TOWARDS DIGITAL TERRESTRIAL TELEVISION IN SPAIN

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ABSTRACT

Television in Spain is nearing an important change. Broadcasters are beginning to disseminate their messages via digital transmissions. While digital terrestrial television (DTT) provides many enhancements over analog television, consumer adoption has been limited. The lack of diffusion can be attributed to variables in the technology, market, and regulation of the innovation of DTT.

The purpose of this work was to explain the diffusion digital television from a technological, market, and regulatory perspective. Digital television is a new and exciting innovation that will enhance both the television industry and the consumers' way of receiving information. The work tries to be a way to understand how public policy can better the transition to digital television and help DTT reach a critical mass among consumers. Furthermore, this work presents various policy recommendations that could be implemented to increase consumers' awareness and adoption of DTT and help digital television reach a critical mass.

CHAPTER 1
INTRODUCTION

Television in Europe and specially in Spain is nearing an important change. Broadcasters are beginning to disseminate their messages via digital transmissions. When this convergence from an analog to a digital signal is fully complete, Europeans will be exposed to the greatest revolution in television history. In fact, television will never be viewed the same way again. The most commonly known advantage of digital terrestrial television (DTT) is the enhanced quality of picture and sound, better known as high definition television (HDTV). However, digital television has the potential to serve the European public in a variety of ways, including each broadcaster being able to use their station to multi-cast four simultaneous streams of DTT programming to the viewer.

While DTT provides many enhancements over analog television, consumer adoption has been very minimal. The lack of diffusion can be attributed to a variety of variables that exist within the technology, market, and regulation of the innovation of DTT. For instance, many consumers feel that they are receiving quality television from their current analog sets. Furthermore, the cost of a HDTV set is still very high for the average consumer and there are currently no benefits, such as tax credits or deductions to entice a consumer to spend a large sum of money for a product they feel is not a necessity. Additionally, the Spanish Government has imposed a mandatory deadline of April 04, 2010 for full transition of analog to digital transmissions. Considering the variables that are present with DTT, it is unlikely that this deadline will be met without some provisions to policy and regulation for digital television.

This work explains the diffusion of digital television from a technological, market, and regulatory perspective. Digital television is a new and exciting innovation that will enhance both the television industry and the consumers' way of receiving information. However, there is insufficient literature pertaining to digital television enhancements and contributions that the innovation will bring to society. The work tries to be a way to understand how public policy can better the transition to digital television and help DTT reach a critical mass among consumers.

Chapter 2 provides the methodology of the research. The work uses policy analysis, which is a social and political activity, to examine how the Diffusion of Innovation Theory can be used to have public policy expedite the transition of digital television. Chapter 3 thoroughly explains the historical, technological, policy, and market variables surrounding digital television. Chapter 4 offers a theory to better understand consumer awareness and adoption of particular technological innovations. Chapter 5 begins by providing a research framework that identifies the key aspects of diffusion theory that may be applied to consumer adoption of DTT. Finally, Chapter 5 presents various policy recommendations that could be implemented to increase consumer awareness and adoption; and ultimately help digital television reach a critical mass.

CHAPTER 2
METHODOLOGY

This work uses policy analysis to examine how the diffusion of innovation theory can be employed to have public policy expedite the transition of digital television. Policy analysis is a social and political activity.[1] Researchers use policy analysis when the subject matter concerns the lives of individuals within a society.[2] Furthermore, the process of policy analysis often involves other professionals and interested groups: "it is often done in teams or office-wide settings; the immediate consumer is a client of some sort like a hierarchical superior; and the ultimate audience will include diverse subgroups of politically attuned supporters and opponents of your work."[3] Eugene Bardach describes policy analysis as an art form rather than a science.[4] Bardach has developed an approach, which he calls the "Eightfold Path" for effective policy analysis.[5] The first step involved in the "Eightfold Path" is to define the problem. This step provides: "(1) a reason for doing all the necessary work to complete the project and (2) a sense of direction for your evidence-gathering activity.[6] Step two of the "Eightfold Path" requires the researcher to assemble some evidence.[7] Bardach explains that in this step, one must engage in two activities: "thinking and hustling data that can be turned into evidence."[8] Third, the researcher must construct the alternatives.[9] By alternatives, Bardach means "something like policy options, or

