable system would have a 5-7 dB better noise situation, but more typical hi-fi FM receivers would have a wider IF and noise bandwidth. Typical FM receiver operation on cable might also be degraded by 1 or 2 dB because of relatively low input signal levels. The calculation for a 43 dB C/N cable system and a 240 kHz noise bandwidth receiver would be:

$$C/N_{FM} = 43 + 12.2 - 15 = 40.2 \text{ dB.}$$

This would produce a baseband S/N of only 55 dB, still 12 dB short of imperceptible noise and 3 dB short of just perceptible noise.

The International Electrotechnical Commission standards, prevalent in Europe, call for C/N_{FM} of 51 dB (in 200 kHz bandwidth) for FM stereo services in cable. Cable systems in Europe do operate with high (compared to U.S. practice) FM stereo carrier levels, typically -3 dB to -6 dB relative to TV visual carrier. They can do so because they carry relatively few FM stereo and TV channels and they designed their systems for this FM stereo performance objective from the very beginning.

Headend signal processors and stereo modulators

Most cable systems process off-air FM stereo services by heterodyne techniques. Most American systems use the Catel FM radio heterodyne signal processor. This is virtually the only FM radio signal processor available in the American market and has been sold unchanged for more than 10 years. Cable systems cannot complain about the price but fussy users might make some adverse comments on specification and performance. The Catel unit provides good (but not superlative) signal processing at a very reasonable price. It does not, however, meet professional standards for heterodyne repeaters. The various European national broadcast authorities are large scale users of heterodyne FM radio signal processors in FM radio rebroadcast facilities (FM radio translators). Their specifications for FM translators are much more rigorous than the specs met by the low-cost Catel processor, particularly in the area of IF group delay distortion and AM/PM conversion. IF group delay distortion affects stereo separation. The Catel IF is not as good as that found in current top of the line FM stereo radio receivers. I do not blame Catel. They respond to the market, and the American cable system market has not demanded or expressed a willingness to pay more for higher quality FM stereo signal processors.

The rest of the audio signal processing equipment (subcarrier de-

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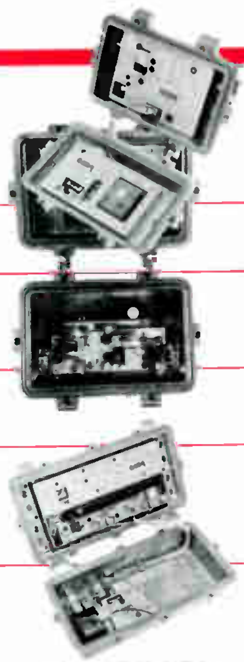

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modulators, stereo generators, etc.) found in the typical cable system headend has similar characteristics—good but not superlative specification at low cost—in response to the manufacturers' perception of the current headend equipment market. This equipment would not be used by fussy professional buyers of FM stereo broadcast equipment.

The attitude of cable system operators is perhaps understandable. FM stereo broadcasters whose entire revenue is bound up in the transmission of a single service will lavish much care and attention on the selection and maintenance of their origination equipment. A cable system operator who operates perhaps 40 such services, and who can perceive very little direct revenue coming from them, will spend the minimum amount that provides acceptable service.

Remedies

If a low C/N is the problem in cable system transmission of FM stereo services, why not raise the carrier levels? Cable systems in Europe usually carry FM stereo services at 3 dB below TV visual carrier levels to provide first-class service.

American systems cannot raise FM stereo carrier levels because the high carrier levels required would overload the system. The total power of 40 FM stereo carriers at identical levels is: $10 \log 40 = 16$ dB greater than the power of a single carrier. Put another way, at -3 dB relative to TV visual carrier it requires only two FM stereo carriers to equal the peak power of a single TV visual carrier; 40 such carriers would be equivalent to 20 TV carriers. Raising the FM stereo carrier level, in a system carrying 40 such FM stereo services, to -3 dB relative to TV visual would be equivalent to adding 20 TV channels to the system loading. Our present system designs just won't stand that much additional loading. Alternatively, if the system is to be designed to accept that much additional loading, system operators would prefer that the loading be TV channels from which significant revenue can be more clearly and certainly expected. Increased FM stereo carrier level is not a practical solution in American cable systems.

The FM deviation could be increased from the present 75 kHz standard. This would trade occupied bandwidth for noise performance. The increased deviation could be provided at the headend by a multiplication and heterodyning process, but additional spectrum would have to be found and new FM stereo receivers for the new IF and deviation developed and provided to subscribers.

If we knew then what we know now, we would have used companding of the L-R baseband in conventional FM stereo radio broadcasting, as used in the new BTS stereo audio standard for television audio broadcasting. Introducing it now would mean new FM stereo receivers for subscribers and complex demodulation and remodulation equipment requirements for cable system headends.

Handling of L and R basebands as discrete channels would improve transmission and stereo separation but also would require new receivers for subscribers as well as increased bandwidth in the cable system.

We can calculate the performance of an AM transmission technique using a 15 kHz noise bandwidth in a cable system with 36 dB C/N_{FM}. The 15 kHz noise bandwidth has: $10 \log 4{,}000/15 = 24.3$ dB less noise than the TV visual carrier. At -15 dB relative to TV visual, the audio service AM carrier would have a $C/N = 36 + 24.3 - 15 = 45.3$ dB.

We would save a lot of bandwidth since a stereo channel would require only about 60 kHz but we would need very high carrier levels to achieve 70 dB C/N. Loading effects would be intolerable unless suppressed carrier transmission was used. Special receivers would be required.

If the cable system has to change modulation technique, allocate additional bandwidth, and use special receivers in order to provide superlative audio services, why not go all the way to digital? It is true that superlative service can be achieved by analog transmission. Several such techniques have been proposed and demonstrated for the new pay cable audio services. Superlative service is also achievable by digital transmission. The advantages of digital audio techniques have been demonstrated by the nearly universal acceptance of digital audio for master recording in professional sound studios and the rapid growth of digital compact discs in the consumer market. Why fool around with analog when digital has unquestioned performance specifications. Digital audio systems meet the highest professional standards for audio system performance. And digital is low in cost. The prices quoted by these companies for headend equipment and for subscriber receivers are very reasonable for the facility provided. Also inherent in digital technology is comprehensive addressability and secure encyphering. Prices would be even lower if a technical standard was agreed on before introduction of the service.

The only disadvantage that I would acknowledge is the increased bandwidth requirement. A typical ultra-high-fidelity stereo digital service uses a 1 MHz transmission channel. This compares with a 400 MHz transmission channel (typical spacing) for conventional FM stereo transmission in cable. The effective occupied bandwidth for the highest quality digital transmission mode is about twice that of conventional analog FM stereo transmission. This is not a bad trade-off, particularly since digital transmission could occupy spectrum that is otherwise problematical for TV transmission (e.g., the entire 88-136 MHz band, 48 MHz in total). This spectrum should be available in most cable systems. Digital audio carrier levels would be low—below the threshold of FCC rule 76.610. Digital audio service should be a very acceptable replacement for the conventional FM stereo service presently offered by cable systems in the 88-108 MHz band, and would not cause system loading problems. Small cable systems with a large number of FM stereo subscribers might not wish to make the change if their subscribers are happy with the present quality of service. My experience in large urban systems is that subscribers are generally not very happy with the quality of service presently provided.

The Japanese companies which are proposing digital audio technologies for cable system use are gradually providing some of the technical details. They typically provide both a super-high-fidelity mode using 16-bit linear encoding and a high-fidelity mode using 8-bit digitally companded encoding. Discrete L and R transmission is provided. I would personally prefer a standard that is directly compatible with the digital chips in the CD players presently being marketed. Ideally the cable digital audio receiver should be integrated with the CD player to provide a "radio receiver" complement to the CD player. The digital cable audio receiver could share the D/A converter(s) and filters in the CD player.

I see no reason why cable digital audio receivers should not be owned by the subscriber. The encyphering and addressing techniques should be sufficiently secure to allow subscriber ownership. An agreement on standards among interested manufacturers would keep equipment costs down and create a competitive market that would benefit cable subscribers. Cable systems also would benefit by being relieved of the burden of buying and maintaining this particular piece of subscriber terminal equipment.

An operating scenario for digital audio services

Initially cable systems would have to provide high quality receiving and demodulation equipment at the headend to derive quality L and R baseband for remodulation to digital format. Eventually audio service providers will see the wisdom of transmitting in digital format from the program provider's main studios. FM stereo radio broadcasters will continue to broadcast in conventional analog format, but there is no reason why there should not eventually be a digital radio broadcast service as an improvement over FM in the same way that FM radio broadcasting was introduced as an improvement over AM. Digital transcoding equipment will no doubt be available for directly translating digital audio received at the headend from the received digital format to the digital format used by the cable system for distribution to subscribers. Again, an industrywide agreement on standards for transmission would be very desirable.

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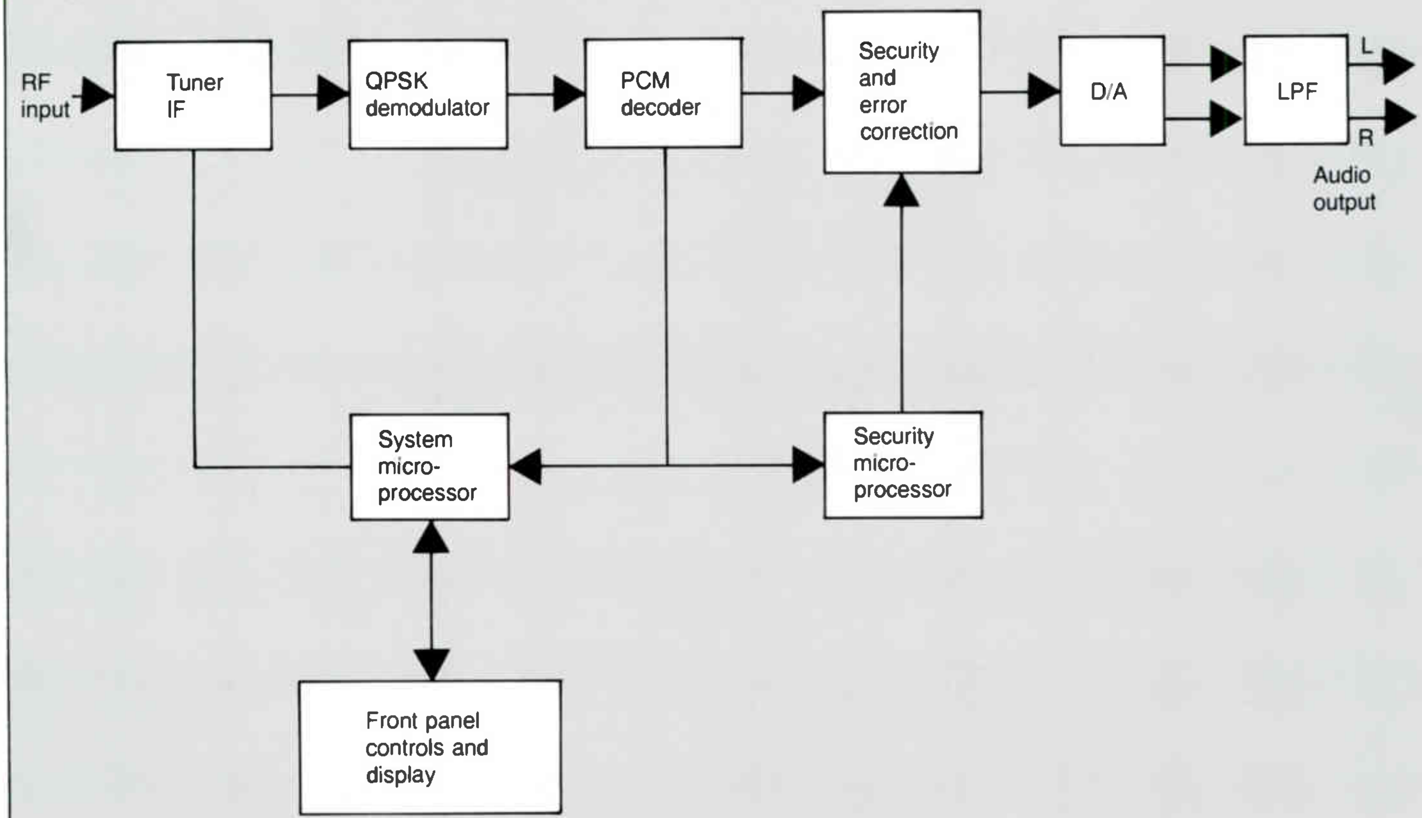
This article was reprinted from the "1985 NCTA Technical Papers," courtesy of the National Cable Television Assocation.

Figure 1: DCAT terminal block diagram



A new digital audio system for CATV

With the recent interest in improving broadcast audio quality for the consumer, various systems are being proposed as solutions. This article provides a review of the current status, followed by a description and field trial activities, of a new digital audio system that can offer quality equivalent to the compact disc. This piece has been updated from its original appearance in the "1985 NCTA Technical Papers."

By William L. Thomas
Director, Research and Development, American Television & Communications Corp.

Audio quality as available to the consumer is improving from both the source and home reproduction perspectives. There also are several approaches being proposed for making similar improvements in the broadcast techniques used to deliver audio to the home, using either direct over-the-air, satellite, MDS or CATV systems.

Table 1 illustrates the relative performance of common consumer audio products. Many of these systems suffer from performance that does not achieve the given specifications. Wherever alignment of the system is required, the operator or the consumer is unlikely to provide sufficient maintenance to preserve maximum quality. Also, records and tapes suffer degradation from repeated usage. In general, a specification of 70 dB signal-to-noise ratio (S/N) is considered acceptable, with an 80 dB S/N considered excellent. As such, only the compact disc and hi-fi VCRs are currently considered to fall into the excellent category.

Product, transmission improvements

Program source improvements are moving quickly on several fronts. In the recording studio, digital multi-track recorders (such as the Sony PCM 3324) are replacing current analog-based machines. The TV broadcast community is adopting the BTSC MTS stereo standard,

'Given an uncertain outcome on the long-term question of channel efficiency, the attractions of digital audio . . . provide ample reason to work with the technology today'

CATV satellite-delivered services are upgrading with digital and high-quality analog transmission, and the compact disc is having a major impact on the studio operations of many quality conscious FM broadcasters.

In the home, the compact disc system also is taking off very quickly. At present, the acceptance rate is growing at least twice as fast as did VCRs. In addition, users of the system are buying double the average number of discs that they previously purchased as albums. This can be explained by both the low cost of home players (under $200 units are available) and the initial need to stock a library with new discs. The net result is that the home listener is moving up in his expectation of audio performance.

Recording equipment improvements are also moving into the home at affordable prices. Beta and VHS hi-fi cassette tape recorders are the main examples of this trend. However, there are other aspects such as PCM adapters for older VCRs and Dolby C modes on standard audio cassette recorders. A new home audio recording system has been unveiled by several Japanese manufacturers. This system provides

Table 1

System	Audio S/N (dB)
Compact disc	90
Hi-fi VCR	80
Cassette (Dolby C)	75
Turntable (LP)	70
Off-air FM stereo	65
Cassette (Dolby B)	65
MTS (DBX NR)	65
Cassette	57
Cable FM stereo (-15 dB)	55
VCR	47

Table 2

System	Channels/6 MHz
M/A-COM PCM digital	8
Sony PCM digital	8
Toshiba PCM digital*	10
Panasonic PCM digital*	12
Dolby ADM digital	16
Studioline analog	20

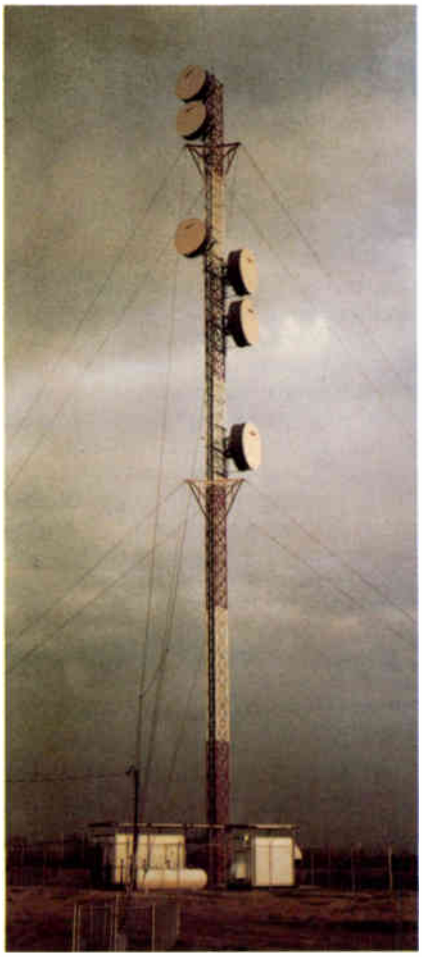
*These systems also have less efficient modes with an S/N of 90 dB.

hours of record time using a digital audio cassette format, based on the 8 mm VCR format.

