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THE MAGAZINE OF BROADBAND TECHNOLOGY / APRIL 1990

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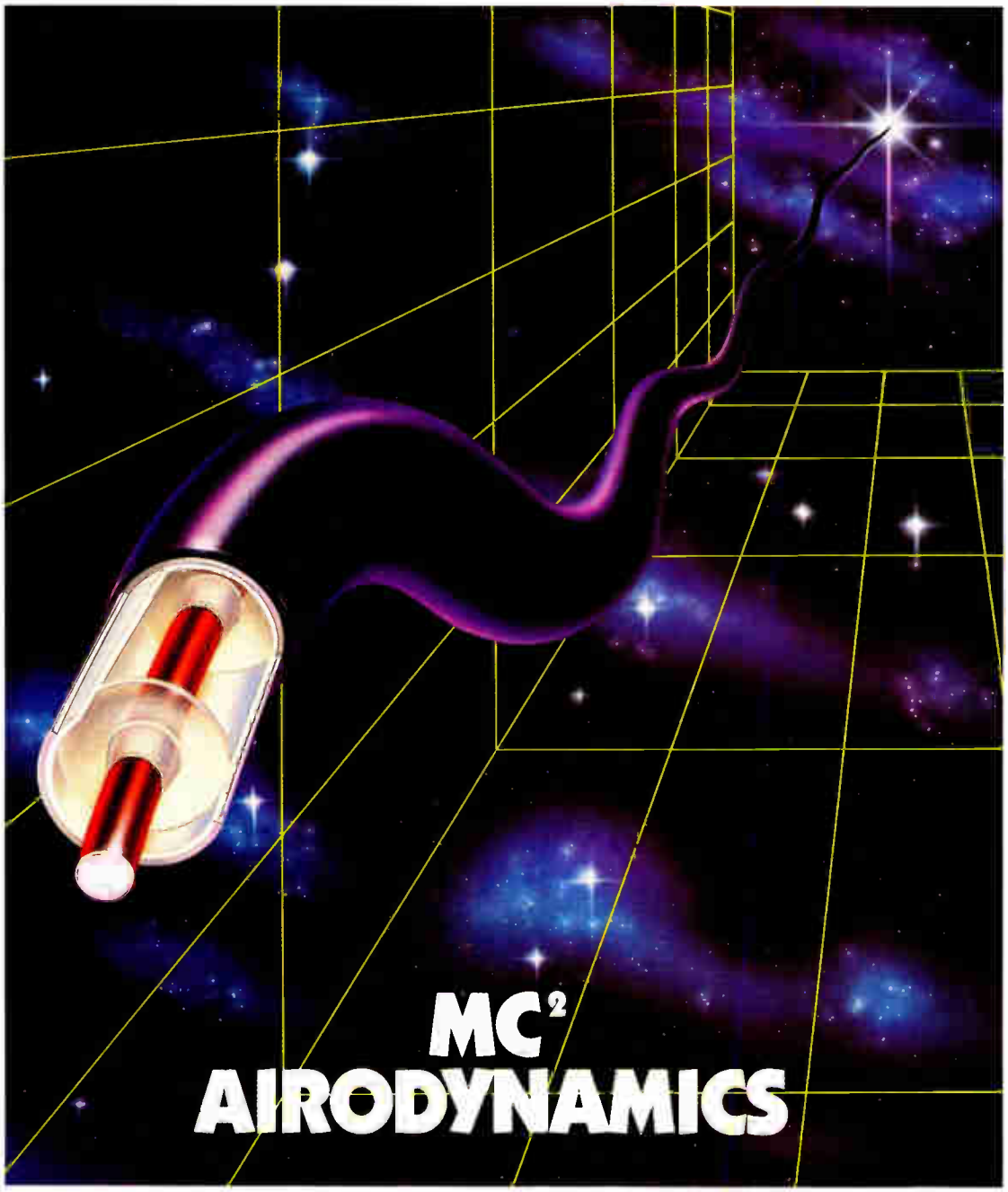

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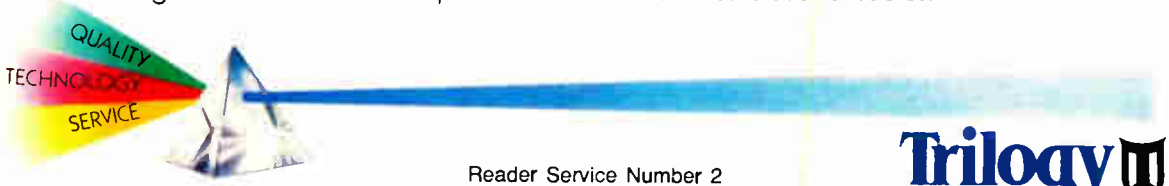

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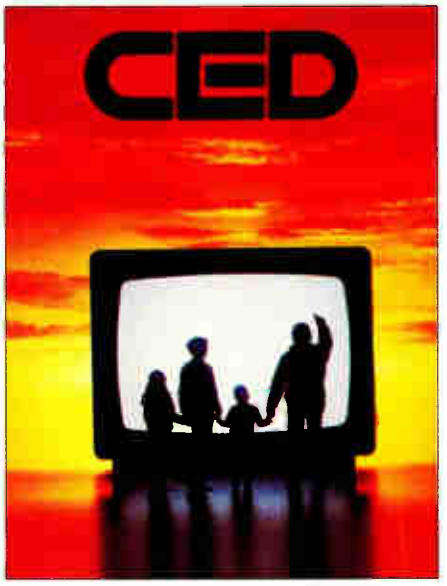
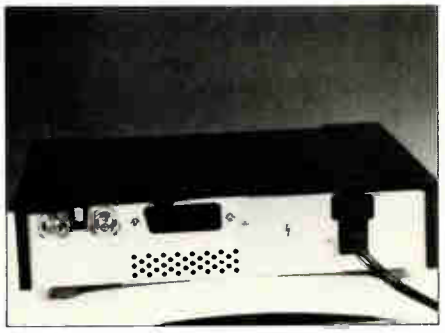


About the Cover:

Making CATV more compatible with consumer gear remains an elusive dream, but one worth pursuing.

A tangled web of interface needs, p. 12



The MultiPort issue, p. 25

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A case for ghostbusters

An age-old specter continues to stalk cable country. Sightings of ghosts are reported almost daily. These are particularly brazen fellers, appearing in cable customer's living rooms rather than hiding in the attic.

These benign cable creatures result from the almost simultaneous reception of the same VHF television broadcast station. One signal is delivered by the cable system and the second, an identical image of the first, is picked up by the cable customer's TV set directly off-air, because of poor electrical shielding in the TV set. Because of propagation or timing differences between the two identical signals, one becomes the "ghost" or secondary image of the other. In cable parlance this phenomena is called DPI or Direct Pickup Interference.

A converter helps

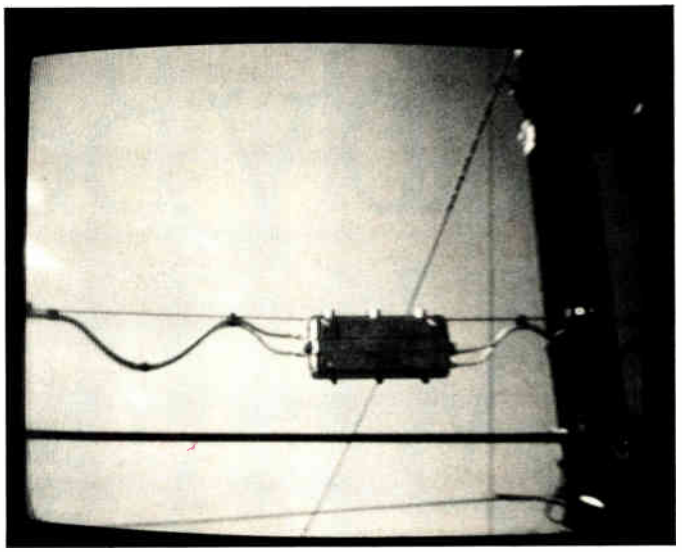
Ironically, in these enlightened times when off-premises and on-premises technology and even the MultiPort approach is seen as the answer to the consumer interface dilemma, the only effective antidote for DPI is the much maligned set-top converter.

The DPI problem is a part of cable's heritage, and set-top converters were used as an early preventive measure for the problem. Other areas of early incompatibility between a TV receiver and a cable TV system were channel tuning capabilities, input signal level tolerances, and scrambled cable services.

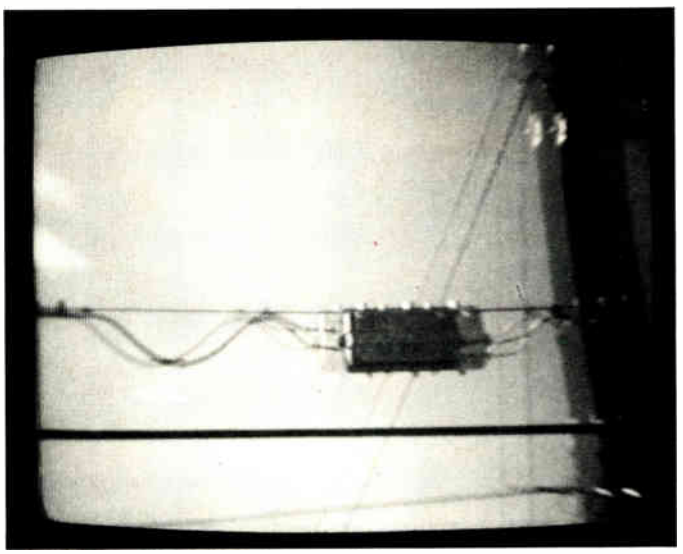
In 1982, a Joint EIA/NCTA Engineering Committee was formed to work on these issues. Represented on this committee were various consumer electronics manufacturers and cable TV companies. The lengthy work of three subcommittees eventually produced a channel identification and tuning standard called IS-6 (currently being updated); the MultiPort descrambler interface, now called EIA Standard 563; and a yet to be completed RF interface standard called IS-23.

One segment of IS-23 deals with the issue of RF shielding in consumer electronics equipment. This RF shielding standard relates to the DPI performance characteristics of a cable compatible TV or VCR. A 1 volt per meter proposal has been "on the table" since 1987. Lacking an applicable U.S. standard, current cable compatible TVs and VCRs are built to a CanAdian shielding standard of 100 millivolts per meter.

By Del Heller, Vice President of Engineering, Viacom Cable



A normal television picture. Photo courtesy of NCTI



A leading ghost, often created by direct pickup interference. Photo courtesy of NCTI

Some performance tests

In 1984, under the sponsorship of the Joint EIA/NCTA Engineering Committee, DPI performance tests were conducted on five then-current brands and models of cable compatible TVs. Each test receiver was connected in turn to a cable system drop and observations were made on the five local VHF stations in the test market for the presence of DPI ghosts. A well shielded set-top converter was first used to determine if the cable system was free of DPI itself and the cable drop levels were adjusted to a uniform signal level of +5 dBmV. All five television receivers had DPI ghosts on the local VHF channels, ranging in intensity from slight to severe.

The ambient field strengths of the five VHF stations at the test site, which was approximately 1.5 miles from the transmit tower, ranged in intensity from 200 millivolts per meter to slightly in excess of one volt per meter. These ambient signal levels are typical to those experienced by cable TV customers in this particular market.

A follow-up test was conducted with these same television receivers in another cable TV system, by additional members of the EIA/NCTA committee, with similar results.

Confusing results

The five test receivers were then subjected to a series of shielding tests in a TV manufacturer's TEM cell. Test results were inconclusive in that no direct correlations could be made in all cases between the results of the field tests and the TEM cell measurements. However, the various tests did demon-

strate to the television manufacturers' representatives that a DPI problem existed and that new receiver designs should be explored. Since that time a moderate improvement in DPI performance has been seen in some television receivers.

Survey says

In 1988 the NCTA Engineering Committee requested that member companies perform a DPI survey of cable compatible receivers in their customers' homes as part of their routine service work. Twelve MSOs, representing 134 participating cable TV systems, responded to the survey; 1,894 survey forms were returned and 633, or 33 percent of the television receivers included in the survey, exhibited DPI on one or more VHF channels.

Since many of the television receivers included in the survey were early model cable compatible receivers (pre-1985) that may not have met the 100 millivolt per meter shielding standard, the television manufacturers requested that the survey list be purged of these early model receivers. Eleven of the 18 major television receiver manufacturers represented in the field survey responded with a list of television models whose initial manufacturing date began after January 1985.

When the 1988 survey list was revised, 70 (33 percent) of the remaining 269 TVs had a DPI problem. Several of the manufacturers not responding to the request for model manufacturing dates represented a substantial portion of the initial receiver count. These manufacturers were not included in the revised list.

Viacom's own research

A recent two-month survey of post January 1985 manufactured cable compatible TV receivers in six of Viacom Cables' systems found 145 TVs with DPI problems during routine service calls. Since our annualized service call rate averages 17 percent in these six systems, with a 270,000 customer base, we might expect to find about 870 customers with DPI problems in the course of one year.

Although the mini-survey suggests that only 1.9 percent of our customers in these six systems may experience DPI problems, our experience has shown a much larger problem than this. Since our DPI tests were incidental to the primary reasons for the service call, the majority of the service calls were not specifically related to DPI trouble.

Our experience has also shown that many customers voluntarily accept slight to moderate DPI in order to retain the convenience of their TV's remote control capability and either reject the option of a set-top converter to eliminate the problem or never call us about their DPI in the first place.

In conjunction with our internal survey, ambient field strength measurements of the local VHF stations were made at random locations in these six systems. Ambient signal strengths ranged from 658 millivolts per meter to 50 millivolts per meter at distances from 1 mile to 8 miles from the transmit locations. In five of the six systems, over 75 percent of our cable customers reside within these distances of the local VHF transmitters.

What was particularly surprising was that although the sixth system is 24 to 27 miles distant from the VHF transmitter locations, the ambient signal tests produced field strength readings ranging from 6 to 50 millivolts per meter, which caused DPI problems on a number of customer's TV sets.

Need cooperative efforts

If we are to see any improvements in the RF shielding of cable compatible TVs and VCRs, an overwhelming amount of evidence indicating the extent of the DPI problem in the cable industry must be presented to the consumer electronics manufacturers. The existing 100 millivolt per meter shielding standard is not adequate for many cable markets.

Another national DPI survey, under the sponsorship of the NCTA or CableLabs, with wide support from the cable industry is needed. Consumer electronics distributors and dealers must be educated about the problem, as well. Although the cable industry has usually avoided the recommendation or endorsement of particular brands or models of TVs or VCRs; perhaps it is time to develop a list of products that perform acceptably when connected to a modern cable TV system.

Problem will continue

Any cable delivery technology that is dependent upon the customer's TV or VCR for tuning capabilities such as off-premises, MultiPort or trap systems, will continue to be plagued with this problem. The only "ghostbuster" we currently have is the set-top converter/descrambler. ■

The consumer electronics

The consumer electronics interface with cable is a problem which vexes subscribers, cable system management and technologies. No one will argue about that. How serious a problem is it? How did we get into this situation? What are the options? And is anything being done about it?

In the past, there was a lot of finger pointing over who is to blame. Cable people felt that consumer electronics manufacturers created the "cable-ready TV" just to increase profits without regard for the subscriber's needs. The consumer electronics industry saw cable as uncoordinated and lacking standards. A consumer electronics product that works fine in one system is a disaster in another. There were areas where the two industries were in genuine conflict.

Some cable operators introduced remote controls as a means of generating new revenue streams. But this practice interfered with the subscribers' ability to use purchased remote controls and with the salability of high end TV receivers. For the consumer electronics industry, this was a serious matter. The business could not survive if only low end products were purchased.

The greatest burden fell on the subscriber. Confusion, frustration and anger were common reactions. The situation appeared hopeless until the cable and the consumer electronics industry came to the realization that our subscriber and their customer were one and the same person. If we worked together, both industries and the consumer could benefit. That work has a good beginning, but a long way to go before the installed base of problems are resolved.

The problem is fundamental

The problem seems to have two fundamental aspects. First, the subscriber often experiences a significant loss of convenience in the use of his consumer electronics equipment when it is connected to cable. Second, the installation and reconfiguration of consumer electronics products and cable have become very complicated.

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

The loss of convenience is evident every time cable is used. It manifests itself primarily through the remote control. Prior to the cable installation, the TV's and VCR's remote control was a handy convenience. But when a cable converter is installed, the subscriber has to deal with multiple remotes; one to turn the TV on and tune it to channel 3, another to select cable channels, and back to the TV's remote to adjust volume or mute the sound.

The VCR provides the most frustration in a scrambled cable environment.

> The requirements for a consumer electronics product to be cable-ready are simple but severe.

With a converter ahead of the VCR, the VCR timer can no longer select the channels to be recorded. Only the channel originally selected on the converter can be recorded without further intervention. A potential solution is the introduction of converters with timers or converter remote controls with built-in timers.

