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Connected Devices and Applications in the Digital Home

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Introduction

This paper attempts to present the viewpoint of the consumer electronics industry concerning the Digital Home. The author's perspective is based on seventeen years in the consumer electronics industry, eleven years in the cable industry, five years as an entrepreneur, and twelve years as a consultant to cable and consumer electronics firms.

The first step is to understand the consumer electronics industry. This is a bit more complex than it might at first appear. The next step is to explore the nature of the technology drivers. A third step reviews the applications. Finally, the implications for cable are outlined.

It is critically important to understand the players in the Digital Home, in particular the consumer electronics industry. The technologies that drive the consumer electronics industry are unstoppable. They enable applications that are complex and can be very confusing for their consumer, our subscriber. All of this gives rise to serious challenges for the cable industry.

The Consumer Electronics Industry, Source of the Devices in the Digital Home

The first thing to understand about the consumer electronics industry is that it is comprised of two major segments which don't always have the same goals. They are the manufacturers and the retailers. Both find themselves in an extremely competitive environment. Retailers operate on slim margins and manufacturers on even slimmer ones. The manufacturer needs the retailer to take and move the inventory quickly. The retailer is worried about getting stuck with uncompetitive products or alternatively not having enough products for the principal selling seasons. Technology obsolescence is deadly. Last year's products with last year's features may have to be sold at a loss.

By definition, consumer electronics products are sold to consumers. This influences the product design, packaging, servicing and support, instruction brochures, marketing and sales training and other aspects of the business. Originally, consumer electronics manufacturers sold their output to multiple, independently owned, "authorized" distributors, regionally located, who each sold to and supported numerous retailers. These distributors handled a variety of products as intermediaries between multiple manufacturers and retailers. This was called two-step distribution and was also a

method of financing for manufacturers since the distributers purchased the products at a discount, getting the inventory off the manufacturer's books and making a profit as they re-sold them on to the retailers. A retailer could obtain products from the catalog in a day or two since they were locally stocked. Later, cost pressures forced the distribution function to be absorbed by the manufacturers.

The alternative to a consumer electronics sale is an industrial sale such as we experience when a cable company purchases cable set-top boxes. In that case, units are stacked on a shipping pallet, wrapped in plastic protective sheeting and bulk-shipped to the customer. Marketing, packaging, and support are much simpler. It's a different market.

The retail landscape has changed dramatically over the last couple of decades. "Big box" store retailers purchase inventory in truckload volumes giving them strong negotiation power. This drives out smaller retailers who don't have the same bargaining position. The Internet has created another option. Manufacturers can sell directly to consumers, retaining all of the margin for themselves. The consumer wins with lower prices, at least in the short run.

Few other industries have members that are so intensely combative. As a result, those who have survived – and many have not – are immensely productive and very efficient, low-cost producers. Their skills in constantly increasing production rates and reducing costs are amazing. A result is that each factory increases output every year. Consequently, there is nearly always a capacity to produce more than the market wishes to absorb. This causes downward pressure on prices.

Additionally, there are few barriers to entry. It is relatively easy for companies (and countries) to enter the business and also leave. Moving factories to lower wage areas of the world is a common competitive practice. There is great mobility in the consumer electronics industry. Familiar brand names from the distant past sometimes reappear on products made in some foreign land. Those brand names have no connection with their long-gone original owners. But they are more familiar than the names of the companies making products under those names.

Because of these factors, the consumer electronics industry lacks pricing power. Not only is it impossible to increase prices, in most cases prices must be reduced each year to match a competitor's action. At the same time, manufacturing costs increase due to inflation, wage and benefit increases, and the addition of new product features. Aggressive cost reduction is necessary to preserve even a small profit margin. For the consumer, there is both joy and aggravation. "Early adopters" who buy the first version of products shortly after introduction experience the frustration of better products and lower prices a year or two later. For some, this does not matter, they love being first. For others, it is off-putting. The consequence for the cable industry is that subscriber homes are continually adding consumer electronics products, many of which have Internet connections.

Most consumer electronics manufacturers do not make all of their components. Most components are made by specialized suppliers. Even the Liquid Crystal Display, LCD, panels are made by a small number of suppliers. These common suppliers tend to cause the products of the various manufacturers to be very similar. When a manufacturer develops a new feature requiring a special component, the manufacturer usually gets only a one year exclusive on the new component. The need to expand volume to reduce price almost always forces the component to become available to all competitors. This leads to commoditization.