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[1] Eugene Bardach, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving*, Chatham House Publishers, 2000
[2] *Id.* at xiii
[3] *Id.*
[4] *Id.* at xiv
[5] *Id.*
[6] *Id.* at 1
[7] *Id.* at 7
[8] *Id.* at 7-8
[9] *Id.* at 12

alternative courses of action, or alternative strategies of intervention to solve or mitigate the problem."[10] The fourth step is to select the criteria of the research.[11] Bardach believes this step to be crucial for permitting values and philosophy to be woven into the policy analysis.[12] The fifth step is to project the outcomes of the alternatives the researcher has addressed.[13] It is important in this step to identify and project the impact that the alternatives will have on the researcher or other interested parties.[14] The sixth step of the "Eightfold Path" is to identify the trade-offs among the alternatives.[15] This step clarifies the trade-offs of outcomes associated with the different policy options for the benefit of the researcher's audience.[16] The seventh step requires the researcher to decide on the best course of action based on his/her own analysis. [17] Finally, the eighth step requires the researcher to simply tell the story to the audience.[18]

This study used only a few of Bardach's steps. First, the problem was clearly identified. Next, evidence was assembled in Chapter 3 and Chapter 4 using a variety of sources that are later explained in this chapter. Third, a framework analysis was used in Chapter 5 to complete the research. The fourth step was deciding the best course of action, based on the analysis of the present material. Finally, the analysis provides a complete and concise account of the research that the audience will be able to understand and ascertain.

Based on the above methodological framework, the work answers the following questions: What are the technological, marketing, and

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[10] *Id.*
[11] *Id.* at 19
[12] *Id.*
[13] *Id.* at 27
[14] *Id.*
[15] *Id.* at 37
[16] *Id.*
[17] *Id.* at 40
[18] *Id.* at 41

policy issues surrounding DTT?

How can diffusion of innovation theory inform policy to improve consumer adoption of DTT? As a result, this research will contribute to new knowledge by providing information as to how digital television will be further adopted by society.

To answer these questions, the following sources and types of data were consulted. Diffusion of innovation theory and digital television both require their own intense review of all relevant information regarding the present research. Chapter 3 utilized the various academic and trade articles, books, Internet sites, and government documents to help explain the technological, market, and policy issues surrounding DTT.

Based on Everett M. Rogers' book *Diffusion of Innovation*, Chapter 4 provides a thorough explanation of diffusion theory. Moreover, Chapter 4 further explains diffusion theory by reviewing journal articles and papers that apply diffusion theory to recent technological innovations. Upon review of DTT and diffusion, Chapter 5 presents an analytical framework that identifies the key aspects of diffusion theory that are the most relevant to understand consumer adoption of DTT. Next, the chapter applies this diffusion framework to digital television, using research from the literature review that encompasses diffusion research (Chapter 4) and the market, technological, and policy elements of DTT (Chapter 3). To complete the policy analysis, Chapter 5 ends by offering policy recommendations that will better consumer adoption of DTT and allow such adoption to reach a critical mass at a faster rate than what's foreseeable in the near future.

CHAPTER 3
DIGITAL TELEVISION HISTORY, TECHNOLOGY, AND POLICY

This chapter provides a basic overview of DTT's history, technology, and policy. First, DTT is explained from an historical approach. After a brief summary of the events leading up to DTT, advanced television in Japan, Europe, and the United States are discussed. Second, Chapter 3 provides information on the technological aspect of DTT. This section explains the differences between analog and digital television and provides knowledge of the advancements that DTT will provide potential adopters. Third, the policy and regulation regarding DTT are discussed. Finally, the current market situation for digital television will be explained. Ultimately, this chapter will provide an overview of the important issues regarding DTT and help explain why a consumer may adopt this innovation.