Transmission system improvements are following closely on the heels of the source and recording upgrades. Over-the-air broadcasters have adopted a new stereo standard for TV—the MTS (multichannel television sound) system—which includes DBX noise reduction. FM broadcasters are mounting a campaign to take full advantage of the quality possible in their current systems. Satellite-delivered signals for CATV headend use are adopting both digital (Wegener ADM Dolby, M/A-COM VideoCipher II) and analog (Wegener Panda II, Studioline) techniques.

For delivery directly to the home, several new alternatives are under development[1,2,3,4]. CATV equipment vendors are developing both in-band and out-of-band systems. An in-band system delivers audio within the video channel. Examples of this are the Oak Sigma series and M/A-COM VideoCipher II, which use digital technologies replacing horizontal sync with digital audio. In an out-of-band system, audio information is broadcast separately in another part of the spectrum. Both analog and digital designs are being suggested. For analog approaches, one alternative is carriage in the FM band in the standard format. A tracking adapter tunes to the proper FM channel when the video channel is changed. Examples of this product are being shown by Pioneer[5] and Westinghouse/Sanyo. A "digital" quality analog system is being shown by Studioline, also of the tracking type. In the digital realm, products have been shown by Sony, Panasonic and Toshiba. Other vendors are known to have both types of CATV systems under development.

Other alternatives include DBS and MMDS (multichannel MDS) delivery systems. In the new DBS products by M/A-COM and Scientific-Atlanta, digital audio channels are standard features. The MMDS market, which is now being launched, is expected to use the lure of digital as one of its selling points. An interesting option in MMDS or DBS is to





also delivers high-quality audio with an S/N of 76 dB. Samples are taken at a 32 kHz rate, with 14 bits reduced to 10 using NIC (near instantaneous companding) techniques. In addition, pre-emphasis is used to further reduce any effects of quantizing noise. The subjective difference between the two modes varies from listener to listener, but tends to be interpreted as a reduction in "presence" or "fullness" of the material. It is very difficult for the average customer to know which mode is being used.

The data is packaged in one msec frames of 2,048 bits each. These encrypted frames include sync information, audio information (one ultra or two super stereo pairs), addressing data and error correction codes. The resulting 2.048 Mbit data rate is QPSK encoded and occupies a 1.4 MHz RF channel.

The headend system supports all encoding requirements for the digital audio system. It is comprised of the following functional elements: A/D conversion, frame formatting, QPSK modulator, and system controller.

The A/D conversion process is a critical function due to the high S/N capabilities of the system. Of particular importance is the input antiailiasing filters, which must constrain the upper frequency to be either 20 kHz (ultra) or 15 kHz (super). To achieve proper rejection of frequencies above these limits and not sacrifice phase response requires careful design. Also included in this function is the pre-emphasis and NIC circuitry.

Frame formatting is a complex task because of all the elements that are put together on a real-time basis. These include audio sample data, which must be interleaved, control information (both systemwide and specific terminal dependent), which must be provided, then all data must be encrypted along with the error detection and correction coding.

The QPSK modulator and upconverter requires a mixture of digital and RF design. First, the incoming serial data stream at 2.048 Mbits must be formatted into dibits for the quadrature modulation process. After QPSK modulation and filtering at an IF frequency, an upconverter must be used to place the channel in the 88-120 MHz range.

For addressable system control, a system controller computer and software must interface to the frame formatting function in the headend. Also, as in any one-way CATV control system, appropriate interfaces must be made with local operators and the billing/management system.

The terminal design has many similarities with existing equipment. A block diagram of the device is shown in Figure 1. As in a baseband video converter, there are tuning and demodulation functions. Similar to a compact disc player, there are decoding, reformatting and D/A functions. It is the marriage of these two families of requirements that is unique. Additionally, a desire to use existing components and low-cost manufacturing techniques completes a picture of the constraints on the design.

The tuning system is standard, covering a range of 32 MHz (88-120 MHz in the initial product). It is microprocessor-controlled with 100 kHz channel steps. For demodulation, a QPSK demodulator IC is used from the Japanese DBS system development.

The PCM decoding involves a reversing of the process that was performed at the headend. The de-encryption process must be performed and de-interleaving of the data is required. Any errors are corrected, or detected for analog concealment. The resulting L/R channel information must be D/A converted and carefully filtered to remove the quantization and pre-emphasis effects. Components were used from previous digital audio projects wherever possible. However, a new design of a security IC was required to handle the de-encryption process in a cost-effective manner.

The user interface is primarily through a set of front panel controls. In addition to a 14-position keypad and two-digit LED readout, it has a volume control and jack for the headphones. An optional remote control has the same features available on the keypad. Basic features include program selection and a memory function for advance selection of an upcoming program. A front panel volume control for the line outputs

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was not included for cost reasons. However, rear panel adjustment controls are provided separately for the L and R outputs.

The field trial

The first field trial of the DCAT system started in July 1985 at ATC's Thornton, Colo., system. It is using an eight-stereo-channel prototype headend and 100 pre-production terminals. A variety of high-quality program sources is being used, with performance measurements being taken on the system. A market trial of enhanced or premium audio is then planned for 1986 as the next step in the development process.

In the engineering trial, which will conclude at the end of this month, several issues are of major concern. Obviously, the audio performance of the system is the main feature to be studied. However, other items are also of a very practical nature: wiring and compatibility issues at the CATV headend, RF signal level requirements, and customer premise interconnect configurations.

At the headend, care was taken to preserve the signal quality available from a number of sources: compact disc jukebox player (a special Toshiba product), M/A-COM VideoCipher II audio from HBO and Cinemax, Wegener Dolby audio from MTV and VH-1, WFMT from satellite, and KBCO (a local FM broadcast source). Figure 2 shows the headend configuration used for the initial phase of the testing.

New techniqes must be derived for making practical field measurements of wideband QPSK modulated signals. An investigation of methods allowed usage of current measurement equipment (such as the Wavetek SAM series) for field testing.

Perhaps the most uncertain outcome was the question of various home configuration possibilities. Since the Thornton system was not designed with the intention of placing an additional terminal in the home, it was necessary to split the signals inside the house by using a DC-8 directional coupler to provide minimum loss of signal going to the TV set. Additionally, this provided an extra measure of isolation between the DCAT terminal and the remainder of the customer's equipment. By noting various examples of actual home equipment configurations, a better understanding of the cable operator's responsibilities will emerge.

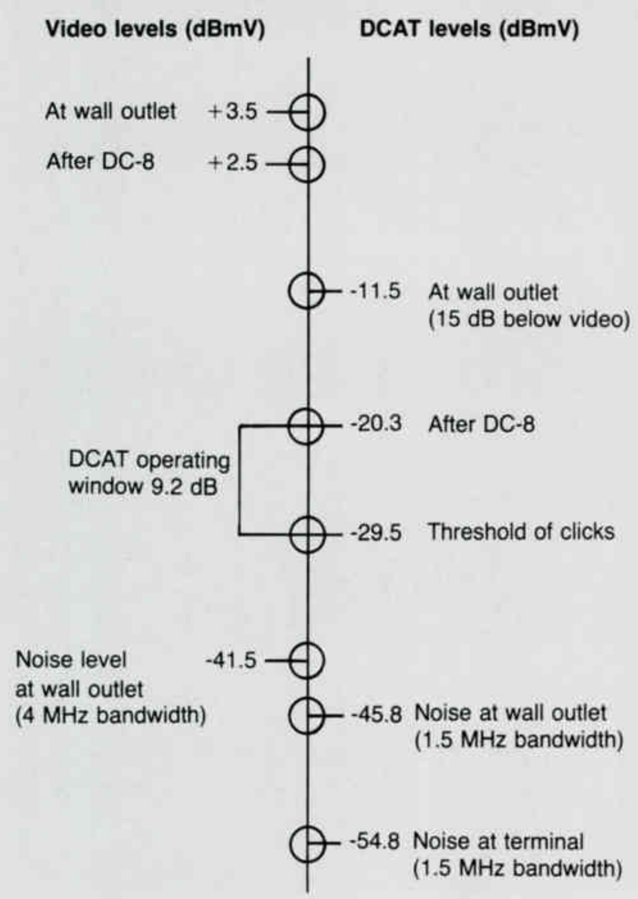
System performance has been measured at selected sites including the headend and locations throughout the cable plant. To help understand performance, the RF headroom available in the plant for the QPSK modulated signal has been determined. See Figure 3 for the results of carrier-to-noise ratio (C/N) measurements made when running the QPSK carriers 15 dB below the nearest video carrier levels. The DCAT signals were placed in the A-2 channel during the field test. (Note that the measurements include a correction factor for the 1.5 MHz noise bandwidth of the systems.)

Results of the field trial to date indicate that the system works very well. It has been determined that if one is willing to maintain the RF carrier levels to within 1 dB of each other at the headend, it is possible to run the channels with only 1.2 MHz spacing. This gives 10 super hi-fi stereo signals in a 6 MHz bandwidth. A second phase of testing (which began in September) will verify any questions that still remain. For this phase, several changes are being made to the headend audio signals, including the addition of Studioline satellite-delivered premium channels.

As a conclusion to the trial, a summary report is being generated including information relative to the previous concerns. With functional success of the DCAT product, the next step is a market trial of high-quality audio for the CATV customer.

At the present time, the ATC new business development unit is in the planning stages of several full-scale market trials of enhanced and premium audio, which would start in 1986. In covering the needs of both enhanced audio and premium services it is expected that 12-16 stereo channels will be carried in a high-quality format, such as that provided by DCAT. Features that are important to the market trial are tracking of audio with video channel changes (enhanced audio), remote control and audio quality.

Figure 3: DCAT signal levels in field trial



The market awaits

Audio source, recording and production equipment has made tremendous strides forward in the last few years. To complete the picture, improvements also must be made in audio broadcasting. Cable systems have an opportunity to set the standard of excellence through the adoption of high-quality audio systems. And judging from the level of sales of high-quality audio products, the consumer is ready. ■

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William Thomas is director of research and development at American Television & Communications Corp. in Englewood, Colo. At ATC he is involved in development of digital audio transmission and home entertainment control systems. Previously he worked at Zenith Electronics Corp. for eight years in the areas of two-way CATV, teletext, ghost cancelling and digital signal processing. Prior to employment at Zenith, he worked at ESL Inc. He has had 14 articles published in the following areas: microprocessors, amateur radio, electrical engineering education, ghost cancelling, teletext, two-way CATV and digital audio systems. He acted as session chairman at the 1983 NCTA and 1985 ICCE conferences. Three patents have been issued to his area of interest. He holds membership in the IEEE and SCTE organizations.

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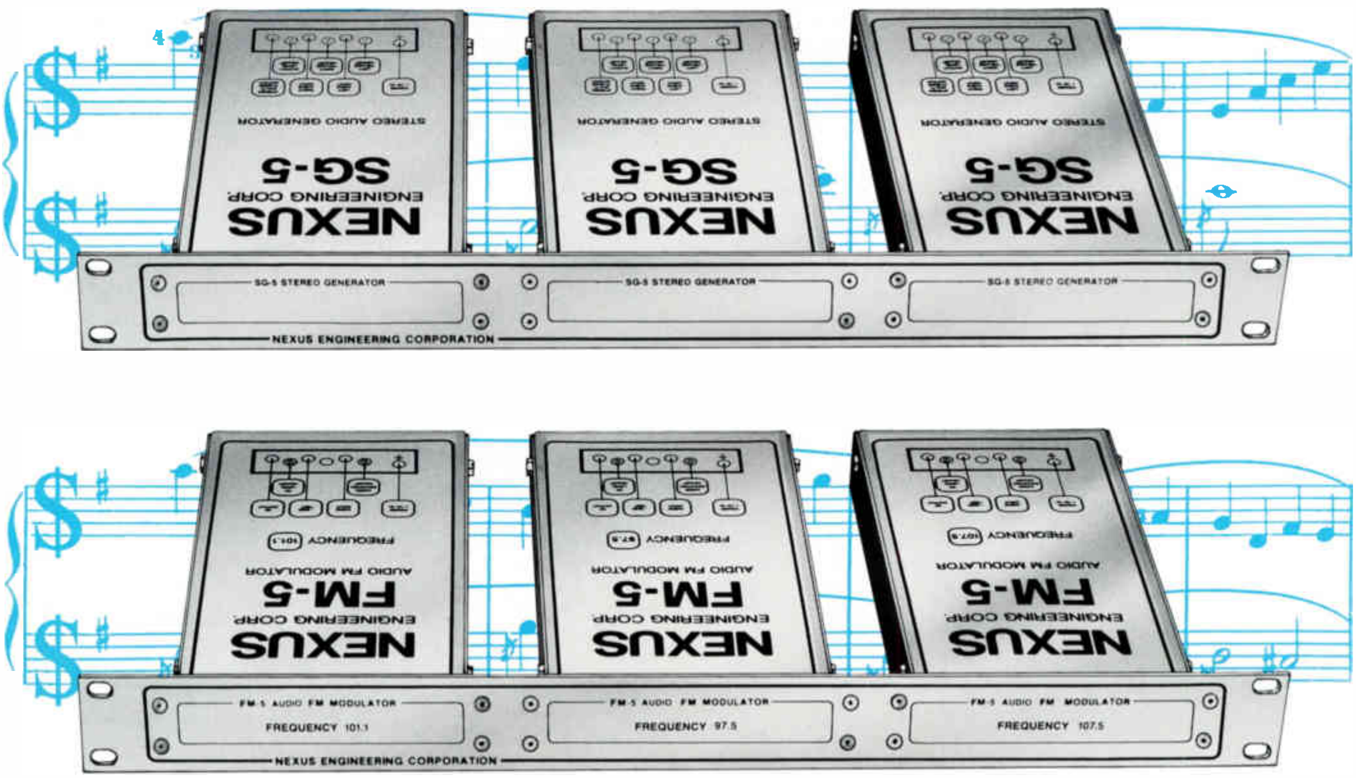

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Pay-per-view technologies: Real-time vs. store and forward

By Marc Kauffman
System Engineer, Subscriber Engineering Department
Jerrold Division, General Instrument Corp.

As the interest in pay-per-view as a method of providing programming to cable subscribers grows, the system operators are becoming more aware of the need for an efficient and reliable ordering mechanism that will allow them to meet current and projected purchase processing needs. There are a number of pay-per-view scenarios being projected—ranging from high price ($4 and up) blockbuster events to lower priced ($.49 and up) "low hurdle rate" events—in anticipation of a boom in PPV. In order to economically accommodate low-cost, high-volume events, the ideal system should have a low variable cost for purchase processing.

PPV experiments have shown that the peak ordering periods occur in the last few minutes before a program begins. Thus, an effective PPV system must allow a large number of subscribers to order on an impulse basis at the last minute.