As a practical matter, this approach introduces another series of steps which must be executed flawlessly if a successful recording is to be made. The subscriber is not looking for a challenge to his mental abilities as he tries to set up his equipment to record a program just before rushing out the door to an unexpected event.

The complication of installation occurs only occasionally. It is first noticed after the initial introduction of cable, and then appears each time a new consumer electronics product is added to the home entertainment center or after moving furniture for cleaning or painting. The complicated installation increases the likelihood of implementation errors which will deprive the subscriber of the full functionality of the cable service or his consumer electronics products. This further contributes to the loss of convenience of use.

Cable-ready, simple but severe

The requirements for a consumer electronics product to be cable-ready are simple but severe. The first requirement is that the product must tune the channels of interest to the subscriber. The second requirement is that a quality picture must be provided.

The first part is obvious. All channels which interest the subscriber must be available without the need of an external converter. If just one channel needs the external device, the subscriber might just as well have a monitor! The less obvious aspect is providing the quality picture. There seem to be three major threats to picture quality: 1) direct pickup interference, (DPI) 2) tuner overload and 3) noise. We'll say more of this later.

The first requirement for compatibility can be met in several ways. If the cable system uses traps for signal security or if the subscriber is simply not interested in the scrambled channels, a descrambler will not be needed in front of the TV. Likewise, if a form of descrambler is used which plugs into the back of the TV, a set-top descrambler will not be required. Two examples of this situation are the pioneering Zenith Base-TAC product and the EIA MultiPort. More on this later.

The second requirement is met if the subscriber does not live near a TV transmitter or if he has a well shielded receiver. Otherwise a converter/descrambler is needed ahead of the TV tuner. The remote control becomes almost useless and the subscriber is frustrated.

Notice that this is a situational definition. If a subscriber who had only basic cable service now upgrades to HBO in a scrambled system, his formerly cable-ready TV will lose functionality when a set-top descrambler is added. Likewise, if he moves closer to a TV transmitter, a TV receiver which previously worked satisfactorily

interface with cable

Photo by Don Riley

may start to exhibit ghosts. A converter may be required to eliminate this problem.

I've often said that one of the main problems with the "cable-ready" TV is that nothing in life is ever really ready. Just as things appear to be almost ready, something changes and the readiness is jeopardized. Recognizing the negative implications of cable-ready, some manufacturers have chosen the term, "cable compatible" instead. But "compatible" is a rubber word which is often stretched to meet the needs of the moment.

In the strict sense, compatible means that two things—like a cable system and a cable compatible TV—work together perfectly without loss of functionality on the part of either. In the loose sense, compatible means they both run on electricity. Unfortunately, compatible is used in the loose sense more often than in the strict sense.

Initially, being cable-ready added little cost to a TV. As an inexpensive feature on a premium electronic tuner, it only required memory space in the microcomputer which controls the tuner. The tuner was a big improvement over the old fashioned mechanical "clunker." The extra cost was for the improved tuner, not for the cable-ready feature.

Later, as more and more channels were added, a small increment in cost was incurred as anther set of tuning diodes were added and more memory was required for the microcomputer. Note that electronically controlled tuning is mandatory for practical tuning of cable channels. Can you imagine a 105-channel mechanical tuner? An automobile steering wheel would be needed to turn the dial!

Returning to the challenge of picture quality, we need to consider tuner performance.

DPI is the result of inadequate shielding and is most severe in off-air channels which are carried on the same channel number. Since signal propagation through the cable is slower than through the air, the stronger cable signal is delayed. The off-air direct pick-up results in a pre-ghost which is very annoying. In an Harmonically Related Carrier (HRC) system, the beats between the transmitted carrier and the cable carrier cause severe diagonal stripes which can render the video unwatchable. DPU is the major tuner technical problem in current products.

Tuner overload results in annoying patterns in the viewed picture caused by tuner non-linearities transferring information from undesired signals to the watched channel. Since the off-air situation has few channels, the usual consumer electronics tuner is better able to cope. If the tuner has not been upgraded for the cable application, difficulties may result.

There is an unfortunate trap in all this. The subscriber who has poor pictures when watching the off-air channels through his cable system is likely to get an external antenna. When he switches to the external antenna, he may get acceptable, even great, pictures. Switching back to cable, he finds poor quality video. The obvious conclusion is that there is something wrong with the cable service. There are essentially no subscribers who are sophisticated enough to understand that the consumer electronics product may be at fault.

I've often said that one of the main problems with the 'cable-ready' TV is that nothing in life is ever really ready.

Therefore, the consumer electronics manufacturers get no corrective feedback. They may not even know they have a problem. Conversely, there is no way for a TV manufacturer to gain a sales advantage by investing in better sheilding. It is not easy to demonstrate this phenomena on the sales floor. Ironically, the stronger the off-air signal, the more likely there is to be a significant disparity between the cable delivered and the antenna delivered picture. The strong signal make the antenna picture sparkle while bleeding through when the TV receiver is connected to cable.

Noise is more of a problem with VCRs. In general, the VCR splits the signal so some of it goes to the recording circuits while the rest is bypassed to the TV. This allows simultaneous recording of one channel while viewing another.

A subterfuge exists in some less expensive VCRs. The signal is split unevenly. More signal goes to the recording circuits and less is bypassed to the TV receiver. This does two things. It helps compensate for noise deficiencies in the recording process and it cripples the TV display which is normally the standard of comparison.

Most cable systems have not been designed to accommodate this trickery. Cable signals may also be split to feed a second set. By this time the pictures are quite noisy. An off-air comparison then results in serious trouble.

In the case where set-top boxes have been added after the system was built, the problem is further aggravated. Set-top boxes generally have a poorer noise figure than TV tuners. The premium channel which goes through a set-top, is split for the second TV set and then is tape recorded has strong impediments placed in the way of video quality.

I frequently am asked to recommend TV receiver models to friends. My suggestion is this: I encourage the would-be purchaser to find a retailer who is on the same cable system he is on and a location nearby. Demand to see the receiver connected to cable and check all the off-air channels. If it plays well in the store, it likely will do so at home. The converse is also true. Poor performance on the showroom floor portends trouble at home.

The problem with this suggestion is that many TV retailers either do not have a cable drop or they split and amplify it so much that their signals are awful. It would be prudent for cable operators to work closely with retailers. A complementary drop and technical advice to ensure quality pictures would go a long way to ensuring that subscribers buy receivers which will play well in the home when connected to cable.

The cable marketing department should consider joint promotions. The TV retailer could become an important cable representative. A cable system which carries stereo TV sound on several of its channels could be a great help in stepping up the retailer's buyer to a stereo set. There is mutual advantage to be gained from cable and consumer electronics retailers working together.

What caused this problem?

Originally there was very little difficulty between cable and consumer electronics products. Both were relatively unsophisticated from a technical perspective. There was little need for the two industries to communicate

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with each other. Things worked well.

But as the technology of the two industries separately evolved, numerous options became available to the designers of consumer electronics products and of cable systems. Without standards and without vigorous communications between the two industries, designers in both industries made a variety of choices which were perfectly valid taken one at a time. The trouble arose when these choices were expected to function together.

Cable's contribution to the problem includes a variety of frequency plans in different cable systems and the use of scrambling. Scrambling is a fundamental technique for restricting access to cable programming and thereby insuring that it can be sold. It is likely that scrambling will be part of the cable tool kit for the foreseeable future. None the less, it must be recognized that, more than any other factor, scrambling as done in the past, contributes the consumer electronics interface problems.

The consumer electronics industry's principal contribution to the problem is the failure to adequately shield the internal circuits of receivers from strong off-air signals. The retail segment of the consumer electronics business added to the difficulties by less-than-clear advertising. Certain other actions, such as the addition of new features (which incidentally place additional demands on cable systems) are a proper consumer electronics business practice which, for the most part, benefit the consumers.

These actions are necessary for survival in the highly competitive consumer electronics business. Examples include the "Picture-in-Picture" (PIP) feature which places a small second image on the screen along with the main picture. It is offered in many of the new "digital" TVs and VCRs. PIP requires two descramblers when the subscriber wants both the large and the small image to come from scrambled channels. Manufacturers will continue such innovation in the pursuit of a viable market share. Cable will have to be nimble on its feet and accommodate these technical advances.

Perhaps the most important consumer electronics trend has no technical component. It is simply proliferation. As prices continue to erode, more and more TVs and VCRs will be found in the home. If cable service is to maintain its value to subscribers, it must be available on most of the home's receivers. Otherwise the subscriber will have the sense that, in most cases, he can do without cable. It is not practical to have full converter/descramblers on top of each receiver in the home.

What's being done?

Acknowledging the root of the problem is the separate evolution of the technologies of the two industries, an important steop toward a solution is to build bridges between the industries' engineers. This will facilitate a convergence of the technologies. That is the motivation behind the EIA/NCTA Joint Engineering Committee. The EIA is the Electronic Industries Association which represents the manufacturers, while the National Cable Television Association's Engineering Committee represents the technical elements of cable.

Perhaps the most important consumer electronics trend has no technical component. It is simply proliferation.

This committee was formed eight years ago to provide a forum for engineers who design comsumer electronics and engineers who design and operate cable systems. These technologies communicate on important technical issues and increase their understanding of each other's problems and constraints. A secondary purpose is to arrive at technical standards for the design of consumer electronics products and cable systems which will facilitate satisfactory performance.

It must be recognized that these are relatively long term efforts. The uncoupled technical evolution of the two industries has gone on for quite a number of years. More than 200 million television sets have been placed in U.S. homes and thousands of cable systems have been built without the benefit of adequate communications. There is no escaping the fact that it will take time to overcome incompatibilties built up over such a long period in such a large installed base of products and cable systems.

The NCTA Engineering Committee recognizes the importance of these long term efforts. But it is not satisfied that they are adequate. To alleviate (eliminate is not likely) the problems in the shorter term, a subcommittee was formed under Dave Large, then of Gill Cable. It has compiled and analyzed a set of connection diagrams to aid cable technicians and subscribers in obtaining the best results from their collection of equipment.

This set of diagrams is available from the NCTA Science and Technology department in Washington D.C. It is much too long to be reproduced here. Unfortunately, that fact reveals that even it is not simple.

CableLabs

The EIA/NCTA Joint Engineering Committee remains hobbled by the dependence on volunteer help. All who serve on the committee have full-time jobs. The committee effort must be shoehorned into a busy schedule with a variety of demands. In 1988, CableLabs, an industry R&D consortium, was formed. Now for the first time, full-time staff can be assigned to work on solving the consumer electronics interface problems. The other volunteer work goes on, but it is coordinated with the substantial efforts CableLabs is able to bring to bear.

CableLabs has a variety of projects in the consumer electronics area under the leadership of Claude Baggett. A symposium on consumer electronics was held during the last week of February.

Standards efforts

There are three levels of applicable standards. The most mature standards are in the "RS" series. RS means "recommended standard." Perhaps the most familiar example of this series is the RS232 standard used with computers and data communications devices.

A step along the way to "RS" is "IS," standing for "interim standard". An IS standard is issued on a trial basis for a year or two. During this period, manufacturers attempt designs in order to more fully understand the consequences of the standard's details. After the trial period, the standard is amended to include learning from the past year and voted upon by the EIA for promotion to RS status.

The least mature phase in the devel-

opment of a standard is the "Recommended Practice." It is intended to indicate a direction for manufacturers to choose where there may be many reasonable approaches.

It is important to realize that these standards are voluntary. Neither the NCTA nor the EIA have enforcement powers. Adherences to the standards depends on the good faith of the companies involved.

The channelization standard exemplifies the process of standards creation. Engineers from the two industries met and educated each other on the various methods used to allocate frequencies in the cable spectrum to channel designations. A debate ensued over the pros and cons. Some questions were deferred until more experience was gathered. The interim standard was issued in May 1983. Manufacturers then evolved their product designs toward compliance with IS-6. IS-6 was approved. In late 1989, the committee took up the issue of updating IS-6. The goal is to extend IS-6 into the 1 GHz range and anticipate what high definition television might mean for frequency assignments.

The order in which channels are added when capacity is expanded and a fair method of indicating capacity to the consumer have been agreed upon.

Before the channelization standard, cable companies used numbers and letters to designate channels in a variety of ways. There simply were a number of equally logical ways of doing this and no mechanism to coordinate between those making the choices. A serious consequence of this situation is that it became impossible for consumer electronics product manufacturers to make receivers which complied to multiple channelization methods. Now, with IS-6, cable practice and consumer electronics design can converge over time to the benefit of the subscriber.

It is important to realize that these standards are voluntary.

As mentioned above, there are two requirements for true cable campatibility: 1) the TV or VCR must be able to be connected directly to the cable without a converter or descrambler ahead of it, and 2) the internal circuits of the TV or VCR must not pick up off-air signals directly. The IS-23 standard is intended to set technical specifications that define what is required for a consumer electronics product to avoid DPI problems in the majority of cable installations.

Additionally, IS-23 deals with signal levels, connector types and the allowable level of signals back fed into the cable. The standard went up for vote at the end of 1986. TV manufacturers found its direct pick-up requirement difficult to achieve. They've asked for further clarification and compelling evidence of the need for such a severe standard. This does not mean that nothing has happened in the mean time.

The engineers who participated in the committee have informally made improvements in their designs. There has been a noticeable improvement in DPI performance over the years the committee has been in existence. One major market share brand has made dramatic improvements. Beneficial results are obtained even when a stan-

dard cannot be created because of differences of opinion. Nonetheless, work continues on reaching a DPI standard.

The EIA MultiPort

Perhaps the standard which has the most potential to solve consumer electronics interface problems is the IS-15 Decoder Interface Standard which is also known as the EIA MultiPort. The standard is embodied as a 20-pin plug on the back of a television receiver or VCR which accepts a set-back descrambler. It has been adopted and endorsed by both the EIA and the NCTA. It is now known as the EIA 563 standard.

The principal advantage of the MultiPort is that it makes a truly cable-ready receiver possible in a scrambled environment. Because descrambling is accomplished after the receiver's tuner, the consumer electronics product can be directly connected to cable. The subscriber regains use of his remote control.

In the case of a VCR, the timer again becomes useful. It can again control channel selection an turn the VCR on and off. An important secondary advantage is a significant reduction in cost to the cable operator. Set-back descramblers will be 40 percent to 60 percent the cost of set-top units. It becomes practical to provide two units, one for the TV and another for the VCR. For the first time, it's possible to watch one scrambled channel while recording a different scrambled channel at an affordable price.

A practical limitation of the EIA MultiPort is that is requires the subscriber to purchase a new MultiPort-equipped TV receiver or VCR. This won't happen overnight. Unfortunately, TVs last too long. The typical life is 12 to 14 years. New receivers are bought every seven years with the old unit put in the basement or donated to one of the kids who grew up with it.

Significant penetration will take time. However, the subscriber who feels he needs a solution can contribute to it by making a purchase. Even that was unavailable just a few short years ago. At the present time, more than 1 million MultiPort equipped receivers are in consumers' hands. Two of the three major market share descramblers are available in MultiPort versions with the third brand promised for mid-year.

The situation is dramatically different with VCRs. Because they wear out, VCRs are replaced every three or four years by heavy users. The rotating heads are a critical mechanical element in an otherwise electronic system. They clog and wear, causing expensive repair bills. In many cases, the cost of repair rivals the cost of a new unit. Since the purchase of a VCR more than doubles the trouble with the consumer electronics interface, it is particularly appealing to find that the EIA MultiPort can bring relief when taken as an option on a new VCR.

Other approaches

If we think further about the above mentioned two requirements for compatibility in the consumer electronics interface, we realize that there are other methods for avoiding another tuner ahead of the TV or VCR. These methods are based on providing a broadband feed into the subscriber's home. "Interdiction" is applied to the channels the subscriber has not chosen. All other channels are "in the clear". Two methods are currently being actively pursued in the cable industry: a jamming method and a trapping method.

> The principal advantage of the MultiPort is that it makes a truly cable-ready receiver possible.

Scientific-Atlanta and The Paragon, an MSO encompassing many of the former Group W cable systems, are developing an off-premises technology which jams the channels the subscriber does not want. In addition, the entire service may be turned off at the tap. It is a fully addressable technology.

From a consumer electronics interface perspective, its virtue is that no tuners are put in front of the TV or VCR. The subscriber's purchased remote controls do their intended job and the VCR timer is fully functional. While there are some technical hurdles, they do not seem overwhelming. The principal challenge with this approach is economic. Because the hardware must be installed outside the home of every subscriber, the up-front cost is a serious consideration.

The trapping method is featured by TCI in its "on-premises" approach. Special, high tech traps are installed in a "tamper evident" cabinet on the side of the house. Initially, the approach is not addressable. However, the "hooks" have been installed in the design to allow future upgrading to addressibility if the business needs dictate. As with the off-premises approach, the subscriber gets a broadband feed with authorized channels in the clear. The consumer electronics interface is well served by this approach.