History of Digital Television

Digital television's roots can be traced back to the history of analog broadcasting. In the United States, television emerged as a viable medium of communication at the start of World War II. During this period the United States placed vital importance on the establishment of technical standards in transmission and reception equipment. In 1940, the National Television Systems Committee (NTSC) convened to decide the early guidelines for the transmission and reception of broadcast television signals.[1]

After the Second World War, the United States led the television revolution and ultimately provided the nation with the 525-line low

[1] *Id.* NTSC also developed the technical developments for adding color to black and white television sets. The term NTSC is frequently used to refer to both the television system and the sets we currently use.

resolution screens that we have all grown accustomed to viewing.[2]

In 1953, the NTSC approved an electronic color television system and petitioned the FCC for adoption.[3] Later that year, the FCC adopted the color standard.[4] After the color standard was adopted, broadcasting stations were quick to upgrade their transmission facilities to offer color programming.[5] By 1957, 106 of 158 stations operating in the top 40 markets had adopted the technology.[6] However, color programming options remained very limited for quite some time.[7] As of 1965, ABC, CBS, and NBC offered only approximately 2,500 hours of programming for an entire year.[8] In the same year, only 4.9% of U.S. homes were equipped with color television sets.[9] By 1970, the number of color television households had dramatically increased to 35.7% and to 68.4% in 1975.[10] The 1980s were monumental for color television, 83% had acquired color TV in 1980 and the number rose to 91.5% by 1985. The latest numbers report that over 99% of United States households had adopted color television by the end of 2002.[11] This is remarkable considering that only five consumer electronics products have even reached the 85% mark at all: TVs, color TVs, VCRs, radios, and telephones.[12] While the NTSC color standard provided the United States with a significant head start over Asian and European counterparts, consequently the emphasis placed in this system halted the implementation of newer technologies that were being developed.

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[2] *Id*
[3] David F. Donnelly, *Color Television*, www.museum.tv/archives/etv/C/htmlC/colortelevis/colortelevis.htm
[4] *Id.*
[5] *Id.*
[6] *Id.*
[7] *Id.*
[8] *Id.*
[9] Television Bureau of Advertising, Inc., *Multi-set & Color Television Households, 2008* www.tvb.org
[10] *Id.*
[11] *Id.*
[12] *Id.*

With the NTSC standard serving as a security blanket, it was not until the 1980s that the political climate forced the United States to seriously consider a change in the broadcast system. In 1981, the first American demonstration of high-definition television (HDTV) was presented at the Society of Motion Picture and Television Engineers (SMPTE) annual conference in San Francisco. The following year, Columbia Broadcasting Company (CBS) along with Nippon Hoso Kuyokai (NHK) presented their HDTV demonstration before the FCC. The presiding Commissioner Abott Washburn said, "It seemed like more than 100% better." As a result of these early demonstrations, in 1982 the broadcasting industry lobbied for the FCC to create a committee to study the impact an advanced television system, whether analog or digital, would have on the United States.

In November 1987, the lobbying turned into fruition as the FCC created the Advisory Committee on Advanced Television Services to analyze the possibility of moving to a more advanced television system. In the same year, HDTV was broadcast over standard television channels for the first time during public demonstrations in Washington, D.C. at the FCC. Commissioner McKinney called the transmission a "landmark", adding the demonstration was "impressive." In 1988, the Advisory Committee began testing both analog and digital HDTV systems. The major problem that broadcasters encountered while creating new analog systems was that the broadcast spectrum was already saturated with signals. The Advisory Committee learned that if high-definition pictures were going to be broadcast, the system would have to be digital so that the analog signals can be used for another purpose. The time wasted in developing new technology since the Second World War made way for other countries to flourish with new innovations. Once playing catch-up to the United States, many Western European

nations and Japan took over the lead in the implementation of HDTV.

In the early 1990's the development of HDTV was in a three-way race among Japan, the United States, and Western Europe. At this time Japan was considered as the undisputed leader in technology and broadcast capability.

Japan

Japan had been developing HDTV technology for more than thirty years. Their government was instrumental in developing and implementing a commercial HDTV industry. Until recently, the Japanese have been at the forefront of HDTV innovation and technology. Now, the United States seem to be regaining the lions share of broadcast technology. This is largely due to the United States' development of an all digital HDTV system, while Japan first embarked on creating an analog HDTV system that is not as advanced as its digital counterpart. The following section will explain Japan's role in HDTV development.