Pay-per-view systems review

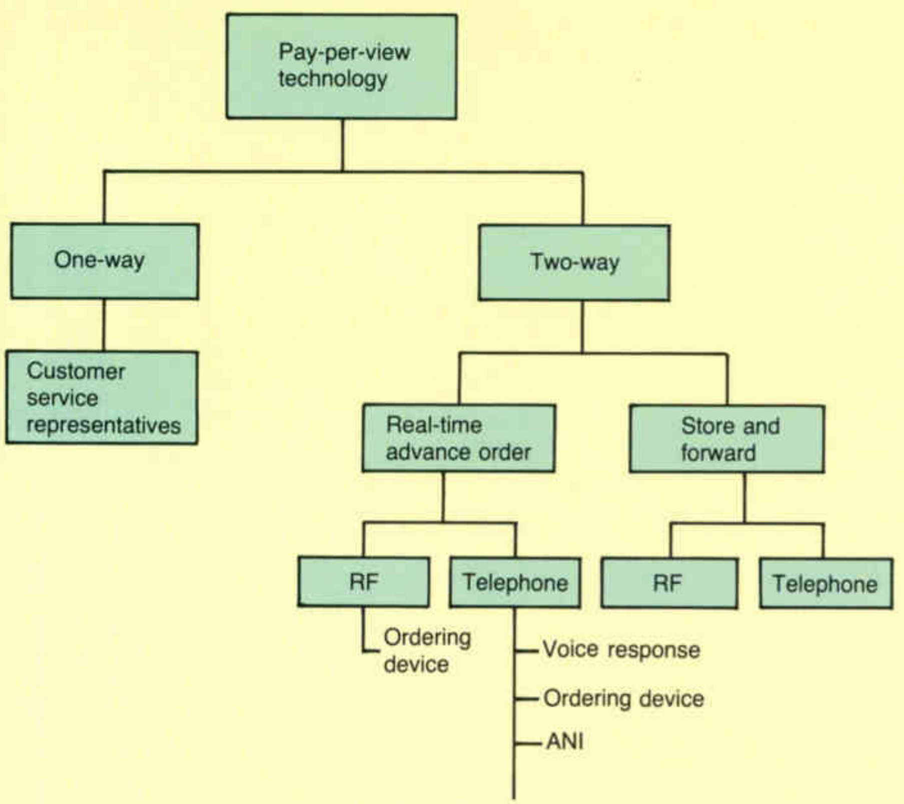
A number of technologies have been developed to allow subscribers to purchase program material on a pay-per-view basis. Figure 1 illustrates the various options.

One of the first distinctions made between system architectures is that of one-way vs. two-way. In a conventional one-way addressable system, pay-per-view programs are ordered by calling a customer service representative (CSR) in advance of the "event." The CSR enters the program selection into a billing computer, which then forwards the request to the addressable controller and enters this purchase information into the subscriber's data base for later invoicing. This approach, while inexpensive to implement in terms of capital outlay, requires subscribers to order significantly in advance (from a few hours to several days), and may require a significant staff of telephone operators depending on the volume of incoming orders. Call-in pay-per-view operations represent a high variable cost, or cost per purchase, for processing the order.

Two-way systems, on the other hand, do away with the cable operator's intervention in the ordering cycle, reducing chances for errors introduced in the ordering cycle. Subscribers enter purchase requests into a device in their home (converter, order box or telephone), and the order is executed automatically.

Two-way systems are divided into two broad categories: advance order (or real-time) processing systems and store and forward systems. Each of these categories can be subdivided further into two-way RF and two-way by telephone. Two-way RF systems utilize the return RF path provided by a two-way CATV distribution system, while two-way telephone systems employ the public switched telephone network to communicate PPV ordering information.

Figure 1: Pay-per-view technology



There are a number of real-time ordering system concepts in discussion today. Real-time RF systems utilize a device in the home that accepts order information and forwards this information to the headend system through the return RF path. The headend checks the credit worthiness of the subscriber, records the purchase and forwards an authorization to the converter. This process can be time consuming, and, in the case of a large system, results in the need to order the program in advance. If the control system is down, or there is noise or ingress in the return spectrum during a broadcast, potential customers will be lost.

Real-time telephone systems have taken a number of different forms. These include:

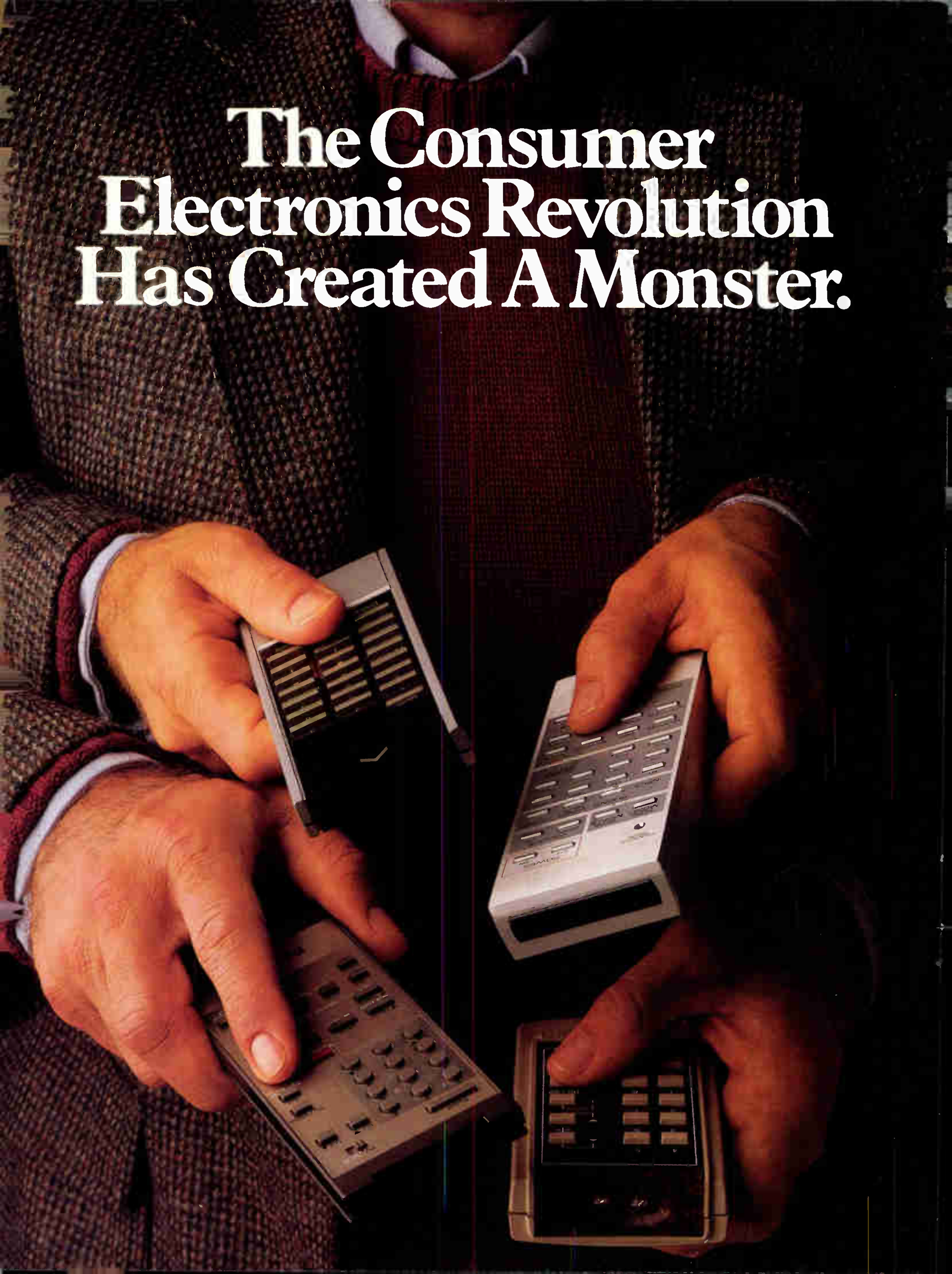
Voice response: Voice response systems utilize a computer at the headend to answer calls placed by subscribers. A series of questions are asked of the caller via synthesized or taped verbal cues. The subscriber responds to the queries by entering codes using the touchtone keypad on his telephone, or a tone generated device if a rotary phone is the only available instrument.

It is estimated that a purchase session with a voice response system requires a connection time that averages between 60 and 90 seconds. When multiplied by many subscribers, this represents a serious limitation to the volume of traffic this system can handle. As well, a voice response system requires a significant capital outlay for headend equipment, phone lines and touchtone devices for those subs lacking touchtone service. However, it does yield a low variable cost per transaction.

Auto-dial devices: These devices allow subscribers to order programs by entering information into a terminal connected to the subscriber's telephone line. The process of communicating with the headend computer is all handled by the microcomputer in the terminal. Once an order has been phoned in, the customer's credit checked and a record established for invoicing, the addressable controller then downloads the appropriate authorization over the one-way addressable system.

Call duration, including connect/disconnect and line recovery, is estimated at 15 seconds. This, again, represents a serious bottleneck when extended to a reasonably sized subscriber base. If a large number of telephone

(Continued on page 48.)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(Continued from page 36.)

lines are used, the bottleneck will then shift to credit verification, order recording and converter authorization stages.

The auto-dial system requires a capital outlay for equipment at the headend and significant outlay for subscriber equipment, but enjoys a low variable cost for purchase processing.

Automatic number identification (ANI): This telephone PPV ordering method, which uses the telephone switching equipment to accept purchase requests, may become available in some electronic telephone switches. With this feature, the telco computer is able to identify calling parties, accept program ordering information and forward this to the cable operator's computer. The cable computer system cross-references a telephone number with a subscriber ID, checks credit, verifies personal identification data, records the purchase for invoicing and forwards an authorization to the subscriber over the one-way addressable system. The system requires a communications path from each telco switch serving the franchise area to the cable computer.

A few bottlenecks exist in an ANI system. First, a typical telephone switch center is equipped with a number of call receivers (CDRs), which create the dial tone and accept dialing inputs. The number of CDRs in a switch is dependent on the peak traffic load anticipated when the switch was designed. This is typically less than 1 percent of the number of telephone subscribers served by the switch. A barrage of calls created by last minute impulse pay-per-view ordering could use all of the available CDRs.

Second, the process of cross-referencing subscriber IDs with telephone numbers, verifying credit, recording purchase data for invoicing and authorizing the converter is time consuming. Handling orders from multiple switches in real-time is a difficult task. If the volume of orders is as high as anticipated, purchase requests are likely to back up at this stage, or be lost if the system cannot queue them.

Implementation of an ANI system requires the cable operator to make a small capital investment in headend equipment and installation. The telephone company may be required to make anywhere from a small investment to significant expansion of the switcing facility. The variable cost per purchase is expected to be relatively high using this type of system.

Note that all of the real-time systems require the establishment of a closed-loop communication link between the subscriber and the headend computer system before a subscriber can view a pay-per-view program. The transaction time is not instantaneous and closed-loop communications for order processing is required for each participating subscriber. It is not unreasonable to expect that with a substantial subscriber base, subscribers will have to order programs in advance of the showing to guarantee sufficient time for processing and communication of program authorization.

Real-time systems also demand that the entire ordering system be operational prior to the program, or potential orders will be lost. A last minute equipment or communication link failure will result in lost revenue opportunity and frustrated subscribers.

Store and forward: Solving bottlenecks

Seeking to overcome the limitations of real-time ordering systems, a pay-per-view technology known as store and forward was designed. This ordering system can provide an effective solution to anticipated operational problems associated with traffic bottlenecks caused by peak order loads. The store and forward technology poses no limits to the number of subscribers that can order an event and provides instantaneous program authorization for immediate subscriber viewing.

In a store and forward system, converters are pre-loaded with purchase credits against which subscribers order PPV programming. The subscriber orders a PPV program by entering a secret personal identification code, either directly on the converter or using the handheld remote unit. If the subscriber has sufficient credit, he receives instant authorization to view the program. The converter is not required to communicate at that immediate

time with the headend system in order for programs to be cleared for viewing. At the time a program is purchased, a program identifier and time stamp is stored in the converter's non-volatile memory. Later, on a non-real-time basis, the addressable controller collects this program purchase information for subsequent billing. *Every* subscriber in the cable system can order an "event" or program up to the last minute before a showing, or even during the first few minutes of a program, depending on the cut-off ordering time determined by the cable operator. In this way, consumers are able to buy on a true "impulse" basis. The store and forward technique is the only IPPV scheme available today that does not require real-time communication and data processing; it totally avoids real-time bottlenecks in the control system.

Jerrold store and forward technology is available in impulse pay-per-view products that use both the RF and telephone return paths. Starfone terminals use the switched telephone network as a return path; Starvue terminals employ the RF cable distribution plant as the return link.

Using a telco return path

Starfone makes possible the implementation of impulse pay-per-view without incurring the cost of installing and maintaining a two-way distribution plant. The system uses the standard addressable system for one-way control functions (subscriptions, terminal control and advance order PPV purchases), and uses the public switched telephone network as a return reporting path for collection of billing information related to purchases made through the subscriber terminal.

Purchase reporting occurs automatically, and does not require any specific action on the part of the subscriber. As well, the hybrid system does not impose restrictions on normal use of the phone by the subscriber, nor does it exhibit signs of its action (e.g., ringing of the telephone).

Figure 2 shows the system architecture using the telephone link for return reporting. The illustration shows the headend with a bank of auto-answer modems and at least one front-end processor (Starfone controller) for the addressable control computer (AH-4). The processor collects data from terminals independently from addressable computer operation, and transfers collected data en mass to the addressable control computer for storage and transmission to the billing computer.

At the headend, each telephone line requires a modem, and each Starfone controller handles up to 12 modems. Telephone lines are configured in a hunting arrangement that allows a single telephone number to access the first available telephone line in the group. More telephone lines, modems, and processors can be added to accommodate any increased load resulting from growth in the subscriber base or penetration rate.

Data collection load handling capability can be illustrated using an example. Assume a system with 100,000 subscribers and 25 percent of converters with data to report; with 10 telephone lines, the addressable system can collect all billing data in approximately 10 hours. There's an approximate linear relationship between the subscriber base, penetration rate, number of telephone lines and the time required for data collection. If the subscriber base or penetration rate grows, the collection time can be held constant or reduced by adding more phone lines.