In both the on- and off-premises approach, the consumer friendly purpose can be frustrated if the consumer electronics product is susceptible to direct pick-up. DPI can become a spoiler which requires a converter ahead of the TV or VCR in strong signal environments.

A strategic view

As the cable industry prepares for increased competition from other delivery media, it is important to maximize all its possible advantages. Other delivery media that depend on digital or FM modulation of their signals have a distinct disadvantage compared to cable. Television receivers and VCRs are designed for AM inputs. When the signal arrives in a different form, a conversion is required. That conversion invariably requires a box to be put on top of the TV or VCR.

This is fundamentally consumer electronics unfriendly. Cable is the only major multichannel media which can be designed to not require this interference with the convenience of use of the consumer electronics products. It is important for cable to recognize this advantage and to maximize it.

Conclusion

A lot of progress has been made. Communications between the cable and the consumer electronics industries has increased and improved by several orders of magnitude. The result will be greater satisfaction with cable service as enjoyed through subscriber owned consumer electronics products.

However, we must have realistic expectations. There are about 200 million television receivers in American homes that were designed before standards were accomplished. It will take time for these to be replaced with more compatible models. But that eventual goal would have never been attainable had it not been for the work of the EIA/NCTA Joint Engineering Committee and CableLabs. ■

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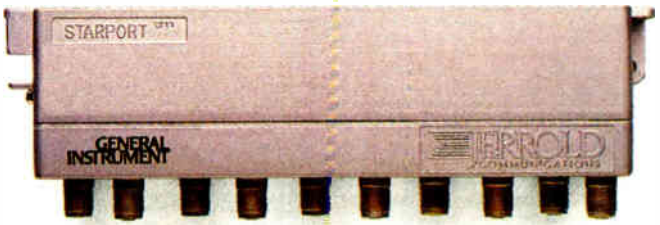

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The evolution of the CATV converter

How the 'little black box' became a high-tech addressable descrambling 'terminal'

Nearly a quarter of a century ago, converters were introduced for the first time. Until then, television reception technology developed entirely in the over-the-air broadcast environment with almost no coordination with cable TV delivery systems or any other potential uses for the TV display component.

Converters were first introduced in the Manhattan Borough of New York to overcome the direct pickup interference from seven VHF stations transmitting from the Empire State Building. Hubert Schlafly, then engineering vice president at Teleprompter, attempted to persuade TV set manufacturers to provide an externally accessible IF jumper so the converter could be connected directly to the receiver's IF instead of through the leaky 300 ohm TV antenna terminals and another tuner.

As a result of the research into the matter of immunity to interference from strong local co-channel signals by the Cable Television Advisory Committee to the FCC, the Electronic Industries Association published a bulletin in 1975 regarding this and other aspects of compatibility with CATV. However, the IF jumper was not discussed and the bulletin never reached the status of even an Interim Standard which would have been subject to rigorous public review.

By George Sell, Contributing Editor

However, receiver manufacturers did begin to provide 75 ohm coaxial input ports. Possibly motivated as much by a desire to improve color reception off-air as to relieve the cable direct pickup conundrum, this helped some. But, because of design flaws, many of these ports turned out to be more or less ineffective.

Perhaps the most disturbing misunderstanding between the two industries came when set manufacturers began marketing the the so-called and much touted "cable-ready" television set, which was "ready" only for non-premium cable customers. The receiver folks genuinely believed they had created the cable-compatible receiver everyone wanted. They were incredulous when they discovered cable operators continuing to install the noxious converter boxes even in front of cable-ready sets.

This is not to mention the angry cable subscriber's response when he discovered, after purchasing a top-of-the-line and expensive TV, that the special conveniences of the remote control were rendered almost useless by a cable connection. And, when they attempted to introduce a videocassette recorder with its own complex features into this mix, there was undoubtedly some hair pulling in the family viewing area.

Although initially intended as an interim solution to an interface problem that was not expected to remain, the low-tech and ubiquitous converter box has operated well for the industry and has evolved, along with the receiver, to become a very complex device.

And, although it may someday be replaced by MultiPort or some form of off-premise conversion scheme, the set-top converter (or as some prefer to refer to it, an "addressable converter/decoder/descrambler terminal," reflecting its high tech nature), still serves millions of consumers.

Don't touch that dial

Convincing the cable subscriber to leave the set tuned to one channel,

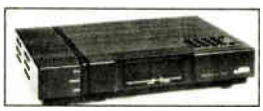
Milestones in converter evolution

1969 Teleprompter uses the first converters to overcome off-air Manhattan interferance. Devices tune non-standard channels.

Jerrold's Starsound MTS stereo adapter

1976 TV receiver manufacturers install 75 ohm input ports.

1977 Pioneer develops two-way addressable converters for Warner's QUBE systems with wired remote control, parental discretion, and power sensor.



Jerrold's Starfone add-on IPPV unit

1979 Hamlin/Regal digital converters with remote control debut.

1982 Jerrold offers automatic frequency control converters.

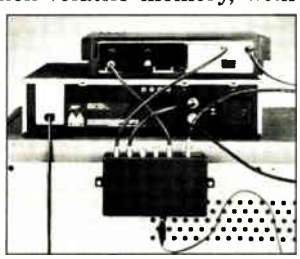
1982 Oak's TC-56 converter with infrared remote control, favorite channels memory is introduced.

1983 Jerrold develops Starcom V baseband addressable converters with remote control and VCR timers.

1984 Broadcast MTS stereo introduced. Many converters were already compatible including S-A, Pioneer, Panasonic and Hamlin.

1984 Scientific-Atlanta develops converters with VCR programmable remote.

1984 Oak offers Sigma baseband encryption, non-volatile memory, with volume control, last channel recall, and parental control.



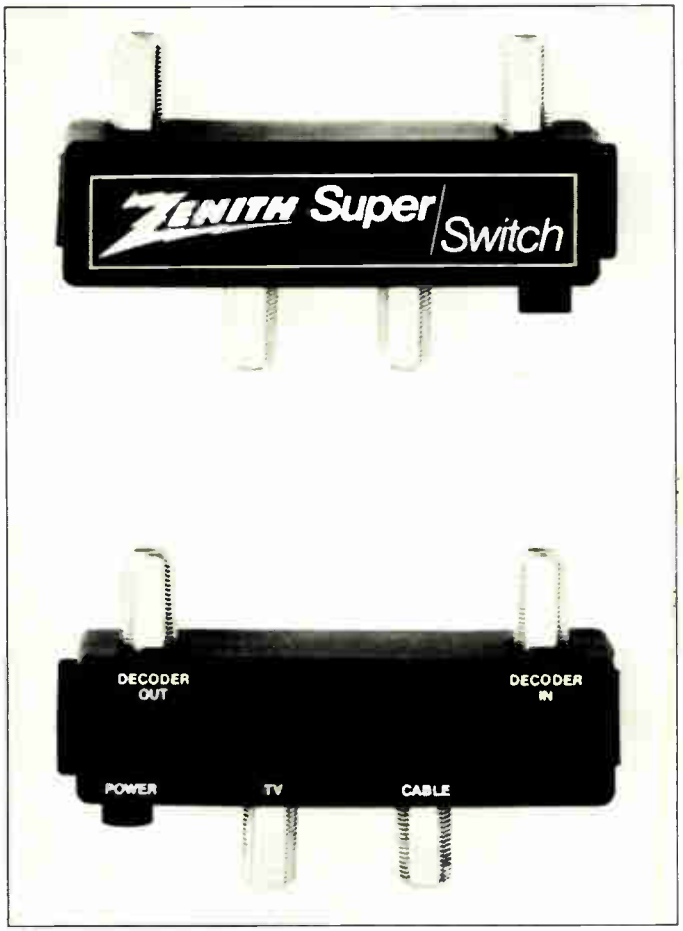
Zenith's VCR interface switcher

1984 CATV industry impacted by BTSC stereo recommendations.

1985 Stereo-capable and cable-ready TV sets hit market. Converter sales begin a steady decline at approximately 10 percent per year.

usually either channel 3 or 4 as determined by the cable operator, was an early problem. For almost 30 years, consumers had changed channels by reaching for the rotary selector knob on the set. This habit was hard to break. All household members had to be made aware of how cable service worked because as soon as someone attempted to change channels the old way, they often thought the system had malfunctioned and were on the phone to the cable company requesting a service call.

But many cable systems did experience actual and frequent outages in the early days and viewers often disconnected the converter at those times. Because of this, some operators introduced an A/B switch, allowing selection between the converter and an off-air rabbit ear or roof top antenna.



Zenith's SuperSwitch allows pay-TV subscribers to use their remotes without flipping a manual A/B switch

The matching transformer

Matching the converter's 75 ohm output to the receiver's 300 ohm VHF input required a transformer. And since the older TV sets, especially black and white receivers, generated strong electromagnetic fields from the picture tube yoke that interfered with the converter's tuning, better shielding of the RF tuner was required.

Distortion caused by additional channel loading was difficult for converter manufacturers to conquer. Also, working with two fine tuners was an early problem. Adjacent channel filtering in the earlier sets was poor. Lacking automatic frequency control (a later innovation) both in the set and in the converter, either the set or the converter, or both, tended to drift off frequency.

Then came the videocassette player/recorder. Where do you put it? Enterprising cabinet makers saw an opportunity here and some made a small fortune designing and building units for home entertainment centers. There was a space for the set, a shelf for the VCR, some shelves for the stereo components, a compartment for records and tapes, and maybe a shelf for the converter. Or, perhaps the converter might be sandwiched somewhere among the bowling trophies and plastic flower arrangements.

And, to get it all to work properly, it seemed at the time that two converters might be necessary, one for the TV set and one for the VCR. How else could the consumer watch one channel while recording another? How could the viewer deal with recording scrambled premium channels while watching either a non-scrambled or scrambled channel? Introduce the video game and you really got a confusing mess!

The first difficulty of integrating the VCR with the TV set and converter was wiring configurations. The question was where to place the VCR in the wiring line-up. The solution, albeit an unsatisfactory one, was to integrate the VCR between the converter and the set. The incoming drop cable was connected to the converter's input port. From the output port of the converter, a cable was run to the input port of the VCR. The VCR's output port had another cable, then, leading to the input port of the TV set, if it had one.

This meant, of course, that most of the control features of both the set and the VCR might be rendered useless. If the VCR did not pass the signal transparently when turned off, you were in real trouble. Many cable operators offered VCR wiring along with initial installation of cable and some specified how all VCR wiring should be done by their subscribers.

Once connected, customer service reps and service tech's headaches were just beginning. Given the multiplicity of wiring configurations, much of the time a service call actually took was in first figuring out just how they did it.

And, the VCR, in many homes, either introduced the remote control for

S.A.'s approach to VCR switcher

1985 Pioneer has its BA-5000 line with VCR timers.

1985 Scientific-Atlanta brings out the VCR switcher.

1986 Oak's Sigma line now has VCR time shifter, on-screen display.

1987 Oak Optional version with integral MTS decoder, addressable volume controlled left/right baseband audio and video outputs.

1987 Pioneer offers the SmartRemote, programmable for various features.

1988 Pioneer's BA-6000 line now has VCR Filter, providing both descrambled and non-scrambled broadband signals to TV and VCR.

1990 Oak's Sigma 2000 line with videophile options including an RF bypass switch making converter transparent unless watching scrambled channel or if set has no remote.

Oak's Micro 550, a 550 MHz, 83-channel remote control converter

1991 CATV industry develops switched bypass transparency, MultiPort and off- or on-premise conversion/interdiction schemes.

the first time or introduced a second remote control, thus inaugurating the multiple remote control problem. Trying to find the correct remote control among the newspapers, magazines and empty bags of chips or popcorn on the coffee table, or down in the cushion of the sofa, became an unhappy evening happening in households across America.

Since the old electro-mechanical converters took away the functionality of the TV set's and VCR's remote controls, converter manufacturers began a harried effort to deal with the problem. When Warner Cable proposed its QUBE systems, it looked to Pioneer to develop a state-of-the-art converter.

Digital and addressable

Beginning in 1977, the Warner QUBE systems utilized the Pioneer two-way addressable converters which included such advanced features as a wired remote control and a parental control feature for prohibiting display of unauthorized scrambled programming. Also, a power sensor on the convenience outlet for the TV receiver told the QUBE headend when the set was turned off even though the subscriber had left the converter tuned to an impulse pay-per-view channel. This avoided false billing for sequential IPPV programs.

The first digital converter with remote control for the general CATV market was introduced by Hamlin USA (Regal) in 1978. By 1981, when this writer assembled the first *CED* "Product Profile," it was decided to feature converters. There were 17 different digital addressable converters available and, of course, a whole slew of block converters and non-addressables.

Some of the better ones had advanced features such as Zenith's Z-TAC with full remote control, and incorporated baseband video and audio output. Sylvania's 4040 offered 16-channel storage and recall, Oak's Dimension II units had multiple tiering, polling and stolen unit deactivation. Pioneer's VIP system had an optional teletext with hard copy print-out and microcomputer adapter. Tocom's 5510A also had teletext and graphics capability along with 24-hour emergency alert and on-screen channel identification. And 400 MHz was the sky-high reach that all attained. Hamlin's SPC-5000 could actually handle up to 440 MHz.

With the competition hot and heavy, and advances coming seemingly every month, some manufacturers sought to avoid rapid obsolescence by making their units modular for future upgrading. One such unit was Scientific-Atlanta's Series 6700. And Texscan was promoting its TRACS system, an early version of pole-mounted, off-premise conversion.

There was much talk about advanced features such as videotext, interactive shopping and banking from the home, opinion polling, computer interfacing and "smart homes." These were the heady times when cable was hot stuff.

Stereo-compatibility

The ad slogan of the day was "I want my MTV" and MTV wanted stereo. So did pay-per-view and special events programmers. Seventy-five million homes had stereo equipment in 1984 and, according to U.S. Census figures, music-listening ranked behind only television watching as the most popular household activities. The marriage of TV and stereo audio was a natural. One survey showed that 93 percent of basic cable subscribers also owned stereo equipment in 1984.

Pioneer's BC-4000 converter boasted a wireless remote control

Simulcasting had been done quite often by now but not always to everyone's satisfaction. And, simulcasting with thousands of local FM stations for nationwide viewing events was a producer's nightmare.

Multichannel Television Sound (MTS) was authorized in 1984 for broadcast. Cable was already able to deliver 14 cable networks in FM stereo, all local broadcast stations that had stereo audio, and all stand-alone music services. Zenith, a pioneer in the development of MTS stereo, was among the first to introduce stereo-compatible baseband addressable converters and a retro-fit program for modifying earlier models.

Passing stereo signals, after BTSC stereo recommendations were announced, was not a problem for many converters, especially RF converters. Descrambling systems were the problem as well as the baseband low pass filters employed to limit the audio to a maximum of 15 kHz and to minimize distortion. BTSC signals traveling through baseband converters had their pilot, stereo difference channel, SAP and any other subcarriers stripped by the low pass filter. If volume levels were set high enough, enough of the pilot carrier might pass through to the receiver and trigger the stereo decoder in the TV set. This could result in noisy, possibly distorted audio.

Add-on adapters proliferated initially. Jerrold's converters, including baseband units, were made BTSC stereo-compatible from 1986 on, as were Panasonic's. Oak introduced an optional product in 1987 with integral MTS decoders and volume controlled left/right baseband audio outputs and this unit is still in production.

Timing the VCR

Problems integrating the VCR continued until the mid-'80s when adaptor switches or VCR interfaces were introduced by Qintar, Zenith, Panasonic, JNEL/CableMaster, and Archer/Radio Shack. Scientific-Atlanta integrated a VCR switch in some units at this time.

But the primary converter/VCR problem that needed to be attacked was recording pay and non-pay channels while watching another channel or timing the VCR to record pay and non-pay programming unattended. Since the pay programming signal required the addressable descrambler to be authorized from the headend, the timer clock function had to be integrated into the converter itself.

Pioneer introduced its BA-5000 converter in 1985 with its own VCR timer. The timer clock could be enabled/disabled from the headend and refreshed about once every minute. The feature also could be used for morning wakeup, late-night shut off and event reminders.

Also that year, Zenith made its TAC-TIMER programmable remote control available. While functioning as a

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full featured remote and was fully compatible with any existing Z-TAC system, it could also allow recording of different channels at different times. The TAC-TIMER worked with any VCR and could program up to eight events in 14 days.

Oak's Sigma line of converters included a VCR "time shifter" feature after 1986. This programmable clock, with the time of day downloaded by the system computer, never needed setting by the subscriber, just the desired channel and time to tune. Sigma also went to an on-screen, five character, alpha-numeric display. Since word prompts were used (and still are) instead of codes, this feature helped subscribers use the timer and IPPV functions.

Not ready for cable-ready

Amid this hyper creativity and proliferation of bells and whistles, cable-ready TV sets were introduced by the receiver manufacturing industry. Cable TV had finally been recognized by the set manufacturers.