Pervasive technical standards are another characteristic of the consumer electronics industry. This is primarily because the products of the consumer electronics industry display programming and other signals that come from other program distribution industries, such as Broadcast, Cable, and Satellite. Thus standards are needed to ensure that there are specifications to guide product design so that these signals can be converted to video and audio. These technical standards are frequently developed by inter-industry committees involving competitors from both the manufacturing and the program distribution sides. Care must be taken that the standards setting process remains legal and does not become anti-competitive. The consequence is that most members of the industry are ready with products shortly after standards are fixed. In this age of downloadable software, products sometimes are introduced based on interim standards with the final standards installed via a software download. This also tends to commoditize.

Just because a product is required to comply with a technical standard, doesn't mean it must be identical to its competitors. Features which distinguish one manufacturer's products from another are prized and critical to a temporary success. The success is temporary because the feature is quickly copied and becomes commonplace. Only a one-model-year advantage can be expected.

Patents are issued in huge quantities to companies in the consumer electronics industry. Rarely are patents used to preclude a competitor from competing. Rather, each party to a dispute brings their patent portfolio to the negotiating table. Cross-licenses are agreed to with a modest flow of money, i.e. patent royalties, from the side with the weaker portfolio to the side with the stronger one.

Understanding the Goals of the Consumer Electronics Industry

The primary goal of a manufacturer (or retailer) in the consumer electronics industry is simply to survive! A secondary goal is to enjoy at least a small profit.

The strategic goal of any company is to find a sustainable competitive advantage to help it compete against the others in the industry. This has not been possible in most of the consumer electronics industry. At best, a temporary advantage is hoped for that will last at least one annual product cycle.

A distinguishable feature visible to a potential customer on the retail sales floor is a prime design goal. That is the time when the purchase decision is made. The usual

retail sales floor has multiple rows of displays all showing the same programming. Almost without exception, the images are excellent and essentially indistinguishable from each other. The programming usually comes from a DVD player or a satellite dish. Very rarely is a cable signal used. This is primarily because most retail establishments are not located in areas that already have a cable feed. So the customer is not able to see performance on a cable signal. The customer's expectations are set by the display resulting from the signal used on the sales floor.

The continual search for the distinguishing characteristic that will make a product stand out amongst similar others on the crowded sales room floor leads to "feature creep", the practice of annually adding new features that are hoped to attract the attention of the potential consumer. Frequently, these appear to be gimmicks rather than genuinely useful additions. Unfortunately, they add complexity that creates confusion for the consumer and the sales person. Too little attention is paid to ease of use leading to confusion and frustration. Complex user manuals are needed. Often, these manuals are available only on-line rather than in-print. Customer support over automated phone systems frequently fails to solve the problem while increasing the frustration.

The consumer electronics business is a difficult one for several reasons including the fact that after the consumer electronics sale is made, there generally is no further revenue for the retailer or the manufacturer. To make matters worse, the products, particularly television receivers, have a long life. A television receiver typically lasts at least a decade; two decades is not uncommon. It seems only the personal computer segment has managed to find a way to obsolete existing products every three to five years. To a large extent, that obsolescence is due to evolving software.

The consumer electronics industry has long lusted after the continuing revenue stream enjoyed by cable. It may be they have their chance now. Many of the new products have Ethernet connectors or built-in Wi-Fi. In many cases, brand name Internet video services are built into the TV. It is believed that in some cases a fee is obtained for building in these services. It is also believed that in some other cases, a continuing royalty is provided. Some manufacturers have added services with their own brand. This may be the achievement of a long-held hope, a continuing revenue stream after the sale of the product.

The "Digital" Driver of the "Digital Home"

Digital technology changes everything! It enables a number of elements critical to the Digital Home. Most importantly, digital technology enables signal compression so subscribers can be offered many choices. Digital technology makes large screen flat panels possible. Communication to the home and in the home is revolutionized by digital techniques. And the signals can be protected against theft and tampering. All of this is facilitated by inexpensive, large-scale digital memory.

The famous Moore's Law states that the number of digital transistors that can be had for a given price doubles every eighteen to twenty-four months. Conversely, the cost a given number of digital transistors is reduced to half every eighteen to twenty-four

months. This is due to continual reduction in the size of the transistors made possible by ever-improving digital semiconductor technology. This advantage is not enjoyed to the same extent by analog transistors. Analog technology's need for linear transfer functions severely limits and complicates the potential for size reduction.