The following scheme is used to collect data from subscribers:

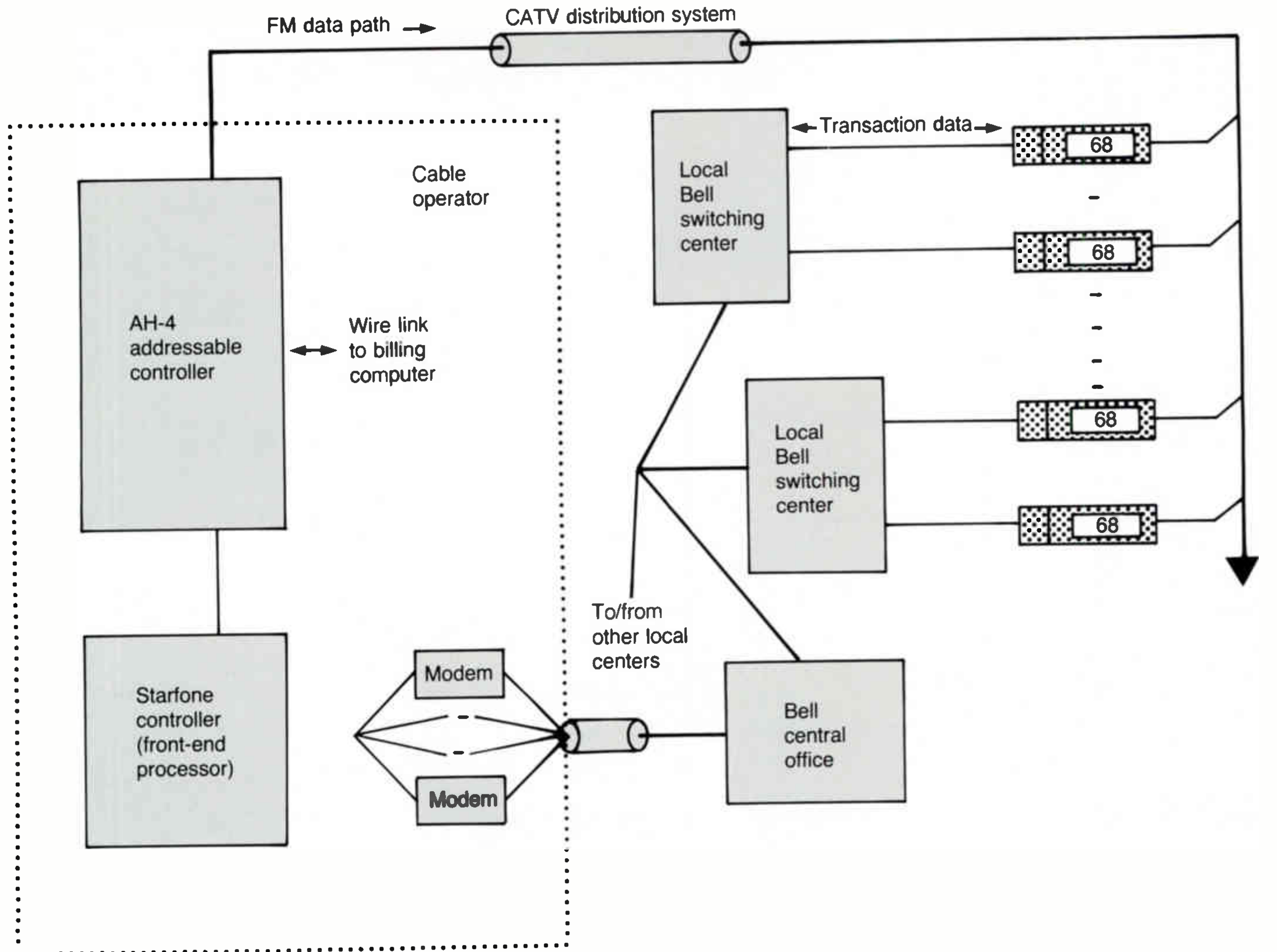
1) Addressable control computer instructs (over the one-way cable data path) a group of terminals to call in if they have transactions to report.

2) Terminals in the group with data begin to call in. If they cannot make a connection, they try again and continue to re-dial until they either make connection, or a given period of time has elapsed.

3) The front-end processor at the headend answers calls via the auto-answer modems, and collects purchase data from subscribers. Data is stored in bulk in the processor for later transfer to the addressable controller. When the processor has completed its transactions with a subscriber terminal, it hangs up and answers the next call. This process is duplicated for each modem on the processor.

4) The addressable controller interrogates the front-end processor to determine whether

Figure 2: Starfone system



all subs in the group have reported. When one cycle is complete, the addressable controller initiates the next cycle.

The subscriber equipment consists of a one-way addressable converter, upgraded to "two-way capability" with the addition of the Starfone side-car unit, which houses the telephone interface and modem. All operational parameters, including the telephone number and call timing are downloaded over the one-way RF addressable data stream and may be verified or changed via the telephone path.

The Starfone controller is a front-end processor to the addressable controller; it collects IPPV billing data from subscriber terminals over the telephone link, and transfers the data in bulk to the addressable controller for storage and forwarding to a billing computer. In addition, the Starfone controller downloads and verifies other operating parameters in the terminal on a terminal-by-terminal basis, by establishing a direct telephone link to that terminal.

Another benefit of this architecture is its remote diagnostic capability. If there's a troublesome terminal somewhere in the system, the operator can command the terminal to call in so he can examine its "state" and contents before rolling a truck. This avoids unnecessary service calls. Terminal verification is accomplished concurrent with data collection by assigning an alternate telephone number to the terminal in question over the one-way data path.

The addressable controller initiates a collection cycle by commanding a group of terminals to dial if they have non-collected entries to report. This command is communicated over the one-way addressable data stream. The number of terminals in the group is based upon the number of available telephone lines and the expected IPPV penetration rate.

Included in the command to dial is an encryption key that's used by the Starfone controller and terminal to encrypt and decrypt data transmitted over the telephone link. Also included is a password that is used to validate the converter's identity when it establishes communications with the Starfone controller. Any terminal in the group with data to report dials the telephone number (downloaded to the terminal during initialization) and waits to be interrogated by the Starfone controller, which stores the collected data and status indicators in its non-volatile memory. In the event of a power outage during collection, the addressable controller collects all data in the Starfone controller buffer when the power is restored, and re-initiates the cycle that was in progress when the power outage occured.

The store and forward system requires an investment in subscriber equipment and a connection to the telephone system in the home. For systems with a sizeable subscriber base, a front-end processor at the headend is necessary. In smaller systems, however, the addressable controller can perform the functions of the front-end processor.

Using the RF path

The Starvue RF system uses the return spectrum of the two-way distribution plant for reporting of IPPV purchases, opinion polling responses and viewership polling data. It also employs the store and forward technology to avoid ordering bottlenecks.

The return transmitter in a converter equipped with the Starvue unit may be tuned to frequencies between 8.3 and 10.4 MHz at the command of the headend controller. The transmit level is also agile under command of

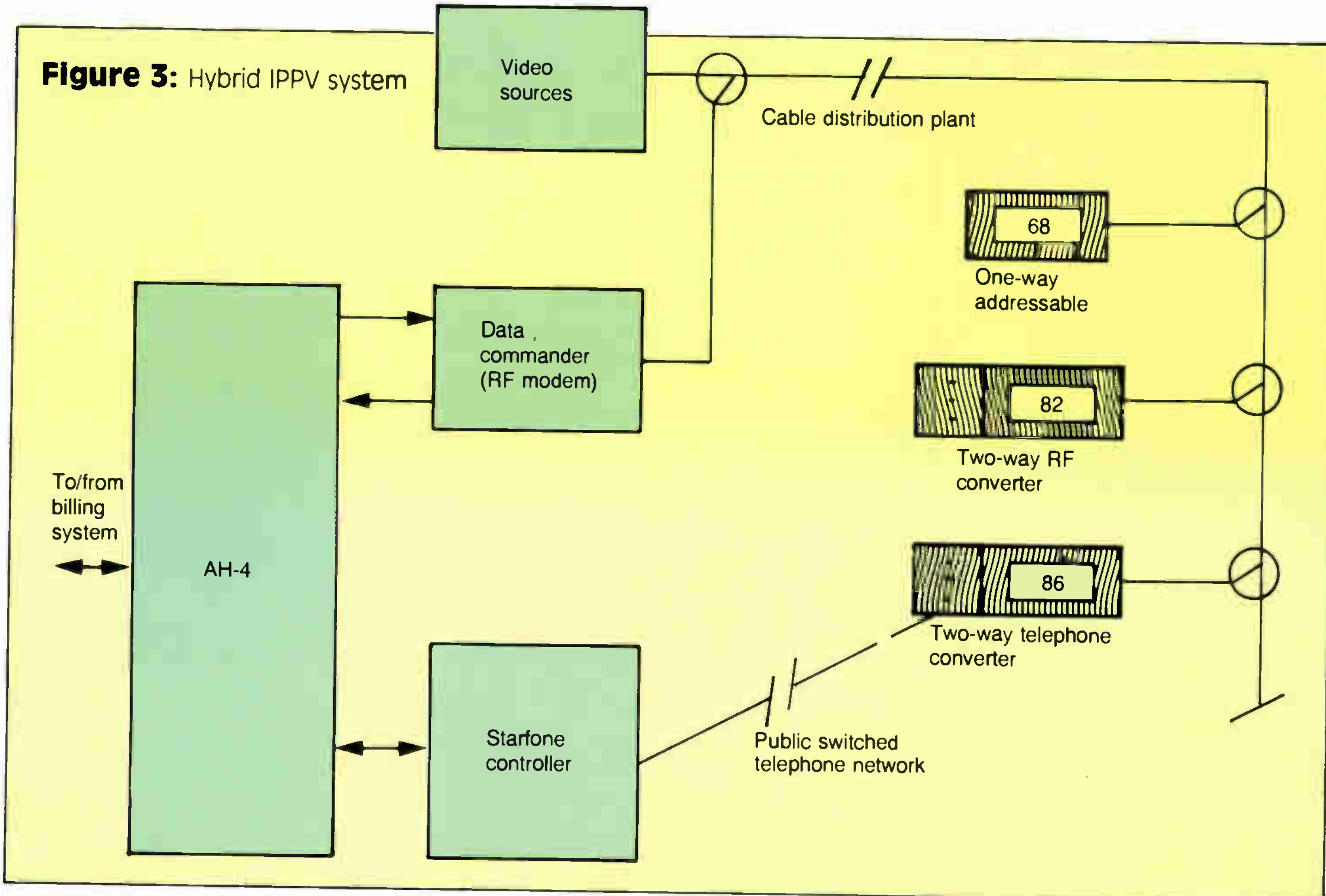


Figure 3: Hybrid IPPV system

the headend. The agile nature of the return transmitter allows the system to strategically avoid ingress, interference or runaway transmitters blocking specific areas of the distribution plant's return spectrum.

Figure 3 shows a diagram of a hybrid system using both Starvue and Starfone terminals for two-way IPPV; it also allows one-way PPV using the advanced call-in method. Using a mix of terminal types in a single system is convenient where selected trunks or hubs are two-way. Those subscribers passed by two-way plant can be given the RF-based terminals, with the remainder getting telephone-based terminals. Also, those subscribing to one-way tiers may still participate in event offerings by calling in to a CSR to place an order.

Flexible advantages

The store and forward system can offer a number of advantages over real-time PPV systems, most importantly, program purchase capability up to the last minute for the entire subscriber base, regardless of size. This type of system also is able to survive a control system outage and continue to allow subscribers to purchase and view PPV events that are shown during this outage. As well, many cable operators may find that the hybrid store and forward impulse pay-per-view approach can provide the greatest flexibility in configuring the system and utilizing the available communication resources, and offer sufficient capacity to handle the ordering loads as the subscriber base grows. ■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Reader Service Number 29.

ANI: Opening the way to cable TV interactivity

By Richard W. Mullen
Public Eye Communications Services

"Many cable operators don't have equipment capable of delivering (pay-per-view) service," the *Wall Street Journal* reported earlier this year. "The high cost of building cable systems has prevented many from adding frills such as new state-of-the-art pay-per-view converters." Pacific Bell's automatic number identification (ANI) system, resembling a central office service, can free cable companies from major new hardware investments, and may dissolve a major obstacle that has confronted marketers of cable pay-per-view (PPV) service: last minute orders.

The changing environment

To meet consumer wants, cable TV is evolving into a service package that would give viewers more control over their programming choices. Two-way interactive cable systems have been possible for years, but not economical for many cable operators. New technologies are breaking the cost and performance barriers so that these operators will be able to offer new services such as pay-per-view.

Pacific Bell has developed a hybrid system that meets these criteria by providing telco-based upstream communications to complement the downstream cable service. The technology is based on Pacific Bell's newly developed system for recognizing and utilizing ANI. The system architecture, for which Pacific is seeking patents, amounts to a type of computerized switching mechanism that can, in a short period of time, efficiently process a large volume of calls to a single number.

To serve a cable company that wishes to offer impulse pay-per-view, Pacific will place "Pacific Bell service nodes" (PBSNs) in strategic locations in a given market area. PBSNs, which function like miniature dedicated central offices, contain the ANI equipment that provides the call-processing service. Pacific can customize ANI systems for each cable operator's anticipated peak-period call volume, raising or lowering the PBSNs' capacity as each cable client requires.

This fall Pacific Bell will direct a market test that may answer many questions about cable TV/telco hybrids—and about the pay-per-view market itself. For this test, Pacific will work cooperatively with Zenith Cable Products, a division of Zenith Electronics Corp., and an MSO in California. Playing a pivotal role in the test is Phonevision, a Zenith product built around its Z-TAC converter to support cable companies' efforts in the IPPV market. The test is scheduled to last for six months. Based on public response and cost-effectiveness, Pacific would market ANI services to cable companies elsewhere in the state in 1986. Later, Pacific may license the technology for other markets across the nation.

ANI system

Pacific's system assumes that the cable company has a large installed base of customers with addressable converters. Viewers who wish to order the PPV program would do so by dialing the advertised phone number corresponding to the PPV event. The system works both with touch-tone (DTMF) and standard rotary dial.

The call is routed to a local PBSN ANI unit. ANI automatically identifies the calling phone number. Phonevision provides the interface between the PBSN and the cable company's computer. The PBSN converts the caller's analog signal to ASCII and sends the customer information to a Phonevision unit on a point-to-point data channel. On receipt of the data by Phonevision, the PBSN acknowledges the order to the customer. (It can provide a positive or negative response to the subscriber if the cable operator's system has "ACK/NACK" capability.)

As currently configured, the cable operator's equipment would match the subscriber's telephone number with the "address" code on the Z-TAC addressable decoder, check the subscriber's billing history, and initiate billing for the new program ordered. (The cable operator serves as "gatekeeper" to protect confidential consumer information.) The cable system's computer would then transmit an "unscramble" order for the PPV program, via Phonevision, to the addressable converter on the viewer's TV set. The entire transaction takes place in real-time, typically in less than 20 seconds. The speed of the process, coupled with the flexible capacity of the PBSNs, virtually assures viewers and cable operators that their orders will go through promptly.

A possible scenario might involve a cable company with 60,000 subscribers, of whom a total of 10 percent would decide to order a specific PPV event. Though the orders would in all likelihood be stretched over days, three-quarters of the total (i.e., 4,500 calls) might come an hour before the show began. Yet this surge would pose no difficulty for the ANI system.