In spite of the fact that many of these top-of-the-line units were able to tune the full range of non-standard channels that cable provided at the time, the cable industry reacted with mixed emotions. At technical sessions held at cable conventions, whenever the words cable-ready were mentioned, they were always prefaced with the words "so-called," and often with a cynical tone of voice.

When the cable industry continued the practice of using converters, this "gift" to the industry seemed to be ill received, or so the set manufacturers thought.

Actually, cable-ready sets were "ready" for basic cable but not for scrambled pay and pay-per-view signals. We still could not dispense with the addressable converter/descrambler.

With the exception of a buying frenzy in 1987 stimulated by deregulation, the non-addressable converter's market has steadily declined since the introduction of cable-ready sets. According to Steve Necessary at Scientific-Atlanta, that decline has been about 10 percent per year.

Apart from leading to the slow death of non-addressable converters, cable-ready sets renewed the quest for consumer interface solutions with the still necessary addressable units. The primary impact was to highlight the need for consumer-friendliness of the cable interface and technology to accomplish this.

MultiPort

The MultiPort solution, a device fitting on the receiver's input port that would allow for the connection of the TV set and VCR without an addressable converter, has been debated for years now. In the beginning, naturally, the converter manufacturers were publically skeptical, and some remain so.

The MultiPort approach grew out of the EIA IS-15 (for Interim Standard number 15) handed down in early 1986. This baseband video/audio connector, analogous to the RS-232 for computers, was a 20-pin connector that would accept any and all peripheral NTSC or RGB inputs. Converters would be necdessary until such time as integrated IS-15 receivers penetrated the marketplace.

Since IS-15, there has been a continuous design evolution down to today's MultiPort proposals. MultiPort supporters hope it will handle the addressability requirement without the external set-top box, which many hope will eventually be integrated inside the receiver circuitry.

Some converter manufacturers complain that while MultiPort solves many of the problems it was designed to solve, it still requires substantial investment in hardware in the subscriber's home by the cable operator and will take a long time before significant penetration occurs. The price of MultiPort devices will come down. Already they are down from the $300 range to around $100. The hope is to eventually have a MultiPort device that will be produced at a low cost such that it could even become a throw-away type of device and sent by mail to subscribers.

Zenith (through a proprietary version called Redi-Plug) and Jerrold were the first manufacturers to actually ship MultiPort devices last year. MultiPort, to work, also needs plugs built into the TV set or VCR. RCA, Panasonic, Quasar and General Electric were the first set manufacturers to ship sets conforming to MultiPort specifications, and Bang and Olufsen has shipped the world's first MultiPort VCRs.

Interdiction without traps

While skepticism about the market for MultiPort continues among converter manufacturers, some have resisted its development and, instead, have concentrated on off-premise and on-premise conversion schemes. Scientific-Atlanta, following intense industry pressure, has reluctantly agreed to build MultiPort units but devotes considerable R&D efforts toward off-premise addressability.

Other manufacturers are going ahead full steam with various versions of off-premise or outside-the-premise systems. Jerrold has what it refers to as an addressable on-premise system called Starport. Raynet, Midwest CATV, AM Communications, Eagle Comtronics and Blonder-Tongue Laboratories have their versions as well. Some are pole-mounted or side-of-the-house configurations. Some rely on addressable traps and others, like Scientific-Atlanta's, use an interdicting carrier that jams the signal the subscriber isn't authorized to receive.

In all cases, the broadband signal eventually entering the home is what the subscriber is supposed to receive and can therefore use all his consumer electronics devices as they were intended to be used including splitting the signal anyway he wishes. In some rare cases, of course, an in-home amplifier might be needed if the signal is split too many times.

But, bottom line oriented cable operators may resist outside-the-home architectures. With re-regulation possible, and if renewed tiering of services is the result, off-premise control could become less attractive. Also the loss of revenues from remote control rentals impacts some operators as does the powering requirement of off-premise systems.

Even with out-of-the-home addressable conversion, converters will be required for subscribers without cable-ready TV sets or cable-ready sets that do not tune all the channels the cable system offers. A new feature of converters that may soon receive a lot of hype is the bypass switch that allows the transparent passing of non-scrambled signals through the converter to the set.

Acknowledgements

The author wishes to thank those who "interfaced" with him on this article: Steve Necessary of Scientific-Atlanta, Gaylord Hart of Hamlin/Regal, Tony Wechselberger of Oak Communications, Jim Slade of Panasonic, Dan Moloney of Jerrold, Larry Cooper of Pioneer, and Vito Brugliera and John Taylor of Zenith. However, any inaccuracies or omissions are my own. ■

MultiPort's economic and business impact

When it comes to signal security systems for cable television, the old addage that "Nothin' works everywhere, but everything works somewhere" certainly holds true. Just about every perturbation of every concept has been tried at one time or another, and some of them even work, at least technically.

But, technical ability is not enough. Don't forget dBs, as in dollar bills. This is the sad truth about many of the systems yet devised. The technology is solid, but the installed cost limits their applicability to a smaller market share, thus making the whole venture less palatable to the manufacturer. But even if the technology and dollars are right, we still have the problem of being able to fulfill the needs of the system, and the tastes of the subscriber. In other words, if the security system can only handle four pay services, and the system requires eight, it doesn't work. If subscribers would rather cancel their pay services and use the local videotape store rather than have a set-top converter in the home, it doesn't work.

How we got where we are

We got into this whole mess by devising service formats which have differentiated availability. In other words, we don't generally treat all channels the same, except in those large urban systems where all channels are scrambled. Second only to this in its impact upon our consumer interface is the advent of the so-called "cable ready" television receiver. I say "so-called" because, as you well know, the sets are not cable-ready. In general, they don't tune enough channels, they don't contain a decoder unit, are not addressable by the headend, and have relatively poor shielding around their single conversion tuner, giving rise to the Direct Pickup Interference problem where the off-air signal interferes with the same channel on the cable.

It didn't take long to learn the difference between supply and demand security, however. If you have a low penetrating pay service, you secure it in a fashion that only impacts those customers who actually subscribe to it. If you have a high penetrating service, you do something to those subscribers who don't take it. The problem is, that, generally speaking, the level of security is not equal between supply and demand systems. The best example is negative vs. positive trapping. You negative trap the high penetrators, positive trap the low penetrators. But positive traps are much easier to defeat.

The other factor to consider is how gracefully the system can be deployed. If you have to double-carry pay services during the transition, or some other such ploy, there is a lot of negative impact to system efficiency and, what's worse, usually to the system's bottom line during the process. If the system requires a major rebuild, or even just an extensive repowering, the cost of transition is often more than the benefits can carry away.

From the front, Jerrold's MultiPort looks a lot like a converter...

A more graceful deployment?

Let's examine another security approach, called MultiPort. Perhaps it's not really a new approach, but just an old approach in a new suit. The MultiPort unit is nothing more than a standard addressable baseband decoder card, along with its associated power supply and communications subsystem, in a small box. What is eliminated is the tuner circuitry and the human interface elements, such as the IR sensor and the channel read-out. The box is not hooked into the signal stream in front of the TV or VCR, but just after the consumer electronics tuner. Thus, the tuner and the human interface elements of the consumer equipment is used, and not replicated as in the case of the set-top converter. The box itself ends up stuck behind the TV or VCR, out of sight and out of the subscriber's mind.

The use of MultiPort requires a special plug on the back of the consumer hardware. A lot of work by the NCTA/EIA Joint Engineering Committee has arrived at a standard for this use, which is known as the EIA-563 plug. There are several thousand MultiPorts in the field now, although in fact they are actually manufacturable prototypes and are in no way optimized as to size, reliability and cost. For those of you who may not know, the EIA, the Electronic Industries Association, represents all of the consumer electronics manufacturers, both here and abroad.

Since the units in the field right now are prototypes, let's talk instead about

By Claude Baggett, Director of Systems Engineering, CableLabs


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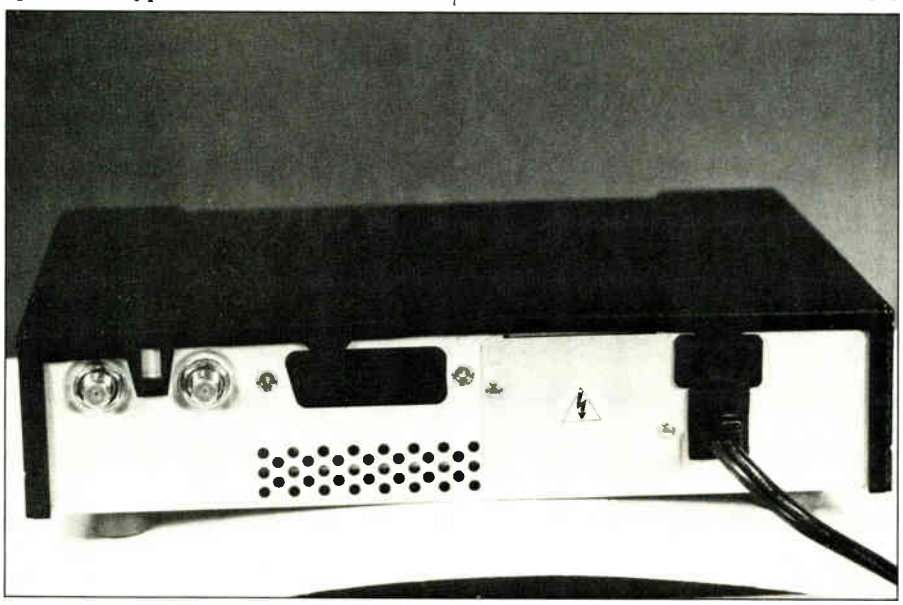
what MultiPort could be if it catches on in our industry. The following numbers are generally agreed upon by the big three (Jerrold, Scientific-Atlanta and Zenith) and represent a useable unit to our industry.

Size wise, the ultimate VLSI unit could be about one inch by two inches by four inches, and weigh but a few ounces. The current models have a thick umbilical which connects them to the television set or VCR via the EIA-563 plug. In the future, this costly cable can be eliminated by using a "poke-on" type connector on the MultiPort, with some kind of a captive device on the consumer gear. This makes the MultiPort a true applique unit and further protects it from accidental harm.



...But from the back, the difference is readily apparent.

Eliminating the above mentioned circuitry and the need for direct human interface, and placing the unit in a more protected environment can mean a much greater mean time between failure (MTBF). If the current generation of decoder cards were redesigned for the best available level of VLSI, most manufacturers feel that the MultiPort could have a MTBF about equal to the television set, or about seven years, with a total useful life of perhaps double that number.

Once again, because the MultiPort is a much simpler device, the cost is also considerably below that of compatible set-top units. It is estimated that a MultiPort would cost the cable operator about $50 plus $10 in full production. This is about half the cost of a typical addressable set-top converter today. I don't know whether this means that our invested capital in the subscriber home is cut in half, or if more television sets in the home have addressable decoders associated with them. Time will tell.

Ramp-up of consumer products

As is the way with all things, nothing is perfect. MultiPort has one problem over which we have little control. Its use depends upon the consumer gear having the appropriate plug installed during manufacturing. I have learned from the manufacturers that this costs them between $3.50 and $10, which is pretty big money in the eyes of the consumer industry.

Their problem is compounded because they can't really show how MultiPort increases the market share of their hardware. However, if the retailers who sell their sets tell them to put it on, it shall be done. This is why we are encouraging cable systems to work with retailers in their franchise area in order to increase demand for plug-equipped sets. This is the only sure way we can have a favorable impact on the manufacturers.

Well, what does this mean? It means that the ramp-up of plug-equipped sets is likely to be rather slow. Indeed, because television sets typically last 13 years, about half that as the primary set in the house, new features are always slow to be dispersed when compared to the total number of television homes. But remember earlier when we talked about graceful deployment? Well, if you are using addressable set-top units now, there is no reason why you can't deploy MultiPort on an indescriminant basis in your systems. They are virtually interchangable. (I say virtually, because those security systems which send control data out in the VBI require an RF modem to place the same data on a separate data channel, usually located around the top of the FM band. This is required because the MultiPort sits behind the television tuner, which does not pass the VBI.)

The bad news is that it could be 5 to 7 years before there is an adequate penetration of plug-equipped sets in our systems for MultiPort to have the total beneficial impact possible.

Self-targeting problem subscribers

The good news is that plug-equipped sets seem to be self-targeting on that cable subscriber who will most benefit from using MultiPort. I must introduce you to the concept of the "problem" cable subscriber at this time. In fact, this subscriber is a very good customer and usually a real videophile. The problem subscriber usually takes 2 to 3 pay channels, does a little pay-per-view on occasion, and, although highly irritated about it, rents a remote to control his set-top addressable descrambling converter. This customer is ready and able to pay the extra bucks to eliminate the set-top and quit renting the remote by buying a plug-equipped set. Of course, as an operator, you better have the MultiPort units ready, or you might lose another good customer to the tape stores.

How MultiPort looks financially

I always hestitate to use hard numbers when describing the net present values of some new thing to representatives of different cable companies. The problem is that no two cable companies agree on the assumptions which go into the calculations, thus they all end up with different answers. In the case of MultiPort, we ran the calculations for a wide variety of assumptions, and found that, although the real numbers might change, the relationship to competitive technologies does not. MultiPort, primarily because of its lower capital cost per subscriber and its addressability features, just represents a better deal to the operator.

Now I brought up one of the big issues about using MultiPort earlier. The subscriber can use the remote which came with the TV or VCR and isn't forced to rent one to control the

set-top converter. This has a negative impact on an operator's remote revenues.

But it may not be all that bad after all. Remote revenues seem destined eventually to go away anyhow. If you look at the growth of universal remotes, both aftermarket and those that now come with the upper level consumer gear, you will find that this ramp-up is much greater than the ramp-up associated with MultiPort deployment, thus having a greater impact on remote revenue loss by far. Also, some operators have been able to charge a small additional monthly fee for MultiPort as a value added service to the subscriber, thus off-setting all or some of the loss. This is another time-will-tell issue.

> In most cases, the engineers do not determine the future strategies for consumer products.

The Joint NCTA/EIA committee

The efforts of the Joint NCTA/EIA Engineering Committee have been very beneficial to both cable and the consumer industries. A lot of credit goes to those who first saw the potential and then worked to make the dialogue take place. The committee is working to finish canonizing the EIA-563 plug standard, defining the channelization out to 1 GHz, striving to convince the manufacturers to replace their current tuner technology with an implementation that is less susceptible to off-air interference, and looking into value-added ways that future subscribers can meaningfully tune and use 150-plus channel systems.

As good as this effort is, it is not enough. In most cases, the engineers do not determine the future strategies for consumer products, this being the domain of the product planners and marketing personnel. One of the main thrusts for the CableLabs effort in this area is to open new dialogues with these individuals. It has been difficult because we, the cable industry, do not buy many television sets. In other words, we have different customers and different requirements.

Joint ventures with retailers

Having tried hard to directly influence the manufacturers without a great deal of success, we think we have found the key to injecting a little cable influence into the planning process. Use the retailers. It all makes such good sense in retrospect, I wonder why we didn't see it earlier. The local electronics retailer has the same customer to make happy that we do, and the interface problems between the consumer equipment and the cable system causes them just as much problem as it does us. Remember, no matter how good our system may be, it must go through the consumer equipment before getting to the eyes and ears of the subscriber. So it is beneficial if we work together.

These joint venture efforts are being tried successfully in such diverse areas as San Francisco, Overland Park, Kansas, and in Denver, Colorado. Typically, they work something like this:

- The cable company agrees to hook up the store and wire the inside. Now this must really be done right so that the customer sees the very best picture there. That means a tech should drop in on a regular basis to check on things and fix any problems.
- Now the store has a clear way to demonstrate why a more expensive set, with the better tuner, does not have direct pickup interference, while a cheaper receiver does.
- At the same time, the salesperson has the opportunity to inquire if the new set owner takes cable. If the answer is no, the customer gets a coupon which gives them a free hook-up, or some other incentive. When the system processes the coupon, the salesperson gets the commission, which is usually more than was made on selling the TV set. If the customer is on cable already, the salesperson may offer a coupon for a free month or two with the purchase of a new pay service.
- When we get all comfortable with each other, we can then ask the retailer to vote for some improvements in the sets through his purchase orders with the manufacturers. We have already pulsed this circuit once and it works amazingly well.