In 1970, the Japanese government owned broadcasting company, Nippon Hoso Kuyokai (NHK), which gains revenue through a mandatory "television tax" imposed on each household, began researching the possibilities of analog HDTV. It was Dr. Fujio of NHK who headed this initial research phase. Dr. Fujio and his core team of researchers were allotted a percentage of the multi-billion dollar mandated tax revenue to pursue research and development. Under Fujio's command, NHK coordinated separate research tasks to equipment suppliers, including Sony, Mitsubishi, and Toshiba, in the development of system components and HDTV-related technologies. By using this method, NHK maximized efficiency and avoided duplication of the desired research and made the results available to all involved companies. As a result of NHK's research commitment, Japan became the first country to offer regular HDTV

programming. In June 1989, NHK began broadcasting one-hour of the standard Japanese analog HDTV (called MUSE) programs per day. By November 1991, the programming was increased to over eight hours per day. People who subscribed to cable or direct broadcast satellite could only view these programs. Ultimately, Japan had to create a conversion system that enabled each television in the country to receive the HDTV signals. However, Japan has recently opted for the 1,125 line, 60 Hz 2:1 for interlaced scanning. The Japanese analog HDTV standard has now been abandoned to make way for a new digital system.

Europe

In 1985, the United States and a number of European broadcasters gave their support to Japan to have the analog MUSE HDTV system adopted by the International Consultative Committee Plenary Assembly (CCIR). However, the majority of the European broadcasters proposed that the adoption of the standard be deferred. The Europeans initiated a proposal to offer an intermediate approach to the MUSE system. This proposal, called MacPacket, differs from the Japanese system in that it would not make existing television sets obsolete. MacPacket would allow users to have HDTV quality from their current sets with the help of a converter box. The European lobbying effort before the CCIR paid off and the CCIR decided not to make MUSE the universal system. This decision enabled the European broadcasters to develop HDTV based on technology derived from MacPacket.

In 1986, broadcasters from nineteen European countries announced the formation of the Eureka-95 project. This venture was created to develop a European HDTV system and to promote the domestic electronics industry. Over 20 companies lead by Bosch, Philips, and Thompson, came up with the HD-MAC, a system that uses analog technology and satellite transmission, just

like the Japanese system. In 1988, the Europeans successfully demonstrated the HD-MAC prototype chain using 1,250 lines/50 Hz/2: 1 for interlaced scanning. However, Europe chose to extend the implementation schedule and launched the D2-MAC system in May 1992. The D2-MAC, developed by SGS-Thompson of France and Philips of the Netherlands, was installed as an interim step towards the HD-MAC, a full analog HDTV system. In the early 1990s the project was completely abandoned for the development of a digital system.

United States

In 1982, CBS worked in conjunction with NHK to bring a universal HDTV system to the World. Many broadcasting and manufacturing companies throughout the United States and Japan had been working together with CBS and NHK in favor of the Japanese system. However, by 1990, the United States believed that it was not in their best interest to continue with Japan and embarked on developing its own system. The United States concentrated on reviving its own consumer electronic industry, rather than pumping money into the Japanese economy.

In 1987, President Bush believed there to be an imminent military threat that a foreign dominated HDTV industry could pose and ordered the Secretary of Commerce to place an emphasis in developing the American HDTV system. Also, in the same year, the National Association of Broadcasters addressed FCC Chairman Mark Fowler and many officers in Washington, D.C. to express concerns over UHF channels. The NAB argued that if the FCC had given away the vacant UHF channels, lack of spectrum space would make broadcasters unable to deliver HDTV. A NAB officer said, “and that would lead to the death of local broadcasting as we know it.” In 1989, the Defense Department agreed to grant $ 30 million to American companies developing HDTV screens and video display

processors to expedite new innovations. The following year, General Instruments (GI) proposed an all-digital HDTV broadcast system known as DigiCipher to the Advisory Committee. In 1991, the FCC fulfilled the spirit of President Bush's order, declaring that the HDTV system would have to be all digital and fit into 6 MHz., the same amount of bandwidth used to transmit an analog NTSC picture.

By 1992, GI in conjunction with the Massachusetts Institute of Technology (MIT) demonstrated the all-digital HDTV DigiCipher for the National Association of Broadcasters Conference and Exhibition in Las Vegas. The Advisory Committee was impressed and ultimately decided there was no need to further discuss an analog contender.

In 1993, the "Grand Alliance" was formed consisting of GI, Zenith, AT&T, and ATRC. The "Grand Alliance's" mission was to jointly develop a single American HDTV system. In the same year, the "Grand Alliance" committed to support the MPEG-2 digital compression system; a six-channel, CD quality Dolby music system; 1,080-line interlaced scanning and 720-line progressive scanning.