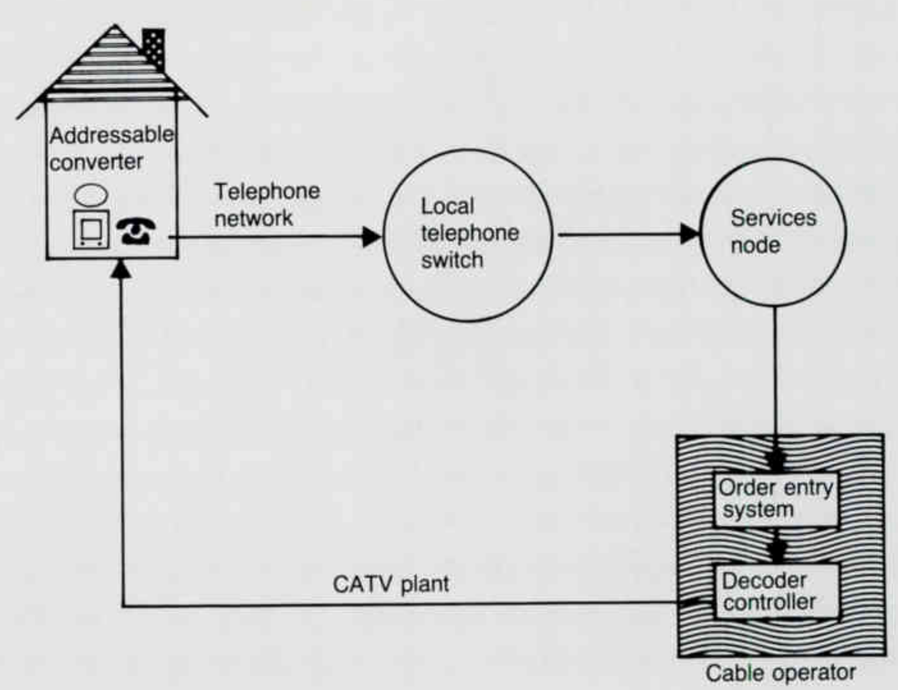
Potential market

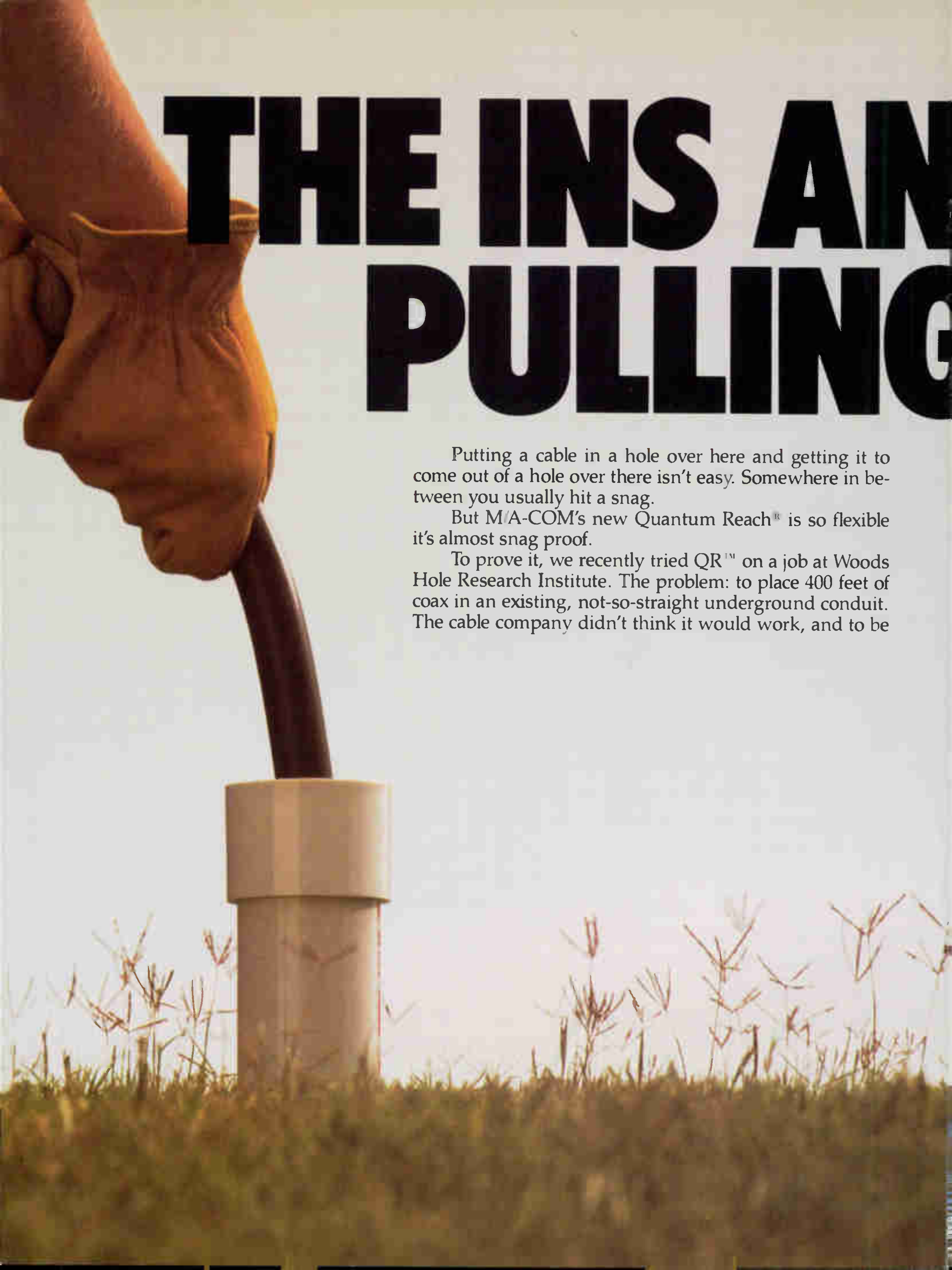
ANI's "user-friendliness" will promote its use, Pacific believes. Its main consumer element is the telephone: a virtually universal instrument that most people are comfortable using. With the technology practically transparent to the consumer, there is no learning hurdle that might foster viewer resistance.

PPV also bears an inherently self-promoting characteristic: In effect it is a "feedback loop" that will help the cable operator gauge almost instantly the popularity of PPV programming. Since Pacific Bell's ANI removes the call-blockage problem, the number of subscribers to a given program will be an accurate reflection of the program's success. The cable operator can respond accordingly with future program offerings.

Pacific Bell anticipates a large market for ANI-based IPPV service. On the average, a

ANI system diagram

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Reader Service Number 31.

California cable system serves some 10,000 subscribers, though the number may range as high as 230,000 (Cox Cable's San Diego system).

The number of California homes equipped with addressable converters (a number critical to Pacific's marketing plans) now stands at about 500,000, according to company estimates. The number is growing rapidly, however: 1.5 million cable homes in the state are expected to have addressable converters by 1989.

The national market, too, is growing. Some 9 million U.S. homes will be capable of receiving PPV by the end of this year. That number may reach 20 million by 1988 and then double again by 1995. According to an industry consultant quoted in the *Wall Street Journal*, consumer sales of PPV events could reach $2.2 billion by the mid-1990s.

Solution to past problems

A number of other ordering-mechanism technologies also are bidding for the attention of cable operators. These competitive systems have certain technical drawbacks, however, that the developers of Pacific's ANI system have worked to resolve:

- The store and forward approach, for example, requires costly additional hardware at the viewer's home; it also offers poor security to the cable operator because viewers have the capability of self-authorizing their orders.
- Two-way cable systems offer inherent interactivity, but they are very capital-intensive.
- Audio response units (ARUs) require a touch-tone (DTMF) phone; this limitation could lower the customer base by as much as 50 percent. More importantly, ARUs are much slower than ANI, taking up to several minutes to process a single call. They are, therefore, highly vulnerable to call-blocking and the overloading of telephone switching systems. They also remove the important advantage of letting viewers place their orders "on impulse."

The home hardware required by the Pacific Bell ANI system is the telephone and a converter-equipped TV linked to a cable system. Pacific's ANI system is totally automated, and is not expected to have any significant impact on the regular telephone switching network.

Future applications

Pacific views IPPV as only the first, and perhaps the simplest, of applications for its ANI technology. The company is studying other ways in which a "two-way" TV set may be translated into products and services. Some activities, such as protocol conversion, will depend on future regulatory and legislative steps taken to clarify the new rules of divestiture. (Under the Modified Final Judgment, Pacific may not presently have a role in the information or programming content of services such as IPPV.) Pacific is considering a number of ambitious new consumer services that would entail the use of personal computers as well as the telephone and cable-equipped TV.

Some new applications for ANI have already appeared on the horizon. One is "impulse shopping," in which viewers use the telephone to order products from a TV "catalogue." Some companies are already experimenting with this concept. ANI could make television a viable marketing medium for many more companies: It could clear the way for a quick, high-volume consumer response to a product offering. The rapid measurement of products' popularity, provided by an impulse shopping system, would enable marketers to focus very specifically on consumer segments.

ANI may also have particular applications for institutional users. A large corporation, for example, might wish to unite a number of its locations with a form of videoconferencing, using closed-circuit TV and the telephone. A large university could transmit its class schedule over a cable channel, using ANI response as a remote sign-up mechanism. Pacific Bell, which has installed optical fiber institution loops in several major market areas, is well-positioned to respond to institutional demand for ANI.

Pacific's ANI system can solve the technological problem of making IPPV simple and cost-effective. The chief variable is consumer response. Pacific's fall market test may provide answers. The cable TV viewing populations includes a large number of well-informed professionals who are accustomed to exercising a high degree of control over their consumer choices. ANI-based IPPV can give them that control.

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Reader Service Number 33.

Hotel/motel pay TV: Investing in future revenues

By Bill Sullivan
President, Shekinah Communications

Technology often makes some kinds of business easier. The correction button on my IBM electronic typewriter enables me to type faster than I could possible do without it. In cable, the dawn of affordable satellite technology led to a boom, which might have never occurred in the industry without those technological advances. Other technologies make businesses possible. A little, taken-for-granted technology such as that behind computer tone generators makes possible a myriad of businesses, from the long distance phone service used by your company, to the telephone answer machine that gives you your messages when it is in California and you're in a phone booth in New York.

Then there are those technologies that add to and complement a business, providing new revenue opportunities without which some companies might stagnate. One such fledgling technology just now beginning to impact the cable industry is that which makes possible hotel/motel pay television. The technology really is not new, but is just now coming into the picture as one that cable operators can use to add to their revenue stream. No longer content to depend on signing up new basic and pay subscribers for their future revenues, some cable operators are taking a hard look at this investment in hotel and motel pay television.

Most frequent travelers might recognize the name Spectradyne. The long-time leader in hotel pay television counts many individual hotels and chains among its customers, including Hyatt Hotels and others. Yet, a company such as Spectradyne, despite its enviable record, does nothing to enhance a cable company's revenues. In fact, Spectradyne is a direct competitor to cable for hotel business, because the company operates its own systems and is, in effect, an MATV operator.

Recognizing the potential and lost revenue in the hotel market, more and more cable operators are beginning to pursue the market with vigor. Individual systems of Cox Cable, ATC, Storer and Times-Mirror are among those companies with hotel pay operations of various sizes and sophistication. Each of these companies now employs a person or staff whose job it is to actively engage the lodging industry as a potential and future customer base, not just for a standard "free-TV" cable installation in hotels or motels, but with pay-per-day and pay-per-view operations that some cable operators believe will enhance their revenue stream.

For the long-term

Up front, most of those involved in hotel pay TV admit there is a substantial investment in hardware and time involved. Jim Walsh, the hotel/motel marketing manager for Cox Cable in San Diego, says, "It's expensive initially to get into it, but you have a solid revenue stream coming out of it. Over the long haul, it will be a money-making situation. We'll absorb the cost now, because over the period of the contract we'll recover our investment and make a profit. It's a long-term investment."

Jeff Norman, director of commercial markets for Storer Cable in Anaheim, Calif., echoes Walsh. "It can be (a good business) as it evolves, but it's slow. There's a lot involved in building these things," he notes. "Because a hotel's a service industry, they really have to be built tight. You have to put the money in and it takes a lot of time and planning."

If there's any industry that should understand long-term investments in both time and money, it's cable television. Yet, the paybacks can be substantial. Norman believes that a pay installation in a hotel will gross three times the money that a cable system can make from simply installing an SMATV or MATV system in a hotel and collecting basic per-room fees. He estimates it takes an average of 16 months to make back the initial costs.

Norman adds, though, that the payback time depends on what has to be done in a given lodging installation. "It depends on the amount of work done initially," he explains. "On a pay-per-day system, if you hit a good month, making $4,000 or so, you can pay the thing off in 10 months. It all depends on exactly what the job entails." Indeed, while the job may often require little more than installing the pay equipment, a more complicated installation adds to the initial investment.

Walsh says Cox Cable usually ends up rewiring, "up to and including completely rewiring the hotel to make it work." He says, "This is true especially in an older property. When you start pushing 20 years old, the MATVs when they were installed were not very good. They didn't need to be, they were only built to handle a few channels. So we go in and see what it would cost to get to the property and to do whatever it would cost inside the hotel." This requires considerable assistance from engineers, says Walsh, prior to writing an individual proposal for the hotel.

The condition of the existing MATV system (or the building of one to begin with) is but the first consideration in pursuing lodging business. The hotel pay TV system's hardware, from headend to in-room equipment, is another major investment.

The basic system

The basic components of a hotel pay system are the computer, which virtually runs the system (including CPU, printer and interface), and a program selector terminal. The computer controls the VCR and character generator, interfaces with the front office display terminal, and diagnoses individual room box problems and other factors such as signal response level for cable system analysis. The computer also interfaces with a billing printer that prints out at the time of purchase (of a pay service), provides an end-of-day and end-of-view billing summary, and also provides an automatic monthly invoice to the hotel. The computer tracks and stores monthly totals for a complete year, as well as tracking refunds.

> *'No longer content to depend on signing up new... subscribers... some cable operators are taking a hard look at this investment in hotel and motel pay television'*

The program selector terminal (the in-room box) provides the hotel guest with an introduction to the pay system. These typically allow from one to three pay services, in addition to the "free to guest" service many hotels choose to include in a package. The pay services are selected by pressing a button or pad, or throwing a switch (depending on the hardware used). With some equipment, the pad, when pressed by a hotel guest, flashes to inform the guest he's selected a pay service. Also available is a free preview feature that allows a two-minute preview period, after which the pay channel selected will automatically scramble unless the guest then presses an order "confirmation button." Most boxes available do not have the order confirmation feature, and after the preview period automatically bill the customer for a pay purchase. Many in-room terminals also feature parental lock-out functions (a must, since Playboy or R-rated movie product is often the pay-per-day service of choice in hotels). Other necessary equipment, such as amplifiers, modulators and the like, is standard to any cable system, built for a hotel or not.

As with a standard cable system sold to individual residents in a franchised area, programming is the product in a hotel pay TV scenario. While the operator certainly must be concerned about the delivery system, the programming sells the service, not the computer or program selector terminal.

Most cable operators report that programming offered on a hotel pay system is a negotiation point hashed out when the deal is struck between the system and the hotel. Norman of Storer explains, "The programming is a la carte. They can pick and choose. We're doing a deal with all the Best Westerns, and they want The Disney Channel, while the Ramada in Anaheim wanted Playboy Channel, and the Holiday Inn wanted Showtime." However, a pay system may require a headend installation with videocassette playback units in the hotel, because most of the satellite-delivered services do not allow programming to be sold on a pay-per-day or per-per-view basis. While many hotel systems operated by cable systems offer services such as HBO, Showtime and The Movie Channel, by contract they must be offered as free to the guest services. While these may enhance the overall value of a hotel service, they don't add to the bottom line. Thus, Playboy Channel (a popular service in some hotels) is offered, or videocassettes are utilized to create a "pay-per" channel. The advent of new, satellite-delivered pay-per-channels is likely to have a significant impact on hotel pay TV.

Until a few years ago, the consensus is that many operators were content to allow the hotel business to "come to them." With increased competition from larger numbers of hungry SMATV operators, though, it is generally agreed that such an approach to the hotel business by cable operators is not sufficient. Brian Bane, director of commercial markets for Home Box Office, says, "For anybody who approaches the market like that, the days of getting any hotel business are over."

A viable profit center

Just how much money there is to be made depends on several factors, some of which we've already noted. Yet, financial examples available point to pay television in the lodging industry as a viable business and an additional profit center.

Using a typical 300-room hotel as an example, figuring in costs of equipment and programming and a relatively modest 13 percent "buy-rate" (buy-rate being the percentage of *total* rooms taking a pay service over a year's time, not just occupied rooms), a cable system operating a hotel pay TV system may realize nearly $30,000 worth of additional revenue from the one hotel in the first year. While programming costs continue through the life of a pay system, equipment costs can be quickly paid with a decent buy-rate, as the hotel pay system becomes an additional profit center for the cable system. The hotel collects about 10 percent of the pay revenue as its cut, but benefits from other factors associated with having a hotel pay TV system. Because the guest is likely to stay in the hotel to eat and drink when the latest satellite-delivered and movie programming is available in his room, this serves as another financial incentive for the hotel to strike a deal with the local cable system to install a pay TV system. The hotel's ease of operation, requiring little staff time to monitor the system, and no time to bill purchasers of a pay service (since it's all done by computer), removes yet another potential objection.

The hotel offering the best chance for success with a pay operation is one where the business traveler is a frequent guest. The buy-rate can often be tied directly to the effectiveness of the in-room marketing materials and strategy used, and a system with considerable marketing savvy might double the 12 percent buy-rate used in the previous example, hence doubling the revenues.

Can you imagine what the cable industry might have been like today if systems had said no to the first programmers who suggested they buy a dish to increase their program offerings? What kind of revenues would cable be earning today if it had not made full use of the advantages offered by this technology just 10 years ago? Satellite dishes and receivers were once a huge financial investment, but experience shows it was an investment that paid off well.