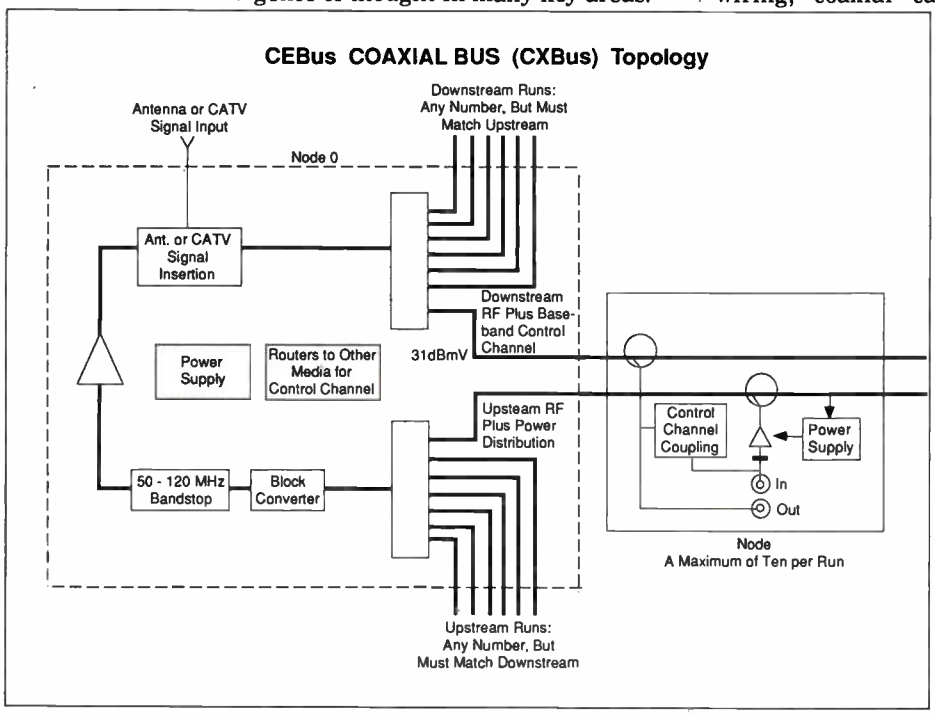
The end result is a happier cable subscriber and a satisfied consumer electronics purchaser, and this is good for all of us. ■

What is home automation?

The question, "What is home automation?" has many answers, depending on who you ask. From a functional standpoint it is the integration of products in the home into one cohesive system. From an applications viewpoint is where the diversity of answers begins. Home automation can provide many services. Among these are:

- An increase of safety and security
- A means of cost effective energy management
- An increase in comfort and convenience of lifestyle
- More productivity for those working at home
- Assistance to those with special needs
- Convenience for the elderly
- Support for the creation of new products not heretofore possible
- Added value and convenience to existing products and services

If one or more of these areas is of interest to you, for personal or business reasons, then home automation has a definite place in your future.



The EIA home automation standard

How it began. In 1983 the Consumer Electronics Group (CEG) of the Electronic Industries Association (EIA) started on its quest for a possible home automation standard. Georgia Tech Research Institute (GTRI) was awarded two study contracts. The first study was to examine the trend toward home automation. Two areas were explored. One of these was a review of the information that was available in the public domain.

The second area was what was being done by companies and organizations in the privacy of their laboratories and research centers. To help in this, GTRI arranged to gather information under a non-disclosure agreement. The output of GTRI's effort was a sanitized report that, without showing individual research, provided a matrix that showed factors such as media, data rate and other parameters that were under evaluation. The results showed that while there were diverse approaches being considered, there was convergence of thought in many key areas.

Based on these findings, a second contract was awarded to GTRI. It was assumed that all basic consumer products would contain some type of microprocessor controller. This time the task was to determine the potential for developing access ports to these controllers. The results of the study showed that it was possible to consider adding access ports to interface with different media in a cost effective manner.

March 1984 marked the first meeting of the group that became the EIA/CEG Consumer Electronics Bus Committee. The original group of 13 consumer electronic manufacturers was soon joined by representatives from many industry segments that saw the potential for home automation. These included security, telephone (both equipment manufacturers and telcos), cable television, semiconductors, appliances and many in the home automation business. In all, more than 250 individuals and organizations have participated. Attendance at the meetings now averages 45.

What it is. The EIA Home Automation Standard is a communications protocol that uses several media as communications pathways throughout the home. The media now under consideration are the power line, twisted pair wiring, coaxial cable, infrared and radio. Future upgrades will include fiber optics when the technology matures to the point that it is a viable service for consumer applications.

The proposed standard consists of two major parts. The first of these is the language and protocol. For inter-product communications to become a reality, a grammar and syntax must be developed that can be understood by all participants.

There are two major parts to this command language. The actual kernel of the message is the instruction to the recipient. This is wrapped in an envelope that contains the information required to get the message delivered. This envelope contains the address of the sender, the address of the destination, its priority, and other necessary data.

In addition to the protocol, the standard defines the physical layer. This is how the actual communications take place over the different media. This part describes the modulation methods, signal levels and data rates. The standard is based on distributed intelligence, so there is no need for a central controller. If the need arises, a central controller, such as a personal computer, can be used to schedule events or select alternative actions.

As stated, the EIA Home Automa-

By Thomas Mock, Consumer Electronics Group, EIA

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the headend are needed. This requires some reconfiguration of the headend and distribution system.

Figure 1 shows the idea of the interdiction system as presently configured. The unit serves four subscribers and can jam 16 channels with excellent security. More channels may be jammed with a reduction of the degree to which they are jammed. Some channels may be jammed more thoroughly than others.

The directional coupler shown at the top of the drawing is the replacement for the normal coupler in the tap. In the test configuration, power is drawn from the distribution system, though we plan to make home power optionally available. The industry seems about evenly divided between favoring system and home powering, with both sides feeling strongly that their view is the only logical one.

A diplexer after the coupler allows for several modes of reverse operation. A plug-in equalizer flattens the spectrum as required. This allows improved service to the subscriber, especially in light of the limited distortion performance of some cable-ready TV sets. Also, the jamming consistency is enhanced by presenting a reasonably flat spectrum.

An attenuator and amplifier provide level correction in an automatic gain control loop, used to improve consistency of service. A data receiver extracts addressing data, transmitted normally on 108.2 MHz, and supplies information to a control microprocessor on the motherboard. Non-volatile memory stores configuration data. The microprocessor extracts data intended for this unit, and loads appropriate information to smaller microprocessors in the subscriber modules.

The subscriber module

Figure 2 is the block diagram of an individual subscriber module, up to four of which may be used with one motherboard. Four voltage controlled oscillators (VCOs) tune different frequency ranges (some overlap is provided, as explained below). The range of each oscillator is limited to about one-third of an octave, to provide for adequate low pass filtering. Switches after each oscillator open when the oscillator slews from one jammed channel to the next (permitted channels may be located between jammed channels).

After low pass filtering, the oscillator outputs are combined then coupled to the broadband signals delivered to the subscriber. A subscriber disconnect switch is provided to drop service completely, under control of the addressable system.

A unique frequency stabilization system allows calibration of each oscillator every few minutes. During a calibration cycle, the other three oscillators are stopped momentarily. The calibration process takes only a few milliseconds, so the loss of jamming on other channels is not significant. Each oscillator is calibrated on each frequency to which it is assigned. To save power, the calibration circuitry is turned off when not in use.

Digital memory containing the current tuning data for each jammed frequency is coupled in turn to a digital-to-analog (D/A) converter, which charges a separate capacitor for each oscillator. The capacitor holds tuning information for it's oscillator while the D/A converter services the other three oscillators.

The multiplexer (Mux) connects the D/A converter to the appropriate capacitor. Each time the microprocessor changes the mux to connect the D/A to another oscillator, that oscillator's switch opens momentarily to allow frequency slewing without causing interference to authorized channels. The effect of this frequency stabilization system is to keep the jamming frequency close to the desired frequency. However, the oscillator frequency does wander within limits between calibration cycles. This controlled wandering enhances the security of the system by making trapping of the jamming carrier even harder.

A diplexer at the output of the subscriber module is part of the reverse system path and is used in the home powered configuration.

The addressing system

Addresses for the four ports are stored in the motherboard non-volatile memory. When a subscriber module is changed, the address does not change. Bar code labels on the outside of the housing show the addresses stored in the unit, with each address located directly under its output port. A test connector allows access to the contents of the non-volatile memory and to the operational status of the unit. A handheld computer may be used to view this information in the field.

Addresses follow the same convention as in S-A's addressable set-tops. They are 28 bits long, allowing for an ultimate population of over 268 million unique addresses. Interdiction addresses are assigned from a different block than are set-top addresses. To reduce the chance of errors, the system manager computer will not recognize the interdiction block unless the interdiction version of the software is used. The interdiction version will also control set-top terminals.

The jamming window

Early in the development of the system, it was decided to use the same oscillator for as many jamming frequencies as possible. An early experiment was to observe jamming quality on a large sample of TV sets, of both current and earlier production. A jamming oscillator was arranged to jam at a controllable offset frequency (with respect to the picture carrier), with a controlled dwell. Dwell is the percentage of time the oscillator is on the channel under test. The time between visiting the channel under test (the jamming frequency) was varied. It was quickly learned that different TVs react differently to a particularly jamming pattern. A jamming pattern that forced one TV to a black screen, barely caused picture degradation on another set. For this reason, all later testing has involved large banks of TVs.

The most common reaction to "good" jamming is loss of sync. Our jamming criterion for good jamming is that no more than one TV in the test can hold sync, and only then on an occasional scene. When the set is in sync, the picture should be extremely degraded, but may be barely recognizable.

Early work centered on determining the lowest dwell at which the threshold of good jamming was independent of jamming frequency over a wide range. A curve of good jamming threshold as a function of jamming frequency was plotted for various dwell times. This curve was bathtub shaped with a broad minimum centered at about 4 kHz. A 20 percent dwell was determined to be the minumum for good jamming.

Allowing for some time to slew jammed channels, it was determined that one oscillator could jam up to four channels with good jamming. The system allows for jamming more channels, but to do so may allow some TV receivers to show a recognizable picture on some scenes. However, most operators who have seen the system feel that a lower degree of jamming is quite satisfactory for most purposes.

Other tests were conducted to deter-

mine the frequency offset and relative amplitude of the jammer, for which the chosen jamming frequency and dwell produced good jamming. We also were concerned about the effect on a lower adjacent channel. Our criteria was that no TV in the test bank could show degradation on the lower adjacent channel, using a sensitive test pattern and trained observers close to the TV sets.

One surprise from these tests was the operation of one 12-inch black and white set. At lower jammer levels, this nemesis TV was out of sync. As the jamming level rose above about +10 dB from the picture carrier, the set suddenly regained sync, yielding a recognizable picture. The picture was seriously degraded by the jamming noise, but the picture was recognizable! Further investigation showed the set had a very good sync separator and noise invertor, which rejected as noise the higher amplitude jamming signal.

From these investigations came the jamming window shown in Figure 3. The window of good jamming is shown within the dashed lines. If the jamming is too low with respect to the picture carrier, good jamming is not always obtained.

Similarly, even with reasonable jamming levels, if the jamming oscillator frequency is too high, good jamming is problematical. At higher jamming levels the nemesis TV would lock. If the frequency of the jamming oscillator was too low or its amplitude too high, adjacent channel interference could be expected on some TVs.

From this jamming window, error budgets were developed for the system. One error budget involved the relative amplitude of the jamming carrier with respect to the picture carrier. The required relative amplitude required automatic gain control. This AGC could have been applied to either the incoming carriers from the cable, or to the jamming carriers themselves. The former approach was chosen, as it will also have beneficial effects on the signals seen by the subscriber. To avoid the requirement for an AGC pilot channel, a broadband AGC system which samples the composite level of many of the channels in the range of frequencies jammed was developed. If one or two channels are removed from the system, the effect on the AGC is minimal.

Another error budget paced development of the frequency control system. This system must hold the oscillator frequency within prescribed limits, but by allowing the frequency to drift within those limits, trapping the carrier is even more difficult. Additionally, since the carrier is frequency hopped between different channels, when observing one channel the jammer appears as a rounded pulse train 100 percent modulating a carrier. This produces sidebands which further complicate trapping the jammer.

Note that the jammer will drift through the picture carrier. At constant temperature, the oscillator will require a long time (on the order of hours) to drift out of the window. With temperature change, the oscillator will drift much faster. Because of this, a variable calibration cycle is provided, with calibration intervals starting at only a few minutes.

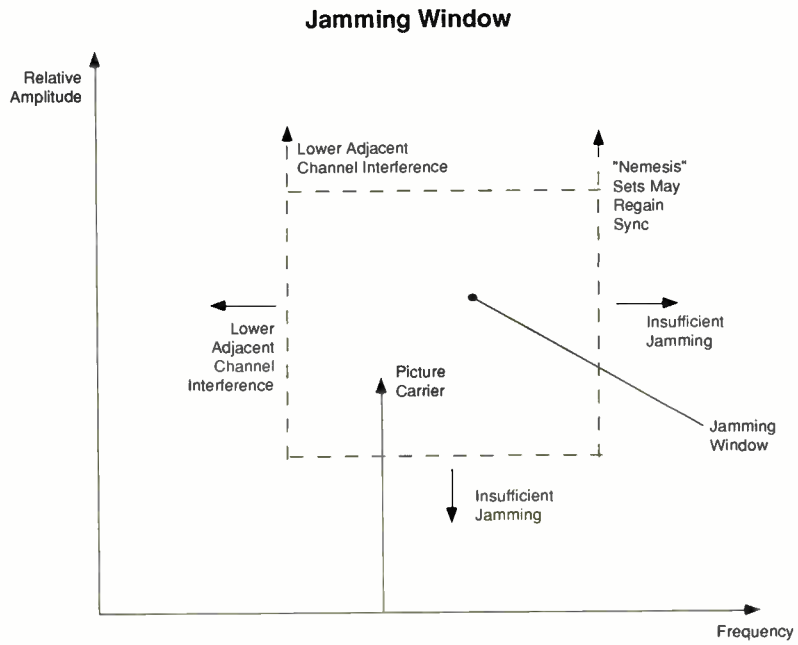


Figure 3

The frequency plan

Figure 4 shows the frequency plan for the present interdiction product. Four of the five oscillators are used in a particular system. The first oscillator, Group A, covers channels 2 through 5. Because the frequencies are so low, we do not benefit from a large number of channels which can be jammed. (Recall that each oscillator can cover only about one-third of an octave because of filter requirements.)

Group A provides for those operators who wish to keep premium programming in the low band. We expect that most systems will opt for using groups B through E. This choice allows for jamming on any channels 14 through 41, with restrictions on the total number of channels jammed. Note that the interdiction system passes the entire bandwidth from 50 to 550 MHz, but the jammed channels are restricted to a smaller band. Additional groups may be defined in the future.

The groups do not overlap except Groups B and C. This overlap was provided to permit complete jamming of the midband. As the frequency is increased, the number of channels jammed by one oscillator also increases. This is because, as the frequency increases, one-third of an octave includes more channels.

The calibration system allows calibration of each jamming frequency with a resolution of around 50 kHz. This means tha the system can be configured for standard, IRC and HRC assignments, and can also accommodate any unusual frequency requirements.

The hopping plan

Figure 5 illustrates the frequency hopping plan. Sixteen time slots are assigned for each oscillator. During each of these time slots, the oscillator is assigned to one frequency in the band of which it is capable. Since maximum jamming requires a dwell of at least 20 percent, four of the time slots are dedicated to one channel when maxi-

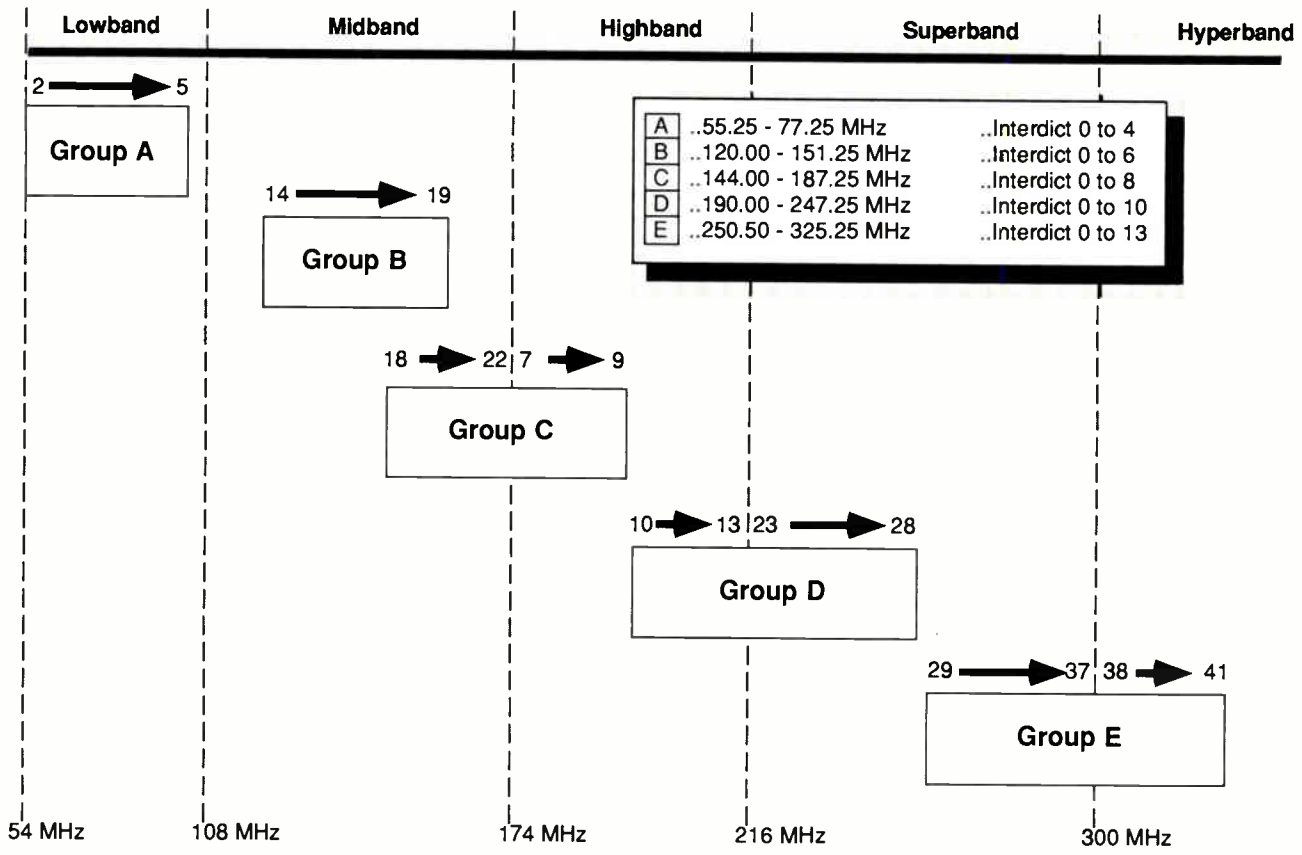


Figure 4

mum jamming is desired. Proprietary hopping patterns optimize use of the time slots.