Over the next several years HDTV would gradually develop and programming would be produced. In 1995, WRAL-HD of Raleigh, North Carolina disseminated the very first public transmission of HDTV. In 1997, the station broadcast the Duke versus North Carolina State football game in HDTV. The station placed HDTV sets on the concourse level of Carter-Finley Stadium in Raleigh offering spectators the chance to experience the broadcast live. That same year, WHD-TV of Washington, D.C. became the first station to broadcast a network program, *Meet the Press*.

In April 1997, the FCC presented a time-line that required all television stations to switch from analog transmissions to digital broadcast by specific deadlines. Stations affiliated with ABC, CBS,

NBC, and Fox in the top ten markets had to have DTT facilities constructed by May 1, 1999. May 1, 2002 was the deadline for all other commercial stations to construct digital facilities. The last construction phase is for all public television stations to have facilities by May 1, 2003. Next on the timeline, DTT stations are required to begin a partial simulcast of the analog channel's video content by the end of 2003 and full simulcast by the end of 2005. This all leads to the goal of full transition by 2006, at which time citizens must have purchase either a HDTV set or converter box to receive the digital signals. However, some television stations will be permitted to broadcast an analog channel if less than 85% of the households in the market have at least one of the following: (1) digital television delivered by satellite or cable; (2) a digital television set; (3) or a converter box that allows for digital viewing on an analog set. [13]

Historical Implications Tied to Policy

The history of digital television created implications that ultimately affected policy. To begin, Japan was the first country to adopt an HDTV system. The Japanese created an analog HDTV system that required 36 MHz. However, the United States government was not willing to devote this much space to HDTV because of spectrum allocation, defense, and industrial policy reasons. As a result, the U. S. policy formation for HDTV was centered on finding a way to use less spectrum, making it ripe for a digital HDTV system in the United States.

Another implication of DTT's history was the lobbying effort by the broadcasting industry. This lobbying led to the American FCC creating

[13] *In the Matter of Carriage of Digital Television Broadcast Signals,* CS Docket o. 98-120, First Report and Order and Further Notice of Proposed Rule making, FCC 01-22 Jan. 23, 2001.

the Advisory Committee on Advanced Television Services. The mission of the committee was to analyze the feasibility of moving to a more advanced television format and to evaluate competing systems. The original plan did not give preference to any one format, such as digital HDTV. As the committee name implies, the new technologies were instead, referred to collectively as advanced television (ATV). In 1988, both analog and digital systems were tested.

However, broadcasting spectrum was already saturated with signals. Ultimately, the committee decided the system would have to be digital. An analog signal of similar quality would require significantly greater bandwidth and there was simply not room available in the portion allocated to television broadcast. Less than a year after its formation, the advisory committee issued and the FCC adopted, a Tentative Decision and Further Notice of Inquiry regarding advanced television. This decision foreshadowed the FCC's pro-digital policy in the coming decade.

The Grand Alliance's adoption of a digital standard that was later manifested to all sorts of scanning format possibilities within DTT and HDTV provided another implication. This development led to policy that did not adopt a universal U.S. standard for DTT. Ultimately, this has resulted in issues regarding programming and scanning formats, multiplexing, and lack of consumer understanding and knowledge of digital television. In contrast, Japan adopted one standard for analogy HDTV, making it easier to adopt a more uniform policy approach.

In summary, digital television's existence is due in large part to analog television and the impact the broadcasting industry had on policy-makers of the United States. Also, Japan and Europe's successes in forming an advanced television system influenced the

United States to implement its own HDTV system. Following demonstrations of HDTV systems, in 1987, the FCC created the Advisory Committee on Advanced Television Services. Ultimately, the Advisory Committee decided that if high-definition picture were to be broadcast they would have to be digital. Thus, in 1993, the "Grand Alliance" was formed consisting of GI, Zenith, AT&T, and ATRC. Their mission was to jointly develop a single American HDTV system. In the same year, the "Grand Alliance" committed to supporting the MPEG-2 digital compression system; a six channel, CD quality Dolby music system; 1080-line interlaced scanning and 720-line progressive scanning digital system. Then in 1997, the FCC presented a time-line that required all television stations to switch from analog transmissions to digital broadcast by specific deadlines. The following section will explain the technologies that exist for viewers to receive this broadcast.

Technology of Digital Television

The historical section explained the events leading to DTT. The following section provides an overview of the technology required for switching from an analog to digital television system.