Admittedly, hotel pay TV will never have the wide-reaching impact satellite technology had on the cable industry. Still, the question many operators must ask themselves is whether or not they can afford to pass up a potentially lucrative revenue generator such as hotel pay TV.

Reader Service Number 35.

IPPV unit

World Video Library Inc. recently announced The Impulser, a hand-held self-contained unit for automatic subscriber impulse pay-per-view ordering and billing.

The Impulser plugs into a modular telephone jack, allowing subscribers to order a movie instantaneously. It contains an information microchip, and automatically identifies the account. The headend computer verifies the account's status with the billing system, and, through the addressable controller, releases the channel in the home, whether it is an impulse order or 24 hours in advance.

The Impulser system utilizes the WVL Command Center, which acts as the interface between The Impulser's directions to the billing system and the addressable controller. Since it uses phone lines, it does not need two-way cable, nor does it need to be near a cabled set. It has dialtone and number-busy detectors, and is capable of dialing out in either a rotary or touch-tone format. The unit has a battery back-up to retain memory.

Viewers enter a three-digit movie code, after pushing the command button, and then enter the hour and a.m. or p.m. The Impulser provides feedback to subscribers via LED lights, which indicate acceptance or problems with the order. By unplugging The Impulser from the telephone jack, subscribers are assured of no unauthorized movie orders.

For more details, contact World Video Library, 9454 Wilshire Blvd., Suite 201, Beverly Hills, Calif. 90212, (213) 859-7040.

Remote monitoring

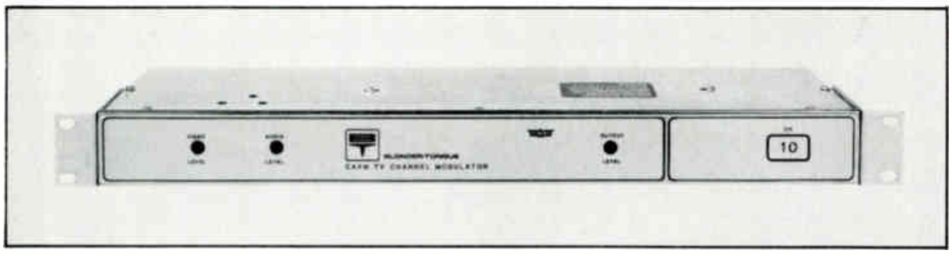
RF/Superior announced a remote computer-controlled instrument, designed to measure cable signal levels, hum, carrier-to-noise and temperature. It is a modular package designed to expand the monitoring capability of the previously announced CAT I system. Features include: automatic level calibration, built-in phone modems, data storage for historical and trend information, and environmentalized enclosures.

RF/Superior is a division of RF Analysts Inc. For further information, contact RF/Superior, 2010 Pine Terrace, Sarasota, Fla. 33581, (813) 922-1551.

Converter

Teltech announced the arrival of the Model RC600 60-channel infrared remote-control converter. The RC600 features microprocessor-controlled PLL operation with synthesized frequency tuning system, large LED digital display and calculator-type keys for direct channel selection or scanning.

For more information, contact Teltech Corp., P.O. Box 405, East Brunswick, N.J. 08816, (201) 238-6329.



A/V modulators

Blonder-Tongue Laboratories announced the availability of its new CAVM audio/video modulator. The CAVM is a heterodyne modulator used to produce a single TV channel to be distributed in an SMATV or MATV network. It is available for VHF (2-13), mid-band (A-I) and super-band (J-W) channels. The heterodyne conversion system provides proper vestigial sideband selectivity for use in adjacent channel color systems. The CAVM accepts input from sources such as satellite receivers, video cassette recorders, closed circuit TV cameras and TV demodulators. Applications may include local origination of entertainment, instructional, surveillance, safety and bulletin board message programming. IF loop-thru capability supplies a padded IF output before channel conversion. This provides the capability to replace standard internally generated IF output with an alternate source of composite IF or allows connection of IF scrambling equipment.

Blonder-Tongue also announced the SAVM audio/video modulator with stereo compatibility. The SAVM is a SAW filtered heterodyne modulator used to put sound and color video on any unused channel of a CATV, MATV or SMATV system. The unit provides a modulated visual and an aural RF carrier output on any single VHF, mid-band or super-band channel. A heterodyne conversion system in the SAVM is designed to furnish vestigial side-band selectivity. The SAVM features field defeatable audio pre-emphasis, permitting transmission of BTSC standard composite stereo signals.

The modulator accepts standard polarity (sync negative) of 0.7-2.5 V p-p level from video sources. As with the CAVM, IF loop-thru in the SAVM supplies a padded IF output before channel conversion and provides the capability to replace standard internally generated IF output with an alternate source of composite IF.

The SAVM's heterodyne channel converter board is field replaceable, which permits service personnel to change channels in the field. Other features include 45 dBmV output, continuously adjustable output level range and low intermodulation distortion. Audio and video level controls and calibrated A/V LED indicators are located on the front panel.

For more details, contact Blonder-Tongue Labs, 1 Jake Brown Rd., Old Bridge, N.J. 08857, (201) 679-4000.

Modem

International Microwave Corp.'s new T1 modem operates at a subcarrier frequency of 6 MHz above video and allows simultaneous data/voice and video communications on one link. Use of linear (FM) microwave radio assures minimal crosstalk between video and T1 and achieves a fade margin of 30 dB for 10^{-6} bit error rate (BER) at -35 dBm receive level with video present. Increased fade margin may be achieved by increasing receive level to -25 dB. Modems contain built-in power supply and alarm circuitries to indicate loss of data or subcarrier. This unit can accommodate paths up to 30 miles and is suited for applications such as universities or hospitals where transmission of video for lectures and demonstrations along with data for computer and voice are useful.

For additional information, contact International Microwave Corp., 65 Commerce Rd., Stamford, Conn. 06902, (203) 323-5599.

Scrambling system

An interfering carrier scrambling system called Positrap for CATV, SMATV and institutional distribution systems has been added to Microwave Filter Co. Inc.'s product line. The system is comprised of three components.

Model EC-(channel) encoder places a jamming carrier between the video and audio carriers of a selected channel to render it unusable at the subscriber's homes. The

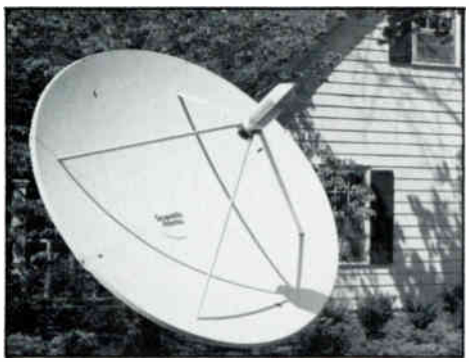
Model LS-(channel) lower adjacent security module, an optional accessory, is used when the lower adjacent channel is unoccupied by programming. It generates an RF signal at the lower adjacent sound frequency making it impossible for subscribers to fine-tune in part of the premium programming.

Both encoder generator and lower sound generator are either combined at the output of the modulator or can be connected directly to the headend combiner. The output signal level is adjustable 43 dBmV to 63 dBmV. All spurious emissions are -60 dBc minimum, 50-300 MHz.

The third component, also an optional accessory, Model PE-(channel) Positrap system pre-emphasis amplifier, enhances the quality of the decoded video signal after the interfering signal has been trapped. It boosts a portion of the signal negating the trap's roll-off. This unit is connected directly to the modulator output of the pay channel. The pre-emphasis amplifier is recommended for channels above 6. It has 6 dB gain and its .5 dB compression point is at 66 dBmV.

All three units are available for channels 2-6, A-I and 7-13. They come standard with F connectors, and operate from 115 VAC, 60 MHz at 12 W.

For more information, contact Microwave Filter Co., 6743 Kinne Street, East Syracuse, N.Y. 13057, (800) 448-1666; in New York, Hawaii, Alaska and Canada, (315) 437-3953.



TVROs, cables

Scientific-Atlanta Inc. introduced a complete system for the reception of satellite television programming in the home. The Homesat line of satellite earth station products includes the Model 8000 perforated antenna, Model 9000 solid antenna, Model 800 receiver and related accessories.

The 2.8-meter 8000 and 9000 antennas are constructed of galvanized reflector panels with a baked enamel finish. The panels are precision-formed, and both antennas offer optional motorization with a swing arm that permits horizon-to-horizon tracking. Also offered are single or dual polarity feed options.

The 800 block downconversion receiver operates in the 950-1450 MHz range. The microprocessor-controlled unit features a built-in antenna positioner and is capable of both matrix and discrete stereo output with Dynamic Noise Reduction. An infrared remote control is standard with Homesat 800, which is descrambler compatible.

In addition, Scientific-Atlanta added flame-retardant versions of two cables to its line of coaxial cable. The new cables are UL-listed bonded drop cable and UL-listed CableFlex. Both flame-retardant cables are designed for applications that require UL-listing for the internal wiring of new and existing structures for broadband communications networks, cable television, computer systems or other uses.

For additional information, contact Scientific-Atlanta Inc., 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

Security products

Arnet Controls Inc. announced the development of new security products designed to fight software piracy and unauthorized computer access.

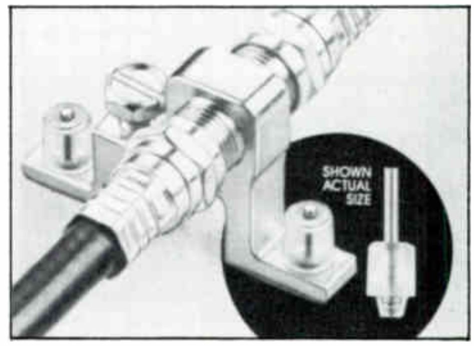
Called Gardware™, the modules are small, electronic "black boxes" that must be plugged

into the computer before protected software will operate or protected on-line systems can be accessed. When the connection is made, the protected software or on-line system and the Gardware security module form a "lock and key" that only will function in unison. The modules are installed by the end user without disassembling the computer. They are "transparent" and will not interfere with the computer's normal operation, according to the firm.

Arnet has designed the security devices to be compatible with a wide range of computers. PC-Gard works with the IBM PC and compatibles; Mac-Gard is used with the Apple Macintosh, and Port-Gard is compatible with any computer or terminal that has a standard serial (RS232) port.

The modules allow the user to make an unlimited number of backup copies from the original program disks. And the copies will not function without the security device.

For more details, contact Arnet Controls Inc., 476 Woodycrest Ave., Nashville, Tenn. 37210, (615) 254-0646.



Ground block fastener

ITW Linx recently introduced a fastener designed to hold a ground block for coax cable. Using an impact tool, a tempered steel pin is driven in to hold the block. It can be used on concrete, cinder blocks, bricks and a variety of other materials, and it is made of clear weather-resistant Lexan. The Fast-Tac pin fits ground blocks that are used for single and dual coax cable. It is available in long pins for brick and stucco.

For more details, contact ITW Linx Communications Products, Illinois Tool Works Inc., 195 Algonquin Rd., Des Plaines, Ill 60016, (312) 296-5469.

Modem, interface

EF Data announced the availability of the BCM-201 cable modem. This modem is a multibus card modem with burst capability for use in broadband local area networks on coax cable. The modulation/detection allows acquisition in 16 bits at a rate of up to 2.5 MBPS in a 6 MHz bandwidth.

In addition, EF Data announced the availability of an RS422 interface for its BCM-101 broadband modem. The BCM-101 is all-digital and fully synthesized. Data rates of 750 kBPS, 1.544 MBPS and 2.048 MBPS are available. Frequency range is 5-400 MHz with a typical error performance of 10^{-9} with .6X data rate spacing.

For more information, contact: EF Data Corp., 1233 N. Stadem, Tempe, Ariz. 85281, (602) 968-0447.

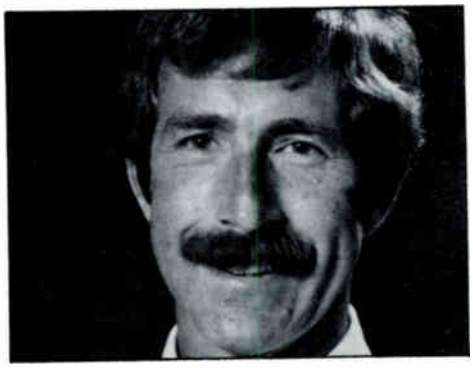
Reflectometer manual

Riser-Bond Instruments (formerly Avtek) is distributing a training manual that details troubleshooting techniques and uses of the digital time domain reflectometer. The data pamphlet for the Model 2901A contains complete specifications, troubleshooting instructions, examples, photos and drawings.

To obtain a copy, contact Riser-Bond, 1109 K St., P.O. Box 188, Aurora, Neb. 68818, (402) 694-5201.

An organizational approach

By Graham Powers
Executive Director, Construction
American Television & Communications Corp.



In a capital intensive business such as cable TV, one of the cornerstones of success is installing your cable plant on schedule, within budget, and in a quality manner such that it lasts through the life of the franchise and, hopefully, beyond. Although urban construction has been slowed over the past several years, there appears to be light at the end of the tunnel. Some examples include: United Building in Baltimore; Scripps in Sacramento; DCI in Washington, ATC, Cox and Warner Amex in New York; and TCI and Group W in Chicago. Also, with the changing state of technology, there is a significant number of ongoing large rebuilds and upgrades. The express purpose of any construction process would be, as stated above, to build quality plant on schedule and within budget. Let's briefly examine each of these areas.

In the area of quality, the first issue to be addressed is the development of good, realistic construction specifications. These specifications should include detail on aerial, underground, drop and multiple dwelling unit plant. We at ATC have developed our own specifications through experience and recommendations from cable and other material manufacturers. A second key in quality plant is the use of field-tested and approved quality products. All materials utilized that affect the quality of the signal are tested and approved by our engineering plant before they are listed on our management-approved materials listing. Finally, in the construction of quality plant, good constant and consistent field supervision is required. It is very difficult to monitor the quality of plant from behind a desk or at the coffee shop.

In the area of scheduling, some basic factors to keep in mind are the construction time frame and franchise commitments. Initially, it is important to understand what outside constraints might affect this area. They include: makeready requirements, permit requirements, and obtaining easements, which vary on a city-by-city basis. Other areas that are equally important are material ordering and delivery lead times. These vary with the status of the overall cable TV manufacturing and production cycles. At some times the vendors have sufficient materials on their shelves, and at other times they have none. So working with your local materials management group can give you excellent insight on material lead time and availabilities.

Next, it is important to determine your actual construction schedule after building in these other considerations. Once that has been established, production rates can be set and an inter-relationship between the different areas of construction can be determined. A key in the successful completion of any large construction project is having production rates that are obtainable and controllable.

Another important aspect is building a cable plant within budget. An important consideration in this area is that of initially establishing an accurate bill of materials, which can be done utilizing past history. Also, even though you may feel that you're receiving very good prices from your material suppliers, if you have a large construction project, obtain bids. In many instances, suppliers will tend to lower their prices if they can provide you a known amount of materials over a specified period of time. Once you have established your material needs, it is time to decide whether you will use in-house or contracted personnel to do the actual construction.

'A key in the successful completion of any large construction project is having production rates that are obtainable and controllable'

Using a contractor

It is important, before the start of any construction, that a good contract with the contractor is drawn up (more on this later). It protects both sides and allows the contractor to have a better idea of the expectations to be met. Prior to awarding a contract, it is advisable to have a pre-bid meeting at the location where construction will occur. During the pre-bid meeting, you should discuss what is to be built, how much and how fast. Also, it is advisable to have plant design available for the contractor to take with him into the field to actually look at the work to be accomplished.

Let the contractor see what your construction specifications will be so there are no surprises. The more the contractor knows about the project, the better he will be able to gauge his worth as he is able to reduce his risks, and the better price the customer will obtain. All pricing that you obtain should be on a per-unit basis, but also have the contractor bid prices for cost plus work, although you will hope to have it minimized. In looking at contractors, it is important to qualify them, possibly before the pre-bid meeting. By qualifying, I mean check financial capability and references, and possibly take a look at sites they are currently working; that will give you a good idea of their capabilities. We generally select the lowest qualified bidder. That does not mean the overall lowest bidder; it means the contractor who has the demonstrated capability to perform the work at the price presented.