If desired, the time slots may be assigned to more than four channels, up to the maximum number of channels of which the oscillator is capable. Jamming effectiveness is somewhat reduced compared with the suggested four channels per oscillator. The jamming effectiveness is very dependent upon the TV.

For example, four of the time slots may be assigned to jam program service X, for which the operator has determined that he needs a high level of jamming. This decision may be made because of the nature of programming on that channel. He may also want to protect program services, Y, Z, T and W with the same oscillator. After protecting X with four of the 16 available slots, 12 slots are availabe to jam the other four services.

These services could all be jammed with four slots, leaving eight for the other three services. If a subscriber buys one or more of the premium programs protected by the oscillator, the jamming time slots normally assigned to that service are distributed among the other protected services. If the oscillator is needed to protect only one service, it will dwell about 80 percent of the time on that service. The remaining 20 percent is the slew time.

If desired, some of the jamming time slots may be assigned to different frequencies within the channel protected. For example, some time slots may be assigned to the picture carrier. Other time slots may be assigned to frequencies about 0.5 MHz, 1 MHz and 2 MHz above the picture carrier. Except for one case shown below, this is not thought to be necessary, but is available if desired.

The lifeline service

Lifeline service is being debated within the industry, as a means of providing very basic service at low cost to the subscriber. The interdiction system may be used for this application by placing available filters in the tap output, using the jamming oscillators to protect filter skirts. For example, a filter passing only the low-, mid- and high-bands may be added at the port output. The jamming oscillators are assigned to jam the midband (groups B and C) and the superband transition region of the filter (group D if necessary group E).

The effect on sound

Television sets almost universally use intercarrier sound detection, in which the 4.5 MHz sound intermediate frequency is derived by mixing the picture and sound carriers. Because the jammer dwells near the picture carrier, this is usually adequate to make the sound unintelligible. Jamming is transferred to the sound carrier in the intercarrier mixer. Typically, the audio is replaced by a loud, rough tone. In some cases the sound output is almost muted. However, a few sets give acceptable sound quality even with the picture jammed. If this is a problem, one or more of the jamming time slots are assigned to a frequency half-way between the picture and sound carriers. Then the second harmonic of the jam-

mer beat falls on the sound carrier.

This has been found to be effective in those cases where sound jamming at the picture carrier is inadequate. However, if the subscriber uses a TV band radio receiver, which does not use intercarrier detection, he can still hear the sound. One could in principle place the jammer on the sound carrier, but if an upper adjacent channel is used, it may experience interference from the jammer on the sound carrier. The reason is that the jammer amplitude is similar to that of the picture carrier, stronger than what the TV is expecting at the lower adjacent sound carrier.

The output level

The system is designed with a nominal output level of +16 dBmV at 550 MHz and +15 dBmV at 450 MHz. While these levels are a little higher than some systems are designing now, it was determined that the extra output level would be important, considering trends in CATV service. These trends include the increasing use of multiple set hookups (a trend which will be accelerated with use of interdiction technology), more complex entertainment center hook-ups and the drive for better quality pictures. Also, because of the AGC used in the system, it is not an option (really, it was never a good option) to change the tap value to give a subscriber more signal level when needed.

The mechanical configuration

Figure 6 shows the open interdiction unit housing, and Figure 7 shows a typical installation at the test site. Note that, even though the unit is large compared with a normal tap (though much smaller than a trunk housing), it compares favorably in size with other things near poles, such as the telephone company splice boot shown.

The top of the housing (Figure 6) contains the tap, equalizer and power extraction circuit. These mount on a seizure board. A piece of hardline coaxial cable traverses the length of the housing not needed by the tap circuit. Because of the higher number of connections required by the off-premises unit, through loss is not quite as low as that of the tap it replaces. However, in the test installation this has not proved to be a problem, as adequate level was available due to normal design practice.

The plug-in directional coupler is available in generally the same values as in conventional taps, and is reversible. This means that the signal may be routed through the housing in either direction. The cover is reversible, so the housing can always be installed to open to the street. When the housing is installed in a pedestal, the seizure board is rotated 90 degrees. This allows the incoming and outgoing cables to attach to the same end of the housing.

A piece of miniature flexible coaxial cable carries the RF signals to the electronics in the bottom of the housing. A flexible, two-conductor cable carries power if line powering is used.

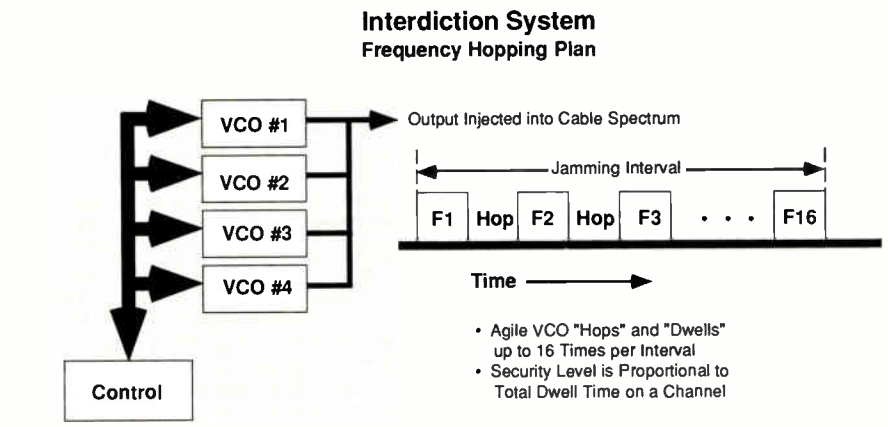


Figure 5

The bottom portion of the housing includes a switching power supply, a data receiver, the motherboard and up to four subscriber modules. Provision is made for a traverse system, not yet available.

The switching power supply is contained in the enclosure (to the right in the photo). The data receiver is just to the left of the power supply, a data receiver, the motherboard and up to four subscriber modules. Provision is made for a reverse system, not yet available.

The switching power supply is contained in the enclosure to the right in the photo. The data receiver is just to the left of the power supply. Four subscriber modules are shown plugged into the motherboard, which is barely visible in the bottom of the housing. Signals from the subscriber modules exit toward the bottom at the left end.

The housing is an aluminum casting similar to those used by distribution electronics, and features hermetic sealing. It is L-shaped at the drop cable exit, al-

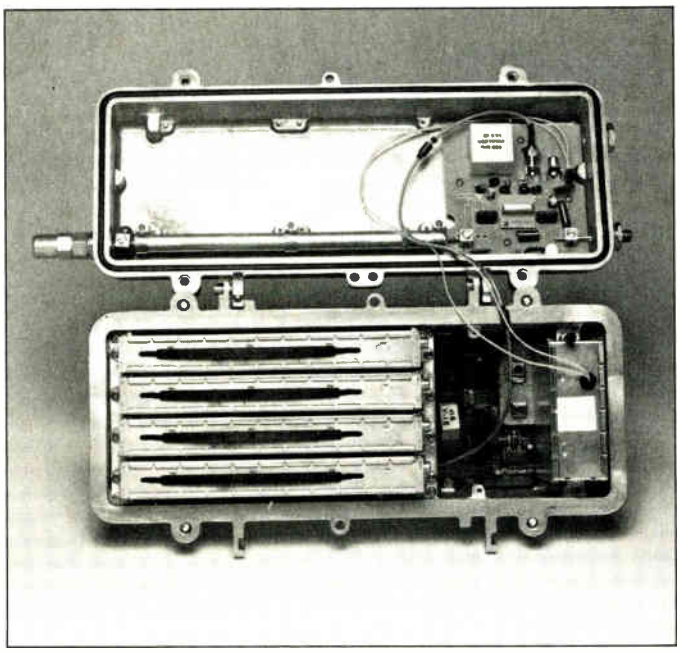


Figure 6. *The interdiction system's housing*

lowing the drop cables' drip loop to be contained reasonably close to the strand.

The installation experience

The first test site is the Warner system in Williamsburg, Virginia. This system had a 300 MHz bandwidth, and was upgraded to 450 MHz at the time of interdiction installation. Program denial was by non-addressable set-top converters using basic gated sync suppression. Installation began in December 1989 is now complete, with about 220 customers connected. Serious testing of the system is only now starting, so we cannot report results yet. However, the system is functioning normally, with no problems noticed.

The area targeted for introduction of the interdiction system was identified. Design maps were created showing the location of units and approximate values of directional couplers and equalizers. Since line powering is used in this installation, each feeder experienced an increased power requirement. The standby power supplies on the trunk could not accommodate this extra power. Where additional power was required, the power connection to the trunk was severed, and a Mini-max power supply was added. A total of four new power supplies were added, though fewer probably would have sufficed. Warner personnel estimated that the interdiction system required the addition of about one-half power supply per mile.

The underground section was populated with larger pedestals. A system manager IV was installed and linked by modem from the Warner Hampton office to the Williamsburg headend. A dedicated trunk with unscrambled premium channels was installed between the headend and the test area.

When a feeder was upgraded to interdiction, power was removed and the old taps were replaced with interdiction units. To support the expanded bandwidth, amplifiers were respaced or upgraded as required. This was not required for the interdiction installation. Then power was restored to the leg. All active devices were balanced, beginning at the point closest to the trunk.

Installation was done by a contractor crew of three men, two with bucket trucks. The third prepared each unit for installation. Preparation consisted of installing stringers, directional couplers and equalizers according to the map design. The crew was not trained on interdiction before the first day of installation, so "on the job" training was employed. After the crew got up to speed, it could install and balance one 20-25 unit feeder per day (nine to 11 hours).

Balancing involved leap frogging from the upstream to the downstream

Figure 7. *A typical installation*

tap. When an installer finished at one pole, the other installer balanced the next station while the first moved to his next pole. The taps were first balanced by measuring AGC voltage in the interdiction unit, using a multimeter. A directional coupler was selected for the prescribed AGC voltage. A signal level meter was used to select an equalizer to yield 3 dB of tilt from 50 to 330 MHz. Existing drops were connected. In some cases, it was not possible to determine which of several drops served a particular house. In these cases a best guess estimate was made.

An installed, the interdiction units allowed all services. Downgrading to the services bought is accomplished later. As part of the initial testing, Warner personnel are visiting each house to inform the subscriber of what was done and how he is affected. Cable-ready TVs and VCRs will be set up. Service will be downgraded to that ordered by the subscriber, allowing confirmation that the subscriber is connected to the port assumed during installation.

Based on experience gained during installation, and experience with other cable plants, Warner and S-A personnel have developed the following observations (most of which are already familiar):

I. Strand maps must be accurate.

II. Design the powering then the radio frequency levels.

III. Required design parameters must be understood.

IV. Because a subscriber's address is now associated with the tap, drop identification is even more important than before.

V. Some change of directional coupler and equalizer values may be necessary during balancing.

VI. Subscriber communication is important, as service will have to be interrupted during installation.

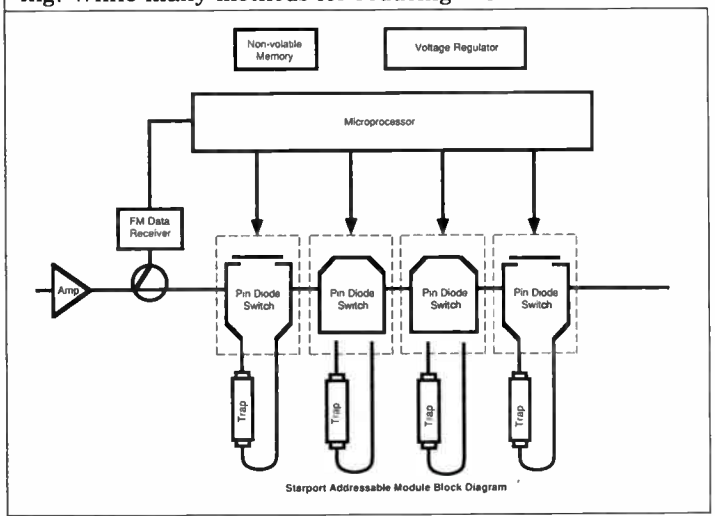
VII. Since the taps are AGC'd, changing tap value to accommodate higher level requirements cannot be done (it was never a good idea). The system provides higher than normal levels. If even higher levels are required, we recommend a larger drop cable or in-home amplification. Amplification is easier than with conventional systems because of the consistency of level thanks to the AGC, and because of the tilt correction in the tap.

The acknowledgement

The author appreciates the help of Scientific-Atlanta senior applications engineer John Cochran, for his help with the experience portion of this paper. Mr. Cochran also developed most of the illustrations and photographs in the article. Ron Horchier and the other people in the Warner system have been most cooperative and have contributed valuable ideas to improve the product. Paragon Tampa has been very helpful in evaluating power supplies. Lamar West and Jack Bryant reviewed the manuscript and made many useful suggestions. ■

Consumer interface issues and solutions

The consumer interface issue has long plagued the cable industry. Operators have been torn between the need to secure channels to protect their revenue base and the desire to provide a service subscribers deem beneficial, easy to use and worth buying. While many methods for reducing this conflict have been tried, few have succeeded. A renewed focus on consumer friendliness, however, has recently generated some positive results.



Starport Addressable Module Block Diagram

When it all went sour

The problem of interfacing cable into the home grew with the arrival of pay television. Until such time, soft security means such as block conversions controlled access to services. Traps were implemented to provide a higher degree of security for those limited subscribers accessing pay television.

As more subscribers began to purchase the early pay services, operators quickly realized the operational deficiencies associated with traps. The costs associated with the need to roll a truck for subscriber to upgrade or downgrade service became unacceptable to most operators. As a result, the push for addressable descrambling converters began to take hold.

While the first descrambling converters controlled only a few services, the added security was seen as advantageous and worth the investment. Addressability provided the operational benefits to justify the cost of the converter. Despite these operator advantages, subscribers began to experience the interface issues associated with descrambling converters. Thus, a renewed effort was placed on developing a more consumer-friendly approach to addressability. Several approaches were tried during the mid-'80s. Each provided various benefits to the consumer, but not in a universally applicable, cost-effective manner.

One such approach was the use of addressable taps that provided the operator with remote connect/disconnect. Used with traps, this pole-mounted device did improve operational efficiencies compared to a trapped-only system, but fell short of the control possible with addressable converters.

A second off-premise approach was a form of the agile jammer. While this product exceeded the addressable tap coupled with traps for remote control of subscriber services, it was plagued by several significant problems.

First, since these devices served multiple subscribers, the cost-per-subscriber for a 50-percent penetrated system was unacceptable. In addition, cost and logistical concerns over powering the unit were never fully resolved.

A third consumer interface approach was the use of in-home video switching units and bypass switches. When used with addressable descrambling converters, these units eased the interconnection of the converter with the VCR and television. Such switching units, however, were often difficult for the typical subscriber to understand and didn't address the key consumer concern: recording one premium service while viewing a second.

The impulse question

Over the past several years, the benefits of impulse pay-per-view (IPPV) have further intensified the consumer interface issue. Operators have viewed impulse as the ultimate in consumer convenience for ordering movies or events. True impulse, however, requires an in-home device to accept the purchase data and transmit the information back to the cable office. Such a device is a natural addition to the addressable converter.

One recent approach to this problem has been to develop a MultiPort decoder. This offers the operator the security and control of an addressable converter while returning all consumer features to the subscriber's TV or VCR. The TV or VCR decoder performs the tuning and passes the signal to the MultiPort decoder for descrambling. A module integral to the decoder easily handles IPPV.