The technology behind broadcast DTT is much different than standard analog television. An analog system uses varying voltages to transmit a television picture. In a DTT system, images and audio are captured using the same binary code of ones and zeros found on computers. These differences require broadcast stations to construct new transmission and reception equipment, costing €2-7 million per station. These advancements in technology will be felt, in further cost, by broadcasters, cable and satellite companies, as well as consumers. Broadcasters will have to buy new equipment, such as cameras, editing machines, tape decks, to name a few. Cable and satellite operators will feel the burden by having to convert equipment and introduce new set top boxes in

consumers' homes that allow subscribers to view DTT broadcasts. Finally, consumers will have to purchase either a converter or set top box for their analog TV to receive digital signals, or an expensive DTT set to view programming.[17]

The costs to switch from analog TV to DTT are almost as great as the differences in the technology of producing the digital content. DTT may provide almost ten times the picture resolution of an analog television picture. Analog television is made of horizontal lines consisting of little dots known as pixels. There can be as many as 525 horizontal lines on an analog TV set, but usually only 480 of these lines are actually visible. There is an electronic device inside the analog set that displays each 640 pixel line, one-by-one, from top to bottom, at approximately thirty times per second. On the other hand, a HDTV picture contains 1,080 lines with 1,920 pixels in each line, consisting of about two million pixels.[18]

HDTV can provide this type of higher resolution because of the formats available in digital television.[19] Multicasting seems to be the greatest advantage that DTT seems to provide the broadcaster.[20]

Multicasting allows a broadcaster two air either four standard-definition (SD) programs; two SD and one HDTV program; two HDTV programs at the same time.[21]

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[17] *Telecommunications, Additional Federal Efforts Could Help Advance Digital Television Transition,* United States General Accounting Office, *Report to the Ranking Minority Member, Subcommittee on Telecommunication and the Internet, Committee on Energy and Commerce, House of Representatives,* GAO-03-7 November 2002.

[18] Peter Seal & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 79

[19] *Id.*

[20] www.current.org/DTV/ last viewed 15/05/08.

[21] *Id.*

The extra channel space allowed to broadcasters will no doubt be used to expand advertising revenue and may even be used for data transmissions. The following table displays the specified 18 digital transmission variations.[22]

DTT broadcast formats may be based upon interlaced or progressive scanning.[23] Interlaced scanning uses the same technology as analog television, in which every other line is visible in one scan[24] where as progressive scanning displays the entire picture in one scan.[25] Currently, the highest level of a progressive signal that will fit into a 6 Mhz DTT broadcast channel is 720-P. ABC and Fox have adopted the 720-P as their format for broadcasting HDTV signals, while NBC and CBS are using 1080-I. Progressive signals are cleaner than interlaced ones, making 720-P and 1080-I signals comparable in quality. A 1080-P signal is the highest resolution format, but is currently beyond the capacity of TV channels. Other than the greater resolution provided by these two HDTV formats, HDTV provides many more distinct advantages over analog television.

First, HDTV provides a much higher quality of sound.[26] The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound.[27] The second advantage of HDTV is the aspect ratio.[28] The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture.[29] HDTV's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewer's

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[22] *Id.*
[23] *Id.*
[24] *Id.*
[25] Peter Seal & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 79
[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] Id.

line of sight.[30] Although SDTV's aspect ratio is 4:3, digital quality SDTV allows for Dolby 5.1 surround sound as well as a clearer picture than analog broadcast.[31] Furthermore, a digital transmission of SDTV allows for the multicasting component that is an essential component of advanced television.[32]

Technological Implications

The technological evolution of DTT has created implications that will affect policy. First, DTT is a much different technology than analog television. The difference in the technology will require manufactures, broadcasters, and consumers to learn new skill sets related to digital television. Thus, an issue raised is how will policy inform each of these separate entities about the technological advancements associated with switching to a digital system and provide information on the new skills needed for DTT. Second, cost will be felt by all of these separate groups. This implication raises the issue on how policy can be implemented to detour some of the financial burdens that will occur due to switching from an analog to digital system. Third, these technological advancements can include higher resolution, multicasting, better aspect ratio, and enhanced sound.