An article in the September 6, 2010 issue of Fortune Magazine has the amazing title of "100,000 transistors now cost less than a grain of rice." The author, Geoff Colvin, purchased a five pound bag of rice for $4.85. He estimated that it contained 150,000 grains of rice. He then purchased at retail a 16GB flash drive for $32.95. He states that there are 128 billion transistors on that flash drive (eight transistors for each of the 16 billion bytes of storage locations). His arithmetic says that for the same price he paid for a single grain of rice, he bought about 125,000 transistors. Now, I don't know if each memory location in his flash drive had just one transistor or if each location stored more than one bit. I'm also sure that there were other transistors on the chip to do the addressing and input / output functions. So the exact number of transistors is likely somewhat different. The point is that a huge number of transistors cost a trivial amount of money. And amazing things can be done in consumer electronics products with that resource. By the way, when I was a youngster of about fifteen years, I received a gift of a single transistor (CK722) to experiment with. That transistor then cost about $8.00. Using the Consumer Price Index calculator from the U.S. Government Bureau of Labor Statistics web site (http://data.bls.gov/cgi-bin/cpicalc.pl), that $8 converts to about $62 in today's money!

The principal advantage of massive quantities of cheap digital transistors is the ability to make inexpensive, large scale memory. Memory is very difficult and expensive to make with analog devices, but simple with digital technology. Large amounts of memory enable the compression of signals. Digital video and digital audio compression become possible because an image can be stored and searched for redundancies to eliminate. Furthermore, that stored image can be compared with the succeeding image and only the changes transmitted. This saves bandwidth and also storage capacity. Similar things can be done with audio and data. Not much compression could be achieved without digital memory. The process is reversed in the receiver, again, using copious quantities of digital memory.

The first application of digital memory in the Digital Home is signal compression. The original purpose of converting the television signal to a digital format was to reduce the bandwidth of a new high-definition, HDTV, signal to fit into the old 6 MHz television spectrum. But HDTV images can only be appreciated on large screens; on small screens they are almost indistinguishable from standard definition images. Fortunately, digital technology is the enabler of large screens.

It was later determined that the same compression techniques that squeeze an HDTV signal into 6 MHz can put several standard definition television, SDTV, signals into that same 6 MHz.

The second application of digital memory in the Digital Home is in flat screen displays. To understand why digital electronics enables large, flat screens, recall that analog television transmits a serial signal which represents the two dimensional image. The serial signal is converted into the two dimensional image by left to right scanning of video lines and then scanning the lines down the image. This scanning was commonly done in a Cathode Ray Tube, CRT. The CRT's electron beam is moved across the image screen by locally created scanning waveforms. These scanning waveforms are synchronized to the signal source. The vacuum bulb needed for the electron beam adds substantial depth to the display and the leaded glass contributes significant weight. The size of the screen is limited by the maximum depth that can come through a residential door frame and the weight that is reasonable for the receiver. My twenty-year-old television receiver has a thirty-five inch screen and just barely makes it through the door. It also weighs four hundred pounds, due mainly to the picture tube. CRT technology is not practical for HDTV's large screen requirements.

Large screen Liquid Crystal Display, LCD, and Plasma screens are relatively thin and solve the problem of getting into the home. They are also relatively light for their size. But they have no mechanism for creating a raster. Each picture element, Pixel, must be individually addressed. Digital transistors in large quantities are required to process signals to drive non-raster, scanned, large-screen video displays.

The third application of digital memory in the Digital Home is to enable much greater digital bandwidth to the Digital Home and wireless communication between consumer electronics products inside the Digital Home. Digital processing and memory are used for complex modulation methods and signal error correction and detection which are necessary for pervasive wireless communication between electrical devices at very low cost. Wi-Fi, Bluetooth, ZigBee and other forms of signal transmission would not be possible with just analog devices. The Digital Home is now interconnected.

The fourth application of digital memory in the Digital Home is the protection of signals against theft and tampering. When services are to be sold, they must be denied to those who refuse to pay. This is done with "conditional access", CA, techniques. The condition for access is the payment of the fee. Present day CA depends on digital processing and memory. A special case of CA is downloadable encryption. The advantage of downloadability is the ability to change the CA technology if it has been compromised. This eventually leads to consumer electronics products with sufficient hardware to accept CA software downloaded by the program provider, avoiding the need for the set-top box. This fulfills another long-held desire of the consumer electronics industry; i.e. the ability to sell cable set-top boxes.