While this approach appears very promising, the penetration of TVs and VCRs with MultiPort capability is minimal. Given the 130 million TVs in service today without this capability, and given a 10-year minimum turnover rate on TVs, it will take many years to penetrate the cable base with MultiPorts.

Another approach is to tackle the main consumer interface device, the remote control. Preprogrammed universal and learning remote controls have been offered as the solution to multiple remotes. Unfortunately, the advantages offered by these remotes have been more than offset by the complexity of operation. Subscribers have shown their unwillingness to spend $50 or more to solve what they feel is an unnecessary interface problem.

Is there hope for the future?

Given past failure to resolve the consumer interface issue, why should we expect better future results? Several items are key to answering this question. First, today's approaches to on/off premise technology are very

By Dan Moloney, Director, Product Marketing, Jerrold Subscriber Systems Div., General Instrument Corp.

promising. Single dwelling unit versions of addressable control modules and addressable jammers offer significant cost improvements over multiple-subscriber devices of the past. Powering is handled in a cost-effective and operationally efficient manner from the subscriber home. While some concerns remain about the level of security the system provides because of the transmission of clear broadband to these denial devices, methods can be developed to alleviate this concern. In addition, the number of services controllable by such a device will soon reach levels acceptable to most operators.

Secondly, several developments for converters in the future will enhance the consumer interface. VLSI developments will enable converters to incorporate two tuners in a cost-effective manner, thereby overcoming the problem of viewing one premium service and recording another. On-screen graphics with menu-driven screens will ease subscriber interaction with enhanced services such as IPPV. It also may provide help screens to show subscribers how to interconnect their in-home equipment. Downloadable messaging will enable operators to communicate with individual subscribers on a target basis and thereby simplify subscriber interaction.

The home as a solution

Thirdly, and by far the most important development in consumer interface, is the onset of electronic home integration. Despite the lack of integration in the distribution network, subscribers will shortly benefit from the cable operator's ability to integrate efficiently the in-home control electronics for video, audio, telphony and AC power. The ability to use the cable remote as a remote telephone exists today. Soon, it also will be possible to control AC outlets in the home with CEBus and X-10 protocols coupled with on-screen display.

In addition, the integration of voice recognition equipment in existing cable electronics will even further enhance the methods by which subscribers interface with cable. As a final stage, all the control electronics will shift to a modular design and located either on the side of the house or in the basement. This will then permit the ultimate in consumer friendliness with an integrated distribution network in the home, despite the state of integration outside the home. ■

CONSUMER INTERFACE CALLBOOK

The following companies have paid a fee to have their listing appear in the Consumer Interface Callbook.

MultiPort

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Dan Moloney
DESCRIPTION: This unit attaches to an appropriately equipped television or VCR and serves as a signal descrambler. Effectively, the EIA MultiPort unit returns all the subscriber features to the TV/VCR by removing the cable converter/descrambler from the path of incoming signals, making those signals transparent to the TV or VCR.

Power & Telephone . . . .(901) 324-6116
Supply Co.
FAX . . . . . .(901) 320-3084
2701 Union Extended, Ste. 500
Memphis, TN 38112
PERSONNEL: Sonny Dickinson, Director of National CATV Sales; Derwin Otwell, National Accounts Manager
DESCRIPTION: We are a national distributor of directional taps, splitters, and installation material for drop.

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Andy Meyer
DESCRIPTION: Scientific-Atlanta's MultiPort product allows transparent consumer interface with cable-ready television sets and remotes. It meets EIA 563 specifications and is compatible with existing Scientific-Atlanta addressable systems.

On-premise Addressability

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

Cable Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Purchase and sale of subscriber products with emphasis on addressable converters and entire addressable systems, both new or refurbished. Various manufacturers. Plain and descrambling "Pay" converters are also available as new or refurbished products. CTI also offers subscriber video control switchers, and new or refurbished handheld remote control units for all manufacturers.

Eagle Comtronics Inc. . . .(315) 622-3402
WATS . . . . . .(800) 448-7474
4562 Waterhouse Rd.
Clay, NY 13041
PERSONNEL: Alan Devendorf, President; Joseph Ostuni, VP/Sales and Marketing, Chester Syp, National Sales Manager
DESCRIPTION: Eagle's addressable trap system is consumer friendly and available today. It incorporates eight tier switching, impulse pay-per-view selection, negative, positive or multichannel trap control, home powering through drop cable, parential control, downloadable credit unit, IBM PC control, external billing compatibility, store and forward return, and is economically comparable to converter-descrambler system.

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; John Burke
DESCRIPTION: Jerrold's STARPORT unit attaches to the outside of a subscriber household and provides an entry way for cable signals to cable-ready televisions and VCRs. Consumer homes equipped with STARPORTs inform the cable operators what services they wish to take and those services are either trapped or transmitted clear into the homes via the STARPORT unit.

More than supplies. Solutions.
Midwest CATV . . . . . .(304) 343-8874
A Division of UNR Industries
FAX . . . . . .(304) 346-0624
P.O. Box 271
Charleston, WV 25321
PERSONNEL: Stephen R. Brazil; Penny Ellis
DESCRIPTION: Midwest CATV is the exclusive distributor of the MATRIX system. Matrix is an on-premises addressable trap system. In two versions, Matrix will solve your single family or MDU needs. We've been in the field since 1988! For tomorrow's system today, call 1-800-MID-CATV.

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Jack Bryant
DESCRIPTION: Scientific-Atlanta's

interdiction technology is a highly secure and reliable alternative which provides a transparent consumer interface. Decreased operating costs, additional marketing opportunities and extra flexibility in your system are three major benefits. There is a family of products to suit your application—single subscriber, four-port, eight-port and MDU.

Off-premise Addressability

BradPTS™

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

CE CABLE EXCHANGE, INC.

Cable Exchange, Inc. . . .(303) 694-6789
WATS . . . . . .(800) 422-2567
FAX . . . . . .(303) 290-9810
5730 E. Otero Ave., Ste. 700
Englewood, CO 80112-3064
PERSONNEL: Dennis Dwyer, VP Sales; Harold Bjorklund, President
DESCRIPTION: Distributors of *off-premise* four port addressable trap with master disconnect. Pay-per-view compatible. Inexpensive XT/AT compatible control system assures simple upgradability when expanding features.

Scientific Atlanta

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Jack Bryant
DESCRIPTION: Scientific-Atlanta's interdiction technology is a highly secure and reliable alternative which provides a transparent consumer interface. Decreased operating costs, additional marketing opportunities and extra flexibility in your system are three major benefits. There is a family of products to suit your application—single subscriber, four-port, eight-port and MDU.

Pay-per-view

BradPTS™

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

Cable Technologies International, Inc.

Cable Technologies International, Inc. . . .(215) 953-0100
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Sale and purchase of subscriber products including Plain, Pay and Addressable converters, both refurbished and new, all manufacturers. In addition, CTI offers subscriber video switchers and remote control handhelds for most major manufacturers. Consulting for cable operators in the use of PPV and IPPV, addressability and other transactional services, marketing services for cable operators, computer software development for addressability.

CUO

Computer Utilities of the Ozarks, Inc. . . . .(800) 541-8825
FAX . . . . . .(501) 741-9812
103-C Industrial Park Rd.
Harrison, AR 72601
PERSONNEL: Herb Lair; John Bartlow
DESCRIPTION: Cable/I—Management Information and Billing System for in-house, on-line IBM PC and compatible with pay-per-view interfaces with Tocom, Zenith, Jerrold and Scientific-Atlanta.

EAGLE COMTRONICS INC.

Eagle Comtronics Inc. . . .(315) 622-3402
WATS . . . . . .(800) 448-7474
4562 Waterhouse Rd.
Clay, NY 13041
PERSONNEL: Alan Devendorf, President; Joseph Ostuni, VP/Sales and Marketing, Chester Syp, National Sales Manager
DESCRIPTION: Eagle's addressable trap switch offers 8 channels of pay-per-view or impulse pay-per-view. Operator controls ordering window from a month before the event to after it has started. Selections are as simple as an event number or a single letter. Subscribers may terminate an event anytime upon the discretion of the operator. Billing versatility is in increments of $.05 up to $50.00 per event in increments of 5 minutes. In-house or external billing available.

JERROLD COMMUNICATIONS
where innovation is a tradition

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Jeremy Rosenberg
DESCRIPTION: Jerrold manufactures store-and-forward technology which allows subscribers to order pay-per-view

CONSUMER INTERFACE CALLBOOK

programming "on impulse." The converter stores the subscriber order and holds the information until it is polled at a later time by the cable computer. The ordering information is then forwarded to the cable office for later billing. Jerrold's Cable Video Store pay-per-view service takes full advantage of this technology by offering events 24-hours-a-day, seven days a week.

MIDWEST CATV
A division of Midwest Corporation

More than supplies. Solutions.

Midwest CATV . . . . . .(304) 343-8874
A Division of UNR Industries
FAX . . . . . .(304) 346-0624
P.O. Box 271
Charleston, WV 25321
PERSONNEL: Stephen R. Brazil; Penny Ellis
DESCRIPTION: Midwest CATV is a full line stocking distributor. Every one of our six regional warehouses is on call to serve you. Your PPV needs are easily satisfied with the MATRIX System, an on-premises addressable trap system. Call us at 1-800-MID-CATV.

PIONEER
PIONEER COMMUNICATIONS OF AMERICA, INC.

Pioneer Communications .(201) 327-6400
of America, Inc.
WATS . . . . . .(800) 421-6450
FAX . . . . . .(201) 327-0963
FAX . . . . . .(201) 327-9379
600 E. Crescent Ave.
Upper Saddle River, NJ 07458
PERSONNEL: Tom Holder, Director of CATV Div.; John Unverzagt, Director of Engineering
DESCRIPTION: Pioneer offers PPV capability and provides a confirmation feature to reduce unnecessary CSR calls. For IPPV, Pioneer offers PULSE, which upgrades the BA-6000 to two-way addressability with telephone and/or cable return. Pioneer's BA-6000 with the PULSE option offers the advantages of IPPV ordering technology, viewer statistics collection and status monitoring.

Power & Telephone . . . .(901) 324-6116
Supply Co.
FAX . . . . . .(901) 320-3084
2701 Union Extended, Ste. 500
Memphis, TN 38112
PERSONNEL: Sonny Dickinson, Director of National CATV Sales; Derwin Otwell, National Accounts Manager
DESCRIPTION: We stock modular hardwire, wire and cords.

Scientific Atlanta

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Andy Meyer
DESCRIPTION: Scientific-Atlanta offers a complete line of products and system for impulse pay-per-view (IPPV) capabilities including addressable set-top terminals, IPPV modules, as well as systems management hardware and software.

Traps

EAGLE
COMTRONICS INC.

Eagle Comtronics Inc. . . .(315) 622-3402
WATS . . . . . .(800) 448-7474
4562 Waterhouse Rd.
Clay, NY 13041
PERSONNEL: Alan Devendorf, President; Joseph Ostuni, VP/Sales and Marketing, Chester Syp, National Sales Manager
DESCRIPTION: Eagle's traps and decoding filters utilize advanced, state-of-the-art design, miniaturization, blocking capacitors, dual O-rings, polyurethyene foam, single board construction for ground continuity, soldered metal shielding and permanent channel identification. Complete line of US, PAL and Secam encoders. Best delivery of standard and custom units in the industry including the UHF spectrum.

MIDWEST CATV
A division of Midwest Corporation

More than supplies. Solutions.

Midwest CATV . . . . . .(304) 343-8874
A Division of UNR Industries
FAX . . . . . .(304) 346-0624
P.O. Box 271
Charleston, WV 25321
PERSONNEL: Stephen R. Brazil; Penny Ellis
DESCRIPTION: Midwest CATV stocks a full line of traps from PPC in each of our six regional warehouses. PPC offers all types of traps to fit every signal security need. For prompt service, call 1-800-MID-CATV.

PPC

Production Products . . . .(315) 682-2031
Co. (PPC)
WATS . . . . . .(800) 468-2288
One Mezzy Lane
Manlius, NY 13104
PERSONNEL: John Mezzalingua, Chairman; Daniel Mezzalingua, President;Andrew Szegda, Vice President; Dominick Maio, Vice President
DESCRIPTION: With mounting pressures for pay television programs and increased pay packages now in widespread operation, the cable system operator requires the ultimate product, insuring optimum performance levels and maximum security to better control the signal integrity to his subscriber base. For more information, call toll free 1-800-468-2288 and ask for your PPC representative in your area.

Power & Telephone . . . .(901) 324-6116
Supply Co.
FAX . . . . . .(901) 320-3084
2701 Union Extended, Ste. 500
Memphis, TN 38112
PERSONNEL: Sonny Dickinson, Director of National CATV Sales; Derwin Otwell, National Accounts Manager
DESCRIPTION: We carry a full line of positive and negative trapping.

Addressable Converters

BradPTS™

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales

CONSUMER INTERFACE CALLBOOK

organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

CE CABLE EXCHANGE, INC.

Cable Exchange, Inc. . . .(303) 694-6789
WATS . . . . . .(800) 422-2567
FAX . . . . . .(303) 290-9810
5730 E. Otero Ave., Ste. 700
Englewood, CO 80112-3064
PERSONNEL: Dennis Dwyer, VP Sales; Astrid Trinkhaus, Sales Coordinator
DESCRIPTION: Sales and *purchasers* of *New, Used* and *Refurbished* addressable converters manufactured by Jerrold, Scientific-Atlanta, Tocom, Zenith, Regency, Pioneer, Oak and others. Supporting products include Addressable Computer Systems, Headends, Encoders, Compatible Electronic A/B Switches.

Cable Technologies International, Inc.

Coble Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Purchase and sale of subscriber products with emphasis on addressable converters and entire addressable systems, both new or refurbished. Various manufacturers addressable products are available including PROMS. Plain and descrambling "Pay" converters are also available as new or refurbished products. CTI also offers subscriber video control switchers and new or refurbished handheld remote control units for all manufacturers.

JERROLD COMMUNICATIONS
where innovation is a tradition

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Dan Moloney
DESCRIPTION: Jerrold manufactures a full line of RF and baseband addressable converters. Jerrold's IMPULSE 7000 series of RF and baseband addressable converters offer such features as remote volume control, favorite channel programming, last channel recall, time control programming and impulse ordering. The TOCOM line of baseband converters offer the same features, including store-and-forward impulse ordering.

PIONEER
PIONEER COMMUNICATIONS OF AMERICA, INC.

Pioneer Communications .(201) 327-6400
of America, Inc.
WATS . . . . . .(800) 421-6450
FAX . . . . . .(201) 327-0963
FAX . . . . . .(201) 327-9379
600 E. Crescent Ave.
Upper Saddle River, NJ 07458
PERSONNEL: Tom Holder, Director of CATV Div.; John Unverzagt, Director of Engineering
DESCRIPTION: The Pioneer BA-6000 is a 550 MHz addressable converter providing compatibility with Jerrold, Oak, Hamlin, Regency and Sylvania scrambling methods. The BA-6000 offers advanced subscriber and operator features such as volume control, VCR program timer, clock display, PPV/IPPV capability and downline loadable system parameters including output channel.

Scientific Atlanta

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Andy Meyer
DESCRIPTION: Scientific-Atlanta addressable set-tops are fully electronic with microprocessor-based control. They are designed with a range of superior subscriber and operator features such as volume control, VCR timer, one touch IPPV buy key, extra surge protection, LED display, VCR compatibility, and enhanced scrambling security. All models are available in an attractive, high-tech package.

Non-addressable Converters

BradPTS™

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

Cable Technologies International, Inc.

Cable Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Sale and purchase of subscriber products including Plain, Pay and Addressable converters, both refurbished and new, all manufacturers. In addition CTI offers subscriber video switchers and remote control handhelds for most major manufacturers. Consulting for cable operators in the use of PPV and IPPV, addressability and other transactional services, marketing services for cable operators, computer software development for addressability.

Cabletenna™

Cabletenna Corporation .(201) 251-7733
FAX . . . . . .(201) 251-6903
401 Spotswood-Englishtown Rd.
Spotswood, NJ 08884

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PERSONNEL: Paul Libby; Leigh Mogil
DESCRIPTION: Cabletenna puts PDQ into all its converters with a commitment for the best possible converter money can buy. That commitment is the best price, fastest delivery, and finest quality available today. We also manufacture splitters, AB switches, stereo decoders and taps.

JERROLD COMMUNICATIONS
where innovation is a tradition

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Julie Kanter
DESCRIPTION: Jerrold's line of plain, non-addressable converters includes the digital DQN model and the digital, remote volume controlled DQNV7. Both models offer such subscriber features as remote control, favorite channel programming and last channel recall.

Panasonic
Communications & Systems Company

Panasonic Comm. . . . . .(201) 392-4709
& Systems Company
FAX . . . . . .(201) 348-7549
One Panasonic Way 3E-7
Secaucus, NJ 07094
PERSONNEL: Richard Strabel, General Manager; Jim Slade, Marketing Manager
DESCRIPTION: Manufactures a complete line of non-addressable cable converters, both with and without volume control capability. The product features proven reliability, a standard 5 year warranty, and an unmatched subscriber brand name recognition.