Getting back to the contract, decide how long you want it to run. We have found contracts of a year or less tend to cause the fewest problems. That is because a contractor who is awarded a multi-year contract may slack up during the job and it may be hard to fire him. However, on a shorter term such as a year, the contractor has the opportunity to cover his fixed costs of moving into the project and also is motivated to perform so that he obtains additional contracts.

Once a contract is awarded, it is important to have sufficient supervisory people on-site to constantly monitor the quantity and quality of work performed. Two methods for ensuring that things go well are 1) monitoring the contractor's production on a daily basis, and 2) agreeing on a weekly basis what production he will be paid for. He is paid for that production minus a retainage. Release of the retainage is customarily based on the contractor's cleaning up all previously noted discrepancies and our people doing as-builts on the plant to ensure that the amount of plant we have been billed for is correct, and that the amount of materials we issued to the contractor were utilized in building our plant. If there are large discrepancies, the materials and/or overcharge for production are charged back to the contractor and taken out of his retainage.

The organizational controls

You may be asking how this can be set up organizationally. Briefly, the way we handle this is that each project has: a project manager who is in charge of overall management and supervision of the project; a project administrator who handles the intricate administrative details such as materials scheduling, final invoice recording and approval, vehicle maintenance and other areas; a construction supervisor for each major area of construction, whether it be aerial, underground or MDU; and sufficient field inspectors to monitor contractor production and quality.

We also generally have a makeready/as-builts person who accomplishes makeready interface, easements and permits at the beginning of the build, and who completes the as-builts toward the end of the build. We have operations managers with up to three projects reporting to them. They have strong administrative and organizational control over projects. They control contract change orders to projects, materials release approval, and general field control issues. They serve as a check-and-balance between the project and the contractor. Each of these operations managers reports to a division manager; each division manager has two operations managers. The division managers provide overall administration and organization of the field locations and interface with the rest of the company.

In addition, we have a construction accounting group responsible for receiving all approved contractor invoices and ensuring that they are paid in accordance with the contract. They also monitor local expenditures for unusual areas and investigate those; they publish internal management reports, such as a cost-per-mile report which details our expenditures by project by major area of expenditure on a per-foot basis; and they publish vehicle expense reports. With their management information reports, we are able to monitor the costs of all our projects on a month-by-month basis. In addition, the group has a centralized inventory management and control system that monitors material usage on the project as well as materials issued to the project. Any variances are analyzed. Finally, they perform a project cost reconciliation on every project before it is retired into our books.

Making it pay

In summary, it is important to build high quality plant on schedule and within budget to assist in the return on assets for any MSO. I have discussed some of the things that must be checked and established while building plant as well as a basic organization to fulfill needs within the company. It is interesting to note that ATC's Construction Division organization expenses are totally capitalized and are built into our cost of plant. In addition, over the last four years we have been within 1 percent of our estimated major construction costs. I mention this not to blow our own horn, but to illustrate that good planning and proper controls do pay off.

The electronic meeting

By David C. McCourt
President and CEO, McCourt Communications Inc.

Videoconferences are becoming an increasingly important segment of the communications industry. Once only novelties that added a dash of glamour to banal business proceedings, they are emerging as a major communications medium in both the public and private sectors. They blend the visual impact and immediacy of television with the personal interaction of a New England town meeting.

Videoconferences require nearly all of our skills and resources, from production and engineering to cable and satellite technology. They transform us from providers of data to catalysts for person-to-person dialogue on a national and even global scale. Their cost-effectiveness enables the exchange of audio and visual communication among large audiences over vast distances. When produced properly, the per-person cost of a videoconference can be roughly equivalent to the cost of preparing and sending a business letter. As well, the economics of videoconferencing combined with the communicative powers of video and multiplied by the countless specialized groups that can benefit from "electronic town meetings" create a wealth of business opportunities for our industry.

This past June, McCourt Communications and its affiliate, McCourt Cable Systems, in conjunction with the White House and the U.S. Chamber of Commerce produced a major international videoconference for the National Community Education Association. The theme for this conference was business/education partnerships and included 10,000 sites across the United States and Canada. The conference originated from Washington, D.C., and was uplinked to two satellites (rather than one) for international transmission and signal quality. We used a professional moderator, a panel of experts on camera, and invited participants from the United States and Canada to phone in questions via landlines.

Before attempting to produce a major, multi-site videoconference, you may wish to consider some words of advice: The key is planning, extremely detailed planning that would do justice to a NASA space flight. Ideally, you should allow a minimum of six months of planning and preparation for a major program. You need all the lead time possible because you face a formidable chore. In addition to helping develop the program itself, you are responsible for providing the downlinks (receiving sites) with necessary technical data, designing the studio set, writing and rewriting scripts, producing taped segments and graphics, and rehearsing and timing the program to the second. Of course, a simple inter-office conference, which connects a small number of sites for a short period of time, is much less complicated to produce. In fact, some large hotels and convention centers already have videoconference capability on a limited scale.

Program content should be developed to take maximum advantage of the power of video. For purposes of both pacing and illustration, roughly one-third of the broadcast should be short, pre-taped segments of case histories interspersed throughout. This requires a major effort to locate and assemble tapes, and then to edit, script, narrate and sequence them into the program.

A videoconference can originate from any suitable location with portable equipment, of course, but for the Washington production we elected to use the well equipped BizNet studio in the U.S. Chamber of Commerce. It has a full sound stage, studio cameras, teleprompters, computer-controlled lighting, a character generator, and digital still store.

For signal distribution there are 26 domestic commercial satellites orbiting 22,245 miles above the equator. Each has 24 single-channel transponders, which are basically receivers/downconverters that step the 6 GHz signal uplinked from earth down to 4 GHz for transmission back. Caution must be exercised when choosing a satellite. Two birds were recommended as perfect for our Washington teleconference, but our calculations of their footprints indicated that the beam of one was too weak at the fringe to be acceptable at our northern receiving sites. Ultimately we settled on Westar 4 and Satcom IV. The obvious lesson here is to do your own homework.

For a major production, such as the one described here, the sponsor of the videoconference should choose a professional production company that can provide a makeup artist and a talent coach to help the panelists address the cameras, read the teleprompter, and act naturally while in the limelight. A good production company also can assist the sponsor in developing a creative twist.

With proper planning and scheduling, videoconferencing can be an extremely effective and efficient method of communication. From a production standpoint, you need a highly organized approach supplemented by a thorough yet flexible backup plan. The immediacy of a live audio/visual production increases the impact of a program, but also magnifies errors geometrically. While the medium is not for everyone, it does represent an interesting and exciting opportunity for our industry.

Suzuki

Tadashi Suzuki has been named president and chief executive officer of **NEC America Inc.,** a subsidiary of NEC Corp. Suzuki succeeds **Dr. Ko Muroga**, who will rejoin NEC Corp. as associate senior vice president and director.

Suzuki joined NEC Corp. in 1954. He was appointed general manager of the Latin America Marketing Division in 1970. In 1973 he joined NEC do Brasil, S.A., and was named president in 1977. Suzuki rejoined NEC Corp. in 1980 as vice president. He was appointed associate senior vice president and director in 1982 and named senior vice president and director in 1985. Contact: 8 Old Sod Farm Rd., Melville, N.Y. 11747, (516) 753-7000.

Rite Communications Co. announced that **Bill Wertz** has been named chief executive officer of Rite Cable and its affiliated companies. Wertz will take the helm of the Miami-based multiple system operator immediately. The company also announced that **Jim Riegler**, the former CEO, will now devote his full time to corporate finance and acquisition opportunities.

Prior to joining Rite Cable, Wertz served as director of operations for Americable Associates. He has more than 25 years' experience in all aspects of the cable industry, including executive management, construction and engineering. Contact: 9990 S.W. 77th Ave., Miami, Fla. 33156, (305) 665-9990.

Brian James joined the staff of the **National Cable Television Association** on Sept. 3, 1985, as director of engineering in the Science and Technology Department. James, manager of standards and practices, Cablesystems Engineering of London, Ontario, since December 1981, has been employed in the cable television industry since 1972. Before joining Cablesystems Engineering, he was employed by Switzer Engineering Services Ltd. from 1975 to 1981.

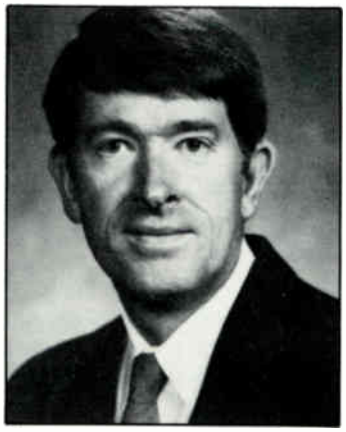
Washington journalist **Steve Tuttle** has been named vice president of public affairs for the National Cable Television Association. Tuttle joins NCTA from Television Digest Inc., where he was Washington managing editor and a senior editor of the Digest's Communications Daily. He has 14 years of experience in newspaper journalism. Tuttle assumed his duties with NCTA on Sept. 23; he succeeds Edward Dooley, who resigned earlier this summer.

J. James McElveen, who has served more than four years as director of public affairs at NCTA, will assume additional responsibilities for the day-to-day management of the department, as director of public affairs/administration. Contact: 1724 Massachusetts Ave., N.W., Washington D.C. 20036, (202) 775- 3629.

Kramer

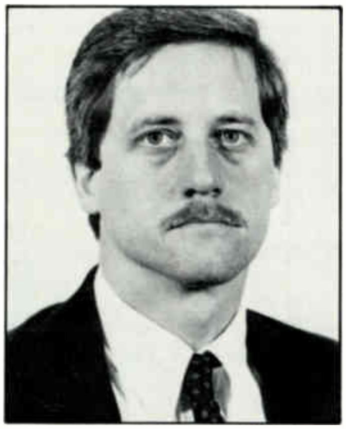
Technology Concepts Inc., a firm specializing in data communications networks, gateways and interconnects, has announced the appointment of **Mitchell Kramer** as vice president of marketing and sales, and **David Hudson** as vice president of business development.

Kramer spent over 14 years with IBM in a variety of sales, marketing and management positions. Most recently, he was responsible for data communications, networking and local area networks at Wang Laboratories.



Hudson

Hudson, formerly vice president of marketing and sales for a machine vision systems manufacturer, will be responsible for new business development. Contact: Old County Rd., Sudbury, Mass. 01776, (617) 443-7311.



Sheldon

Shaw

Kevin Sheldon has been promoted to the position of director of national sales/field service at **Regency Cable Products.** Sheldon has been with Regency for almost three years. In his former position as software engineer, he was primarily responsible for all of Regency's computer programming and support. Contact: 4 Adler Dr., E. Syracuse, N.Y. 13057, (315) 437-4405.

John Shaw, SCTE region 4 director, has taken a position as national sales and marketing manager with Regency Cable Products. Prior to this, he was with Wavetek Indiana. Contact: 7707 Records St., Indianapolis, Ind. 46226, (317) 545-4281.

Reilly

Tim Reilly has joined **Cable-Tek Center Products Inc.** as director of sales and marketing. Reilly previously held the position of sales manager for Telecrafter Products Corp. Contact: 129 S. Abbe Rd., Elyria, Ohio 44035, (216) 365-2487.

Vaughn Clevenger recently was named as director, product assurance at **Bytex Corp.** Most recently, Clevenger managed quality assurance at National Semiconductor. He has also held management positions at Peterbilt Motors and Signetics Corp.

Bytex Corp. named **Samuel Klaidman** as director, manufacturing technology. Most recently director of corporate consulting at Solotest Corp., Klaidman also held management positions at Xylogics, Incoterm, Dennison Manufacturing and RCA.

Robert McNerney was named as director of information systems at Bytex. Formerly director of information systems for the Harvard Community Health Plan, McNerney also held management positions at Digital Equipment Corp., Minute Man Data Services Inc. and Texas Instruments. He began his career as software consultant for IBM Corp. Contact: Southborough Office Park, 120 Turnpike Rd., Southborough, Mass. 01772-1886, (617) 480-0840.

Kelly

Satstar, a unit of Millimeter Wave Technology Inc., has appointed **P. Michael Kelly** as national sales manager. Most recently Kelly was national sales manager for Gould Dexcel's Innovision product line. Prior to Gould Dexcel, Kelly spent eight years at Scientific-Atlanta where he most recently held the positions of manager for broadcast audio marketing, Satellite Communications Division, and sales manager for business development for the division. Contact: 1395 Marietta Pkwy., Building 700, Marietta, Ga. 30067, (404) 425-9385.

Floyd Shacklock has joined **Scientific-Atlanta Inc.** as a marketing specialist in the company's Coaxial Cable Division in Phoenix, Ariz. Shacklock will be responsible for marketing activities in non-cable television markets. He comes to S-A from Teledyne Ryan and Motorola. His most recent position was as marketing manager in Motorola's Government Electronics Division. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

Vogel

Robert Vogel, SCTE region 1 director, recently was appointed senior broadband engineer at **Sytek Inc.** Prior to this, he was a CATV applications engineer with Raychem Corp. Contact: 2010 N. 1st St., Suite 401, San Jose, Calif. 95131, (408) 275-9860.

Microdyne Corp. announced the appointment of **Mark Chew** as senior systems engineer. Chew has 11 years of experience in video systems and SCPC communications at Scientific-Atlanta and RCA Americom. Contact: P.O. Box 7213, Ocala, Fla. 32672, (904) 687-4633.

Compucon Inc. announced the promotion of **David Zumwalt** to manager of the Mobile Communications Services Division. Zumwalt joined Compucon in June 1981 and managed the early development of its DTS (digital termination systems) and DBS (direct broadcast satellite) services. Contact: P.O. Box 809006, Dallas, Texas 75380-9006, (214) 680-1000.

Tele-Engineering announced the appointment of **James Lyons** to the position of operations manager of the Product Division. Prior to joining Tele-Engineering, Lyons had over 11 years of engineering experience in the electronics industry, both in production and design. Contact: 12 Humbert St., North Providence, R.I. 02911, (401) 232-5444.

Satellite delivery of cable audio

By Jim Trecek
Vice President, Sales and Corporate Communications
And Shaun Johnson
Assistant Vice President, Engineering and Special Projects
Southern Satellite Systems Inc.

Satellite delivery technology has been dramatically improved over the last five years. Pre-taped stereo music is uplinked from various points across the nation on video transponder subcarriers with excellent frequency response, dynamic range and signal-to-noise ratios, and has been shown to be acceptable and desirable to most listeners. Each channel of stereo is transmitted on a single 15 kHz subcarrier, while each mono service is transmitted on a single 7.5 kHz subcarrier and synthesized into stereo at the headend (since most of the source material is in mono format). Once the signal leaves the uplink and is received at the headend, it is processed through satellite receivers, subcarrier demodulators and FM multiplex stereo modulators and then sent through the cable either as basic FM in the 88-108 MHz FM band or in the 108-120 MHz band (cable Channels A-1 and A-2) as a secured service requiring a block converter for reception. These signals can be transmitted at levels up to 38.75 dBmV without prior authorization from the FCC. But anyone implementing operation in the 108-120 MHz band should be fully familiar with the commission's rules on this subject prior to such implementation.

The FM multiplex analog delivery system is the accepted standard of transmission and delivery and will likely remain dominant during the next few years, although digital systems are being developed and reviewed with increasing interest, as are improved analog systems such as the CBS Technology Center's FMX system (which, while being fully compatible with existing FM receivers, also offers a signal-to-noise improvement in excess of 20 dB to a specially equipped FMX receiver). Although a digital system has the potential to be superior in quality to an analog one, the expense differential between the two is not cost-effective for many cable operators at this time. Since much of the audio will continue to be delivered in analog format for years to come, the installation of a digital system at this time could result in costly, redundant hardware. When all the smoke clears, the end result rests with the ear of the listener and the quality of the equipment being listened to. In most cases, the consumer has not yet invested in the quality of equipment that would allow differentiation between analog and digital quality.