The Connections in the Digital Home

In-home, digital, two-way communication enables the connections between a wide range of interesting consumer electronics devices and applications. Not only can these devices communicate with each other, but more importantly, they can access the Internet. These products are an important sales opportunity for the consumer

electronics industry and a major churn reduction method for cable. They lose much of their utility without the high speed Internet connection.

Importantly, in the home, wireless radio frequency connectivity has the potential for self installation of these devices. That removes a major cost impediment and the need to drill holes and string wires throughout the house, a major inhibition to the success of such products. The potential exists, but will only be fully realized, when installation and set-up are made easy enough for the non-technical consumer to implement. Until then, it's an employment opportunity for technicians and an additional cost impediment to sales.

Non-raster scanned, flat displays of varying sizes have become pervasive, built into a wide variety of consumer electronics products. Almost every new electronic device has a screen. Some are monochrome and only display text and simple graphics. All of these screens offer the potential to help with using the features built into these devices and the many choices made available. For the most part, this potential is still unrealized. Much work is needed on "human factors" to make these products "consumer friendly". Very few consumer electronics manufacturers have mastered this.

Consumers can watch video on numerous such displays and many of them can be wirelessly connected to an in-home system. The convenience of "place shifting" can be enjoyed by consumers. Video can be seen on television receivers, computers, the new computer video pads, and even smartphone displays.

The Applications in the Digital Home

Of course, digital cable provides the premier applications for the Digital Home. Hundreds of television channels, high-speed Internet connectivity, and Voice over Internet Protocol, VoIP, are the basics. The high-speed Internet connection is the back door for other applications via consumer electronics devices.

The applications of most interest to the consumer electronics industry are those that will result in more sales. Hardware sales are the first priority. But a close second priority is the sale of software and even subscription services on the hardware. If the consumer product is game hardware, Internet downloading of new game software is a natural. Games played against other players at different locations are especially attractive.

An early entry into the Digital Home came from Disney, called MovieBeam. A set-top box came with a hard drive loaded with a hundred movies. Each week, about ten of them would be replaced. Purchases were reported via a telephone connection. A proprietary modulation technology originally from EnCamera Sciences Corporation injected a megabit per second of digital data into the analog television signal without damaging the television signal. An over-the-air active antenna received these signals via the Disney owned ABC network and an arrangement with PBS. No monthly fee was involved, just a "rental" for twenty-four hour access to movies chosen by the viewer. The set-top box had an Ethernet connection for continued use after analog broadcast

television disappeared. The system was rolled out in twenty-nine cities, but failed to meet its financial objectives and was eventually shut down.

A number of alternate routes for video programming ride on the Internet connection.

An example of such connected devices for use with ordinary television receivers is the streaming media player sold by RoKu. (I have no idea where the name comes from or what it means, if anything.) The small set-top box has an Ethernet socket and built-in Wi-Fi for Internet access to video and Ethernet connection to photo and audio collections on the PC. HDMI, component, composite, S-video and optical audio outputs are provided and, of course, another remote control. There are no monthly fees for RoKu, but a number of services accessed thru the RoKu box, such as Netflix, do have monthly fees. A wide variety of Internet program providers participate; RoKu claims tens of thousands of choices. RoKu is a fine example of an easy-to-use-and-set-up device with compelling applications.

RoKu is not alone. Apple TV has a similar device, but with Apple provided programming. Recently, the price of the Apple TV box and the price for programming was more than cut in half. An agreement with ABC and Fox provides ninety-nine cent access to selected episodes. Still, Steve Jobs refers to Apple TV as a “hobby” of his rather than a business he hopes will be as successful as other Apple products.

Google, the web search giant, is turning to television. Google has announced that it is working with Sony to launch a “Google-enabled Internet TV” and a set-top box version which includes a Blu-ray Disc drive. Logitech is also working with Google on a set-top box. Google plans to offer software and data streams which will enable viewers to search, discover and organize content on the television receiver. With all the video that’s available, help in this regard could be very attractive. Google already provides searches across YouTube clips, Amazon’s VoD service and Netflix’s streaming video on personal computers. Google is planning to bring this capability to the big flat screen as well. One recent estimate for adding the processor and additional memory for Google TV to a television receiver put the retail price increment at $300. However, those prices only go in one direction. Time will tell whether this effort becomes successful.