PIONEER
PIONEER COMMUNICATIONS OF AMERICA, INC.

Pioneer Communications .(201) 327-6400
of America, Inc.
WATS . . . . . .(800) 421-6450
FAX . . . . . .(201) 327-0963
FAX . . . . . .(201) 327-9379
600 E. Crescent Ave.
Upper Saddle River, NJ 07458
PERSONNEL: Tom Holder, Director of CATV Div.; John Unverzagt, Director of Engineering
DESCRIPTION: Pioneer offers the BC-4600 remote converter providing volume control/ mute and volume control indicator. It provides 550 MHz, 83 channels, sleep timer, muted channel change, parental control with remote override and favorite/last channel recall. Programmable features include the output channel, frequency offsets, upper channel limit and channel and spectrum allocations.

Power & Telephone . . . .(901) 324-6116
Supply Co.
FAX . . . . . .(901) 320-3084
2701 Union Extended, Ste. 500
Memphis, TN 38112
PERSONNEL: Sonny Dickinson, Director of National CATV Sales; Derwin Otwell, National Accounts Manager
DESCRIPTION: We distribute Antronix, non-addressable, 72-channel converters.

Scientific Atlanta

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Dave Levitan
DESCRIPTION: Scientific-Atlanta non-addressable set-top terminals are designed with a range of superior subscriber and operator features, such as conveniently placed keys, stereo compatibility, infrared programmability, volume control, wide bandwidth and descrambling capability. All models of non-addressable set-tops are attractively packaged in the industry's smallest unit.

Remotes

ABC CABLE PRODUCTS

ABC Cable Products . .. .(303) 694-6789
(Cable Exchange, Inc.)
WATS . . . . . .(800) 422-2567
FAX . . . . . .(303) 290-9810
5730 E. Otero Ave., Ste. 700
Englewood, CO 80112-3064
PERSONNEL: Dennis Dwyer, VP Sales; Harold Bjorklund, President
DESCRIPTION: Since 1986, ABC has manufactured and distributed a full line of cable converter *"compatible"* wireless remote control units. We feature product that is compatible with OEM converters made by Eastern, Hamlin, Jerrold, Oak, Panasonic, Pioneer, RCA, Regal, Regency, Scientific-Atlanta, Sylvania, Texscan, Tocom and Zenith.

Cable Technologies International, Inc.

Cable Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Sale and purchase of subscriber products including Plain, Pay and Addressable converters, both refurbished and new, all manufacturers. In addition, CTI offers subscriber video switchers and remote control handhelds for most major manufacturers. Consulting for cable operators in the use of PPV and IPPV, addressability and other transactional services, marketing services for cable operators, computer software development for addressability.

JERROLD COMMUNICATIONS
where innovation is a tradition

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Julie Kanter
DESCRIPTION: Jerrold offers a full-featured remote control for its converters. Remote controllable features include volume control, last-channel recall, favorite channel programming, impulse ordering and timed recording. A modified version of the standard remote control also allows subscribers to turn on televisions, removing the need for two remote controls in the home.

PIONEER
PIONEER COMMUNICATIONS OF AMERICA, INC.

Pioneer Communications .(201) 327-6400
of America, Inc.
WATS . . . . . .(800) 421-6450
FAX . . . . . .(201) 327-0963
FAX . . . . . .(201) 327-9379

600 E. Crescent Ave.
Upper Saddle River, NJ 07458
PERSONNEL: Tom Holder, Director of CATV Div.; John Unverzagt, Director of Engineering
DESCRIPTION: Pioneer offers the SmartRemote™, one remote which consolidates functions from multiple remote controls. The easy-to-program Smart Keys learn up to eight different functions from a consumer's TV, VCR or other consumer electronic equipment. All eight functions can be programmed within minutes. A comprehensive marketing support program is provided.

Scientific Atlanta

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Andy Meyer
DESCRIPTION: Scientific-Atlanta offers both standard remotes and a Complete Remote Control. Standard units are available with and without volume control with duplication of Scientific-Atlanta set-top keypad functions as well as direct channel entry. The Complete Remote Control (CRC) unit consolidates functions of several remotes into a single, easy to use unit. All remotes are designed with tactile feel keys and convenient key layout.

Audio/Stereo

FM Systems

FM Systems . . . . . .(714) 979-3355
WATS . . . . . .(800) 235-6960
FAX . . . . . .(714) 979-0913
3877 S. Main St.
Santa Ana,CA 92707
PERSONNEL: Frank McClatchie, President; Larry Morris, National Sales Manager
DESCRIPTION: **Audio Level Master:** ALM673, automatic absolute TV audio loudness control; **Modulation Measurement System:** AMM, measures loudness of TV audio modulation; VVM, measures video sync & white level; VMM, measures video modulation depth; CSPM-1, measures BTSC stereo performance in cable system; **FM Processors:** FMC664CC, translates off-air FM to cable FM; **Stereo Processors:** FMU622/FMU623, Galactic Radio & other audio services.

JERROLD COMMUNICATIONS
where innovation is a tradition

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Dave DelBeccaro; Charles Dougherty
DESCRIPTION: Jerrold offers a digital audio service over cable, Digital Cable Radio, which features 16 channels of CD-quality audio. Jerrold also manufactures a BTSC stereo encoder, the COMMANDER MTS, which encodes satellite-delivered stereo audio into BTSC format for stereo televisions. All Jerrold converters pass stereo signals transparently to stereo televisions and VCRs.

LEAMING INDUSTRIES

Leaming Industries . . . . .(714) 727-4144
FAX . . . . . .(714) 727-3650
15339 Barranca Parkway
Irvine, CA 92718
PERSONNEL: James Leaming, President; Robert Leaming, Vice President; Keith Rauch, Senior Engineer; Kim Litchfield, Sales
DESCRIPTION: Audio transmission equipment for satellite cable and broadcast. Product line includes STL and SCPC equipment, stereo processors, BTSC generators and audio automatic gain control amplifiers.

Accessories

BradPTS™

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

CE CABLE EXCHANGE, INC.

Cable Exchange, Inc. . . .(303) 694-6789
WATS . . . . . .(800) 422-2567
FAX . . . . . .(303) 290-9810
5730 E. Otero Ave., Ste. 700
Englewood, CO 80112-3064
PERSONNEL: Dennis Dwyer, VP Sales; Harold Bjorklund, President
DESCRIPTION: Compatible *Electronic* A/B switches for Addressable and *non*-addressable converters. Mechanical A/B switches, splitters, traps and other indoor and outdoor passive components. Distributors of the *UNiWAND* and *One-for-All* Universal Wireless remote control units.

Cable Technologies International, Inc.

Cable Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Sale and purchase of subscriber products including Plain, Pay and Addressable converters, both refurbished and new, all manufacturers. In addition CTI offers subscriber video switchers and remote control handhelds for most major manufacturers. Consulting for cable operators in the use of PPV and IPPV, addressability and other transactional services, marketing services for cable operators, computer software development for addressability.

CONSUMER INTERFACE CALLBOOK

Jerrold Communications .(215) 648-4800
FAX . . . . . .(215) 443-9454
2200 Byberry Rd.
Hatboro, PA 19040
PERSONNEL: Ed Ebenbach; Dan Moloney
DESCRIPTION: Jerrold offers a group of A/B switches for subscribers wishing to switch between cable television signals and off-air signals on antennas or between cable and some accessory such as a computer. The switches can also be used to switch between a converter and VCR or between two cables.

Pioneer Communications .(201) 327-6400
of America, Inc.
WATS . . . . . .(800) 421-6450
FAX . . . . . .(201) 327-0963
FAX . . . . . .(201) 327-9379
600 E. Crescent Ave.
Upper Saddle River, NJ 07456
PERSONNEL: Tom Holder, Director of CATV Div.; John Unverzagt, Director of Engineering
DESCRIPTION: Used with the BA-6000, Pioneer's VCR Filter provides a solution to the consumer problem associated with the interface of VCRs and cable television converters. The inexpensive VCR Filter allows a subscriber to view and record different channels without the inconvenience and confusion of switches, splitter and extra jumpers.

Qintar . . . . . .(800) 252-7889
FAX . . . . . .(805) 523-1491
P.O. Box 8060
Moorpark, CA 93020-8060
PERSONNEL: Michael D.; Norm Dubuc
DESCRIPTION: Complete line of consumer interface switches such as: VCR Switch Kits, Antenna Switch Kits, High Isolation A/B Switches, Video Control Centers, Multi-input Video Switch Boxes, Interface Accessories for impulse pay-per-view. Manufacturers of complete line of drop splitters, wall taps, connectors, adaptors, jumper cables, telephone/video wall plates, and amplifiers.

Related Services

BradPTS . . . . . .(518) 382-8000
FAX . . . . . .(518) 382-8452
1023 State St.
Schenectady, NY 12301
PERSONNEL: Len Gigliotta, National Sales Manager; Joe King, Manager National Accounts
DESCRIPTION: BradPTS is the industry's largest CATV equipment service and sales organization. With nine full service facilities strategically located throughout the U.S., we service and sell the following products: All major makes and models of converters, amplifiers, trunk stations and headend equipment, IPPV accessories and a full line of exact replacement remote control units. Factory authorized warranty services is provided for Panasonic, Oak, Alpha Technologies, and others on a prearranged basis. For additional information call (800) 382-2723 (NY) or (800) 999-2723 (Ind.).

Cable Business Associates .(213) 424-9253
(Cable Exchange, Inc.)
FAX . . . . . .(213) 424-0284
2446 Palm Dr.
Long Beach, CA 90806
PERSONNEL: Bill Hammond, Local Manager; Dennis Dwyer, VP Sales
DESCRIPTION: Full line addressable converter repair. Authorized Zenith, Jerrold, Scientific-Atlanta, out of warranty service station, Panasonic in/out of warranty service.

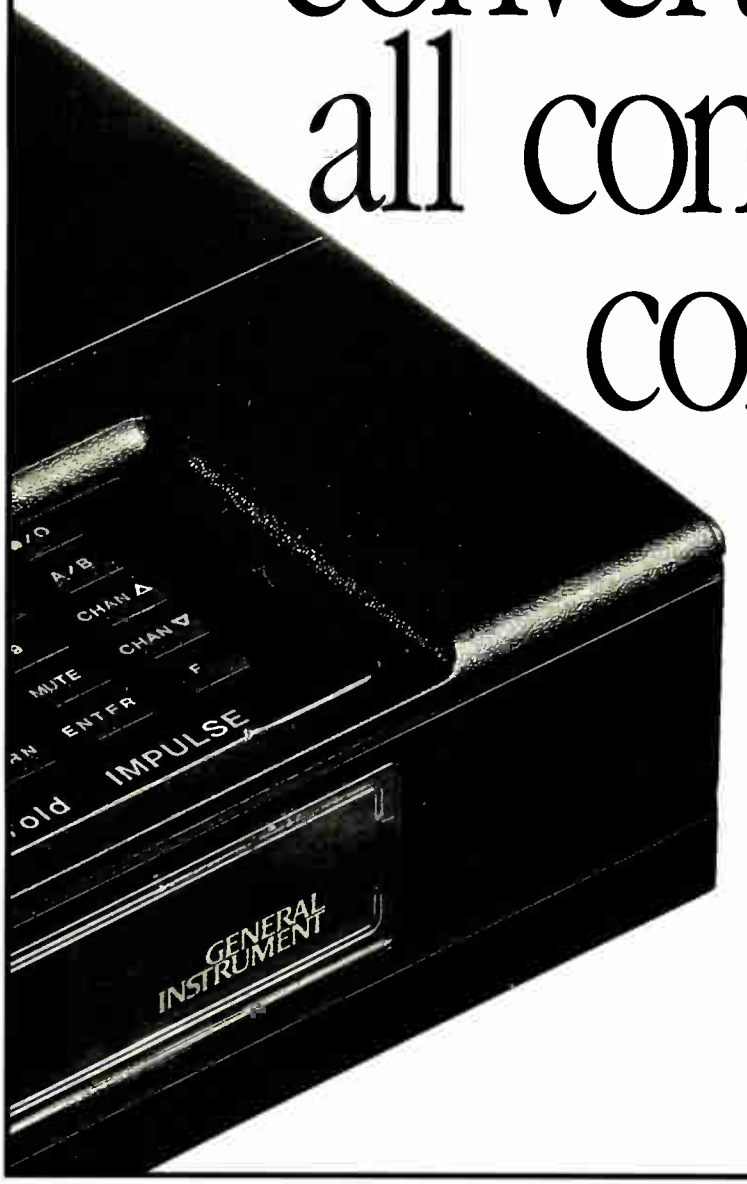
Cable Exchange, Inc. . . .(303) 694-6789
WATS .(800) 422-2567
FAX . . . . . .(303) 290-9810
5730 E. Otero Ave., Ste. 700
Englewood, CO 80112-3064
PERSONNEL: Bill Hammond, Local Manager; Dennis Dwyer, VP Sales
DESCRIPTION: Full line addressable converter repair. Authorized Zenith, Jerrold, Scientific-Atlanta, out of warranty service station, Panasonic in/out of warranty service.

Cable Technologies . . . .(215) 953-0100
International, Inc.
FAX . . . . . .(215) 322-6127
1051 County Line Rd., Ste. 107
Huntingdon Valley, PA 19006
PERSONNEL: Pete Morse, President
DESCRIPTION: Sale and purchase of subscriber products including Plain, Pay and Addressable converters, both refurbished and new, all manufacturers. In addition, CTI offers subscriber video switchers and remote control handhelds for most major manufacturers. Consulting for cable operators in the use of PPV and IPPV, addressability and other transactional services, marketing services for cable operators, computer software development for addressability.

Scientific-Atlanta, Inc. . . .(404) 441-4000
FAX . . . . . .(404) 925-6280
Box 105027
Atlanta, GA 30348
PERSONNEL: Steve Necessary; Angela Bauer
DESCRIPTION: Scientific-Atlanta offers repair, replacement parts, emergency parts, project management, technical support and technical training services for its line of cable television products.

Why BradPTS is #1:

We service more addressable converters than all competitors combined.



BradPTS services and sells more addressable, plain and pay converters than anyone in the industry. Send your converters to BradPTS for the same fast, quality service that made us #1 in the nation. Call your nearest customer service representative at any of the BradPTS facilities listed.

BradPTS™

NATION'S #1 SALES AND SERVICE SOURCE.

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(800) 624-7289
(in state)
(800) 331-3219
(out-of-state)

Bloomington, IN
(800) 333-PTS-1
(800) 999-2723

Cherokee, NC
(704) 497-3314

Fenton, MI
(313) 750-9341

Longview, TX
(800) 443-8522

Sarasota, FL
(813) 351-6700

Schenectady, NY
(800) 382-2723
(out-of-state)
(518) 382-8000

Seattle, WA
(206) 244-5770

Tampa, FL
(800) 759-2288

Ventura, CA
(805) 644-2598
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West Columbia, SC
(803) 794-3910

REGAL® Introduces...

The new standard in non-addressable convertors

The most advanced state-of-the-art convertor design in the industry today!

Regal's new RC-83 Convertor is the smallest available, but it's big on features. The units include self test diagnostics, small footprint, 550 MHZ, favorite memory channel, last channel recall, and non-volatile memory.

The RC-83 Convertor is completely I/R downloadable to include:

- Channel Wrap-around
- Channel Allocation Tables
- NTSC – HRC – IRC – EIA Frequency Assignments
- Parental Guidance
- Barker Channels
- Channel Elimination
- Transmitter Disable

For more information, call our toll free number:
1-800-36-REGAL

REGAL® Technologies Ltd.

SUPPLIED BY ANIXTER CABLE TV

WEST-ANAHEIM: (714) 779-0500, (800) 854-0443; **DENVER:** (303) 740-8949, (800) 841-1531; **SEATTLE:** (206) 251-6760, (800) 426-7665; **MIDWEST-CHICAGO:** (708) 350-7788, (800) 544-5368; **CLEVELAND:** (216) 526-0919, (800) 321-8068; **DALLAS:** (214) 446-CATV, (800) 231-5006; **IRON MOUNTAIN, MI:** (906) 774-4111, (800) 624-8358; **SKOKIE, IL HDQTRS:** (708) 677-2600; **EAST-ATLANTA:** (404) 840-7901, (800) 242-1181; **LONG ISLAND, NY:** (516) 293-7788, (800) 645-9510; **NEW JERSEY:** (201) 328-0980, (800) 631-9603; **ORLANDO:** (407) 240-1888, (800) 477-8396; **CANADA-CALGARY:** (403) 250-9646; **MONTREAL:** (514) 636-3636; **TORONTO:** (416) 568-8999; **VANCOUVER:** (604) 321-5885.

CORPORATE OFFICES: REGAL TECHNOLOGIES LTD., P.O. Box 46076, Chicago, IL 60646, 1-800-36-REGAL

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