The process of delivering quality audio to cable systems via satellite inevitably begins at the production stage, with care being exercised in the selection of discs, proper cleaning and handling, and proper transfer of material to tape for playback. The remainder of this article will discuss how SSS goes about the production and playback of its Starship Stereo service, as well as how the audio product is ultimately delivered to the consumer.

Behind the scenes

At the production facilities, both vinyl disc and compact disc (CD) are used as program material sources. Inputs from the various turntables and CD players are mixed in an Audio Arts 800 Series mixing console, where strict attention is paid to levels since no attempt is made to use AGC on the audio to allow preservation of as much of the original dynamic range of the music as possible. The output of the mixing console is fed through a Burwein transient noise eliminator, which in turn feeds an S.A.E. impulse noise reduction unit, the combination of which reduces hiss, clicks and pops to an imperceptible level on quality discs. This noise-reduced output is routed through a DBX 180 encoder for maximum noise reduction and is transferred to a ¼" half-track reel-to-reel tape deck. This process yields music with a signal-to-noise ratio of 90+ dB and frequency response of 30-30,000 Hz ±3 dB. Some of the formats are played back strictly on single-format reel-to-reel decks, and for those, the process of production ends at this point. Other formats are reproduced on 1" eight-track machines, where the material is transferred one format at a time to the 1" tape as is; that is to say, the DBX encoding is left alone and not decoded and re-encoded during the transfer process.

For the uplink subcarrier equipment, SSS chose the Wegener 1600 Series subcarrier modulators with the associated demodulators to monitor the quality of the downlink signal to more closely resemble cable headend conditions. The following outlines the specifications of the uplink/downlink performance using this series of equipment.

Main carrier deviation: 0.95 MHz
Occupied bandwidth: 130 kHz
Frequency response: 50 Hz-15 kHz, 1 dB
Distortion: 1 percent
Peak signal-to-noise: 70 dB typical
Peak program level: +18 dBm
Impedance: 600 ohms, balanced

With the music so produced and delivered to the cable headend, it now must be delivered to the consumer. By far, the most common delivery method on cable is standard FM multiplex, as has been previously mentioned. Since the L-R portion of the FM signal is actually an amplitude modulated subcarrier at 38 kHz, it is important to operate the signal on the cable at the highest legal level available in the system to maximize signal-to-noise performance. It is equally important that the cable trunk and drops be well-maintained and well-designed for the same reason, since the cable system itself is the major source of degradation to the signal. Tests, which were performed prior to the FCC's decision to raise the notification threshold from 28.75 dBmV to 38.75 dBmV, have shown that in a well-maintained cable system, FM stereo signal-to-noise ratios on the order of 56-58 dB could be achieved at the end of a 25-amp cascade, even at the lower level. Obviously, the new threshold level will offer significant noise improvement over that without requiring the time-consuming and detailed commission notification and permission cycle.

Since most systems are already looking at Satcom III-R (where the vast majority of the audio subcarriers are located), the expense for basic satellite reception gear—dish, LNA and receiver—is generally nil. However, the headend audio processing equipment represents a major investment, especially for a small system. Using the Leaming or Wegener communications headend processing equipment, you can calculate your equipment investment and payback according to the following figures:

One mainframe per four audio formats: $500
Pair of processor cards per format: $1,200
Block converter for secured service: $25
Programming costs: Variable

Totalling these costs reveals that a 10-format headend audio processing investment will be in the range of $14,000 at startup for equipment alone. If some of the more popular music video sources are to be added, the same hardware costs apply for each service. If the operator elects to use the secured mode of operation, most of the initial $25 cost for the block converter can be recovered with an installation fee and deposit. After determining which formats apply in a given market, the operator can calculate the system's investment in hardware and programming and build the basic business and marketing plan.

It's just the beginning

It is safe to say that it is within the capabilities of the well-designed and well-maintained cable system of today to deliver in analog form music of sufficient quality to satisfy all but the most demanding audiophiles. It is probable that in the years ahead advances in analog and digital technology (particularly in terms of bandwidth consumption and cost effectiveness) will allow the cable audio industry to progress and deliver increasingly higher quality to the consumer.

Texscan PATHMAKER CATV

WE DIDN'T CHANGE THE NAME, BUT LOOK WHAT WE ADDED!

It's hard to improve on a reputation built from 15 years of field proven reliability. So, Texscan's Pathmaker distribution line retains all the outstanding features you've come to respect such as: Upgradability, Ease of Maintenance and Efficient Construction.

But, now we've added more reasons to buy Texscan Pathmaker equipment with *Splitband* and *Feed Forward* capabilities.

Our Series 1000 Multiservice Amplifier offers *Split-band* for local area network applications. A single 5-210 MHz amplifier covers a wide area of return bandwidth options, selectable by four different modular plug-in diplex filters. And, the forward amplifier covers from 150-450 MHz to complement any one of the diplex filters you choose. Both the forward and reverse amplifiers offer provisions for either thermal or dual-pilot closed loop circuit AGC.

The Pathmaker *Feed Forward* amplifier also features the modular, drop-in design for ease in upgrading and reduced cost. The Series 2000 Trunk Amplifier will feature *Feed Forward* towards the end of this year. Call your salesman for details.

The Station shown contains: Model 752 covering 5-108 MHz with 12 assigned channels 150-450 MHz with 50 assigned channels.

Model 753 covering 5-120 MHz with 12 assigned channels 174-450 MHz with 46 assigned channels.

Model 754 covering 5-174 MHz with 21 assigned channels 216-450 MHz with 39 assigned channels.

Model 755 covering 5-210 MHz with 28 assigned channels 264-450 MHz with 31 assigned channels.

Texscan Corporation
1440 Goodyear Drive
El Paso, Texas 79936
(915) 594-3555

Texscan CORPORATION

CALENDAR

October

Oct. 1-3: International Construction & Utility Equipment Exposition, "ICUEE/85," Fairfax Airport, Kansas City, Kan. Contact (312) 236- 6470.

Oct. 2-3: Online Conferences Ltd. system security conference, London. Contact 01-868 4466.

Oct. 2-4: Magnavox CATV training seminar, Atlantic City, N.J. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.

Oct. 3: SCTE North Jersey Meeting Group technical seminar, Victors Holiday Inn, Wayne, N.J. Contact Bill Westerman, (201) 353-6157.

Oct. 7-9: Magnavox CATV training seminar, Atlantic City, N.J. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.

Oct. 8-10: Jerrold technical seminar, Pittsburgh. Contact Beth Schaefer, (215) 674-4800.

Oct. 9: SCTE Southern California Meeting Group seminar at Hughes Microwave facilities, Torrance, Calif. Contact Joe Girard, (213) 208-2340.

Oct. 10-11: The Bureau of National Affairs' conference on international telecommunications, The Mayflower Hotel, Washington, D.C. Contact (800) 424-9890.

Oct. 11-13: Satellite Today's Eastern home electronics satellite dish/video expo, Orange County Convention Center, Orlando, Fla. Contact Bonnie Mundie or Dee Botsford, (602) 581-0188.

Oct. 14: The American Teleport Association's second membership meeting, New Orleans. Contact Gerhard Hanneman, (415) 781-1191.

Oct. 14-17: Building Industry Consulting Service International's fourth annual "Telecom West" conference and exposition, Sheraton Scottsdale Resort, Scottsdale, Ariz. Contact Joe Greenberg, (602) 965-1740.

Oct. 15-17: Satellite Communications Users Conference, New Orleans. Contact Kathy Kriner, (303) 694-1522.

Oct. 15-17: Texscan Instruments training program, Indianapolis. Contact Ron Adamson or Brenda Gentry, (317) 545-4196.

Oct. 16: SCTE Delaware Valley Chapter meeting on technical management, Williamson Restaurant, Horsham, Pa. Contact Beverly Zane, (215) 674-4800.

Oct. 20-23: National Cable Television Association legislative conference, Sheraton Grand Hotel, Washington, D.C. Contact (202) 775-3629.

Oct. 21-23: The National Satellite Cable Association/*Private Cable* magazine annual convention, Hyatt Regency, Fort Worth, Texas. Contact (303) 798-1274.

Oct. 22-24: C-COR Electronics technical seminar, Montreal. Contact Debra Cree, (814) 238-2461.

Oct. 22-25: International Council for Planning and Innovation's "WorldCom 85," Hyatt Regency Hotel, San Francisco. Contact (703) 437-0027.

Oct. 23: SCTE Chattahoochee Meeting Group tutorial for BCT/E exam, Holiday Inn Airport/South, College Park, Ga. Contact Gary Donaldson, (404) 949-7370.

Oct. 24: SCTE Florida Meeting Group's BCT/E examination, Holiday Inn, North Lakeland, Fla. Contact Richard Kirn, (813) 924-8541.

Oct. 25: SCTE Cactus Meeting Group amplifier demonstration seminar, Ramada Inn, Phoenix, Ariz. Contact Bill Down, (602) 245-1050.

Oct. 28: Waters Information Services conference on "Profit Opportunities in Data Broadcasting," Westin St. Francis Hotel, San Francisco. Contact Merrill Oliver, (607) 770-1945.

Planning ahead

Dec. 4-6: Western Show, Convention Center, Anaheim, Calif.

March 15-18: National Cable Television Association annual convention, Dallas.

June 12-15: Cable-Tec Expo '86, Phoenix (Ariz.) Convention Center.

AD INDEX

The story of Channel 1

By Robert A. Luff
Senior Vice President, Engineering
United Artists Cablesystems Corp.

On 80 million TV sets and half as many CATV set-tops for as long as most people can remember, the dial begins with Channel 2. So what happened to Channel 1?

What happened and why

As we sit in our easy chairs with a remote control scanning up to 54 channels of high-quality CATV channels, it is hard to envision the first mechanical television monsters of the late '20s with motors and mirrors and disks that started our industry. In 1933, RCA was the first to rid the TV set of motors and gears and mirrors and successfully demonstrate an all-electric TV system. RCA's W2XBS experimental TV transmitter sent the first TV signals from the Empire State Building at approximately 42 MHz, which later became the mysterious Channel 1, although not yet numbered as such.

A year later in 1934, Congress adopted the Communications Act, which established a new federal agency, the FCC, to control the rapidly developing radio and television technology and address the widespread interference between ship communications and early radio broadcasting. In its first year, the FCC moved all new radio experimentation to frequencies above 110 MHz and allocated television to two bands, 42-56 MHz and 60-80 MHz. There were still no channel numbers associated with either of these bands yet.

The depression was at its worst in these years and progress was slow for television. But by 1936, others were joining RCA's TV pioneering efforts, but with their own non-compatible all-electronic systems. The FCC held standards hearings and decided that bandwidth should be universally 6 MHz (RCA's was only 2 MHz), but declined to establish any line or frame rate recommendations. In 1937, Philco gave the first convincing demonstration of a superior working TV system that is the foundation of today's TV system, although the audio was AM modulation since Major Armstrong had not yet invented FM.

Finally in 1938, the FCC reaffirmed two separate TV allocations totalling 19 television numbered channels, each channel with a bandwidth of 6 MHz—and RCA's 42-48 MHz Empire State Building transmitter was refitted and soon officially licensed as the first TV Channel 1.

The TV industry was happy with the FCC's 19 TV channels but had hoped for a continuous TV band in order to reduce the costs of tuner design. Nonetheless, TV flourished, and at the opening of the New York World's Fair on April 30, 1939, RCA demonstrated its commercial TV system to the world with a telecasted address by the president of the United States, and declared that its Empire State Building TV free Radio City Music Hall programming would continue as a public service. In the same year, all large New York department stores offered as many as nine different TV models with screen sizes from 5 to 14 inches and costing $189 to $600. Early sales success prompted RCA newspaper ads announcing the "arrival of television," despite a growing tide against RCA's 441-line system in favor of either Philco's 605-line system or Dumont's 625-line system.

In addition, at UA's now famous Alpine tower site in Alpine, N.J., perched on the high Hudson River bluffs overlooking the New York City skyline, Major Edwin Armstrong had developed FM modulation. Its superior transmission quality spurred many enthusiastic experimental FM transmitters between 42.6 and 43.4 MHz—the low end of Channel 1. Within one year the FCC had over 100 applications for the new FM technology, which it could not process because of the lack of frequencies and harmful interference with TV Channel 1. In March 1940 the FCC gave in to growing FM technology enthusiasts and assigned the continuous band of frequencies between 42 and 50 MHz. FM radio broadcasting began on our Channel 1 on Jan. 1, 1941.

And there went Channel 1! But the story of Channel 1 is hardly over. The TV channels were *renumbered* with Channel 1 now assigned 50-56 MHz (roughly the previous Channel 2 spot) and all the remaining channels shifted up similarly. Needless to say, the TV industry was not happy over the loss of Channel 1 or the reduction from a 19- to 18-channel allotment. The changes in channel frequencies caused most TV broadcasters to go off the air for months to complete extensive transmitter changes. The receiver industry and public confusion that followed resulted in a loss of public trust and a near collapse of an already slowly developing commercial TV industry.

As the TV broadcasters rebounded, they forcibly petitioned the FCC to approve and adopt into its rules a final set of TV standards in order to avoid a possibility of future interruption of television service and obsolescence of public television receivers and public confusion and loss of confidence.

The National Television Standards Committee, NTSC, was quickly formed, and in April 1941 today's NTSC 525-line, interlace, 6 MHz bandwidth, vestigal AM video, FM audio TV standard was adopted and is still in use.

One of the first stations to be once again refitted and go on the air opening day with the new NTSC format was RCA's old W2XBS (now licensed WNBT) transmitting on the new Channel 1 from the Empire State Building. By spring of 1942, only three stations—two in New York and one in Philadelphia—were in full operation, transmitting to 10,000 NTSC television receivers. Then the war came and all new television broadcast approvals were halted by the Defence Communication Board and existing stations were limited to just four hours of transmission per *week*—all devoted to war-related activities.

The war effort as we know brought about an extraordinary leap in communications technology. As the war ended, frequencies once thought to be only experimental, like the TV band, were now in tremendous demand. The FCC was faced with a monumental task. The entire spectrum allocations and uses had to be totally re-examined and revised. Hearings began in September 1944 and the FCC was quickly attacked by TV interests who felt they had waited long enough and should be given ample spectrum to develop. But there were so many other new users of the spectrum to be accommodated that ultimately in June 1945 the FCC was forced to *reduc*e TV's allocation from 18 to 13 channels and move the entire FM radio band from 42-50 MHz to 88-106 MHz (later increased to today's 88-108 MHz), which obsoleted 500,000 home FM receivers! All TV channels were shared with the just developing two-way mobile radio services.

Our TV Channel 1 was still around but moved back to approximately the same 42 MHz spot it had occupied from 1938 to 1940. But, its use was greatly restricted—it could only be assigned as a community channel and limited to 1,000 watts (other TV channels were allowed 50,000 watts).

Even with reduced TV channels and sharing with mobile radios, the TV boom was on. The FCC received many more TV applications than its 13-channel, 400-station allotment plan (one TV station for each major population density area) could accommodate. To provide for more stations, the FCC threw away its "safety factor" of minimum mileage between co-channel and adjacent channel assignments, and by the end of 1947 nearly 175,000 TV receivers were in use selling for an average of $375.

But interference began to develop as a result of too closely spaced TV stations and rapidly increasing mobile services, sharing the same bands. Finally, in 1948 the FCC declared that TV and mobile services could no longer share frequencies and a new exclusive space had to be found for the mobile service.

On June 14, 1948, our TV Channel 1 was deleted from the allocation plan and its frequencies were assigned exclusively to the mobile services. The FCC decided not to renumber the TV channels. Since 1948, TV receivers have started with Channel 2.

And that's what happened to Channel 1!