The line between TV and PC has significantly blurred. Previously, these were very dissimilar, each with its own applications and uses. Now, video is commonly consumed via PC. This is done primarily via the Internet, but some PCs come with television tuners and aftermarket add-ons are available both for internal installation and external connection. Many very narrow interest programs are sold on the PC. Just one example, the recent Rolex Equestrian Championship Three Day Event in Kentucky, was offered live over the Internet for a fee. Many consume (waste?) hours on YouTube video clips, a fun “work-avoidance” activity. “Social Networks” such as Facebook and Twitter consume more PC time, especially among the young. And Skype provides free P- to-PC video phone connections anywhere in the world at no charge.

Now the television receiver is taking on a PC personality. Nearly all television receiver manufactures now sell “Internet TV” receivers. The Internet connection makes it possible to sell programming on demand. If the consumer electronics manufacturer installs access to a video provider, a fee is almost certainly involved. This is similar to the computer industry practice of installing introductory versions of software on new computers. This has been called “crapware” (if the Wall Street Journal can call it that, I suppose I can too!) because for the most part, it is unwanted and annoying. This is just one more way in which television receivers and computers are “converging”.

In fact, the differences between computers and television displays are disappearing. The computer I am writing this paper on has a full HD display. The sticker on the computer says it has a 1080p screen. The laptop also has an HDMI connector on the side. At the same time, the large screen TV has a computer connector. It also has Ethernet and Wi-Fi so it can be connected to the other devices on the home network.

We are rapidly moving to a world in which nearly everything electronic is connected. All of the home computers are Wi-Fi connected to each other and the Internet. The home server, the color laser printer, and the TiVo are also networked as is the non-TiVo DVR from the cable company. An Ethernet-connected server can currently be had for about $200 with a one terabyte drive and a slot for a second terabyte drive (which costs less than $100). With the second drive in place, a RAID relationship is established, duplicating the contents of the first drive. If either drives experiences a failure, the surviving drive can be used to replicate itself onto a new drive. This becomes the backup for the family’s computers and also the electronic family album with photos, videos, and music accessible to any Wi-Fi or Ethernet device in the house. In some products these photos, videos and other files can be password accessed from any Internet connection in the world.

In my home, remote monitoring, home security and home automation are near-term projects already in the planning stage. Wi-Fi, Bluetooth and ZigBee will allow me to avoid excessive drilling of holes and running of wire. While some products come with just an Internet connection, Wi-Fi adapters allow installation where a Cat-5 wire is inconvenient. The hope is for significant convenience improvement and even somewhat of a “greener” energy posture. The seven handset wireless phone system is connected to cable VoIP. This system also connects via Bluetooth to the cell phone. So if the cell phone is in Bluetooth range of the base station, it can be answered from any of the seven cordless handsets, even the one in the barn.

In spite of all the computer-like features, these consumer electronics products must not behave as computers. The consumer electronics industry must avoid “the blue screen of death” when the device locks up and requires a total reset. Installation and set-up must become as automatic as possible to allow easy self install.

The relationship between the cable and the consumer electronics industry has been a checkered one. In the 1980s and 1990s, the cable industry wished television receiver manufacturers would just make monitors and leave the tuning to the set-top box.

Conversely, the consumer electronics industry argued for government rules against scrambling. Of course, both of these position are unrealistic since they are each very destructive to the business models of the other side. Inter-industry committees devised technical solutions that allowed a set-back approach with the descrambler connected between the television receiver's tuner and the rest of the television circuitry via a set-back plug. While the technology worked and was affordable, the business mavens in the two industries did not cooperate and the approach was not successful. The digital world saw another approach that came to be called CableCARD™. This is a special use PCMCIA card. The PCMCIA card is also called a "PC card". CableCARD was to obviate the need for a set-top box by plugging the card-carried decryption circuits into a CableCARD slot in the television device. This approach was also meant to allow consumer electronics manufacturers to make and sell digital cable set-top boxes with additional features. In order to ensure that the cable industry supported the CableCARD, the consumer electronics industry obtained an agreement that resulted in a Federal Communications Commission, FCC, requirement that new digital cable set-top boxes include CableCARD rather than have built-in conditional access. This, of course, added significant unnecessary expense to the set-top box. Somehow, this did not result in large numbers of consumer electronic products using CableCARD. While the cable industry has installed over twenty million cable set-top boxes with CableCARD, only about five hundred thousand CableCARDs were requested by subscribers for use in television receivers. Since my cable system recently went all-digital, I went looking for a television receiver with a CableCARD slot to use with the CableCARD offered by the cable company. I also went looking at retail for a digital cable set-top box, either with or without a CableCARD slot. I found neither and was usually greeted with just a blank stare by the sales person at the store. I only found a TiVo digital video recorder with a CableCARD slot.

If I was a cynical person, I might wonder why I could find no retail products with CableCARD slots. I might think that CableCARD is not offered because it might compete with the Internet TV offerings which might be a continuing revenue stream for the television receiver industry. But I am not a cynical person.

We continue to use the term "set-top box" even when there is no usable set top on a flat screen television. But then, you still hear people refer to the television remote control as "the clicker".

More and more, we are getting to where, in the words of the ad, "there's an app for that". With computer power built into so many products, the applications continue to grow.

Cable's Role in the Digital Home

The Digital Home constitutes both challenges and opportunities for the cable industry. Cable is now in a much more competitive environment. Cable is accustomed to competition from overbuilders, Direct Broadcast Satellite, the telephone company's offerings, and broadcasters. Now there are services that sneak in over the Internet connection. More importantly than ever before, cable's services must be clearly and

visibly superior. It is most important to be clearly superior to the services coming from the Internet because they are readily available and easy to compare with cable service. This can be done by the subscriber with the push of a button. Not only must the programming and video quality be superior, but the ease of use must be much better. A principle factor of “ease of use” is being able to find programming that is of interest. A comprehensive electronic program guide with great human factors is essential. This can be a major competitive advantage over the Internet delivered competition.

And don’t forget the elderly. More of the population falls into that category. They, more than most, need ease of use. My 92-year-old mother-in-law’s cable system just went all-digital. She now, for the first time, has a set-top box. She only watches two or three different shows and their repeats. This is a major source of joy in her life. But she has difficulty dealing with two remote controls. Twice we received calls for help and a nearby sister-in-law has had to drive over to resolve problems. A cable technician was even called once. The problem stems from the very slow channel change causing her to think she didn’t press the button on the remote control properly. So she does it again. And again. And pretty soon the TV is no longer on channel three and a crisis is in full swing. Several things have been tried including strategically placed tape on the remote control buttons. But the problem persists. Hardware and system designers need to keep the elderly in mind and create service categories for them that are simple to use. Achieving this will be a major competitive advantage and the key to loyal subscribers who will not want to change to a competitor.

When customer service is required, it must be more effective and friendly than that provide by the new competitors coming in over the Internet. Again, this can be a major competitive advantage.

Nearly all Internet services are advertiser supported. Much of this advertising is different from that on cable because it is much more targeted. It can be based on “click stream analysis” and detailed knowledge of the consumer. This makes it less irritating. Intrusive advertising is both annoying and ineffective. Cable must respond to this challenge. In doing so, cable can create a significant advantage for itself by reducing the number of ads, but making them more carefully targeted, even individually addressable. The added revenue from addressable ads more than compensates for reducing the quantity. Ads that are meaningful are not (as) objectionable. Ads for products and services which are inappropriate and otherwise unwanted are very annoying. Attractive offers for products already purchased without the special offer are particularly offensive. With addressable ads, such insults can be avoided. Bringing this under control can be still another competitive advantage.

The existing analog television receivers are another issue that needs a solution. Most subscribers do not want a set-top box on every existing television receiver and VCR. Many can’t afford that. Years ago, I wrote a column in which I estimated the volume of exiting television receivers that would be made obsolete by the transition to all-digital television. Very conservatively, the volume then was a cube one mile on each side! The solution in my home is a four-channel agile analog modulator with inputs from the

digital set-top boxes and its output feeding the cable system already in the home. An infra-red signal transponder allows changing channels from other rooms. This has worked out quite satisfactorily, but was not inexpensive. The products used were sold to the professional market rather than the consumer market. Opportunity exists to provide more cost-effective solutions to cable subscribers and reduce the frustration over retiring those old analog television receivers and VCRs.

As more and more digital consumer electronic equipment is bought and brought home to be in-home connected, the cable operator will have the challenge of avoiding being blamed for the stuff that doesn't work! Of course, being able to make it work for a fee could be an opportunity. But this is loaded with risk.

Another major challenge will be to minimize and also deal with the lost revenue due to consumers by-passing some cable services by substituting these other Internet delivered services.

Conclusion

In summary, the "Connected Devices and Applications in the Digital Home" are both a challenge and an opportunity to the cable industry. Cable technologists need to understand the nature of the other players in the Digital Home. This includes taking into account their goals and needs. The unstoppable technical drivers of the consumer electronics industry must be appreciated. These give rise to complex and confusing applications, some of which impact the cable business. Opportunities for cable need to be maximized while responding aggressively to the challenges.