An issue that is raised is how will policy address these advancements and which advancement will likely take a more prominent role to help increase consumer adoption. Furthermore, depending on which advancement drives adoption, monetary gain will be achieved by broadcasters and/or manufactures. How will policy address this issue, and what steps might be taken to assure

[30] Id.
[31] Id.
[32] Id.

broadcasters will still serve the public interest requirement while earning a profit? Another implication based on technology is the progressive versus interlaced debate, including the 18 possible scanning formats available with DTT. The issue this raises is that with the creation of a single or standardized format(s), much consumer, industry, programming, and retailer confusion would be eliminated from the scenario.

In summary, the technology behind DTT is much different than standard analog television. These advancements in technology will be very costly to broadcasters, cable and satellite operators, and consumers. However, the costs are due to the extreme advancements DTT will have on television. First, DTT provides almost ten times the picture resolution of an analog television picture. Second, multi-casting will allow for many more viewing options and 18 digital data transmission options, benefits to both consumers and broadcasters. Finally, with a 16:9 aspect ratio and 5.1 Dolby digital surround sound, DTT will provide the consumer with an extremely enhanced viewing experience.

DTT Policy and Regulation

The knowledge of the historical and technological aspects of digital television is necessary for understanding the role of policy and regulation of DTT. This section will thoroughly explain how DTT has been regulated in Europe.

Regulatory models for allocation of digital capacity and access to DTT networks

The regulatory model chosen by different countries for the allocation of digital capacity (spectrum) has also been considered as a factor

that affects the development of DTT.

Very different regulatory approaches have been adopted: in most cases (Germany, UK, Netherlands, Italy, Spain, Austria, Ireland, Lithuania ...) the capacity is allocated to one or more network/multiplex operators. In other cases (Sweden and Finland) the capacity is allocated directly to channels.

In evaluating the regulatory model though, what appears to be relevant, rather than who has been assigned the capacity, is how access to this capacity is regulated.

Two different regulatory approaches seem to emerge: in a first group of countries (e.g. Finland, Germany, Sweden) the channels' line-up is the result of a selection made directly by the regulator/government through public procedures that are very similar to those used in the analogue environment; in this case whether the frequencies are allocated directly to the broadcaster or to a network operators, the line-up of channel that have access to the capacity is predefined by the government/regulator.

In a second group of countries (Italy, UK, Norway) the capacity is managed as a whole by a multiplex/network operator who is relatively free in using the capacity and selecting the channels part of the line-up. In this case, some limitations or constraints (must carry, capacity reserved to special categories of broadcasters, etc.) are imposed in order to preserve public interest objectives such as diversity and pluralism.

As far as the offer structure and the business model are concerned, two different DTT models and "paradigm" for DTT appears to emerge:

- a "free to air" model, where DTT is conceived as a technologically advanced version of the analogue TV offer, thus aiming at covering almost the entire population with an improved line-up and some additional services;
- a "pay-basic" model, where DTT is seen as alternative/complementary to TV offers provided by cable and satellite. This last model has been adopted in some countries also as a way to strengthen the " national" character of terrestrial broadcasting versus the increasing number of foreign channel on satellite/cable TV channels (Northern European countries, Netherlands)

Policy measures introduced to support the penetration of DTT

A relevant section of the research was aimed at assessing policies introduced in different countries to support the development of DTT. Generally speaking, the analysis of the information collected shows that only in few countries demand- side policy measures have been adopted in order to support the diffusion of receivers in the households. Among them, only in Italy public subsidies have been introduced (€ 150 for every MHP interactive STB), whereas in all the other countries policy measures to support the diffusion of the receiver are focused on technical standardization.

As far as offer-side support measures are concerned, in several countries some form of indirect incentives or regulatory measures have been introduced to stimulate the creation of new channels for the digital platforms and to support specifically network and platform operators.

Analysis of the development and features of DTT in some EPRA (European platform of regulatory authorities) countries

In order to evaluate the relation between the development of DTT in EPRA countries and some features of the broadcasting environment, it was necessary, in the first place, to classify the countries in relation to the progress and results achieved in the transition process.

Tab. 1.1 – DTT development in EPRA countries

	Countries	Degree of DTT development		Degree of DTT regulation				
		DTT platform commerciall y launched	DTT penetration beyond 0%	Regulation for the start up of DTT already drafted	Digital frequency planning implemented	Capacity already allocated to operators for the launch of DTT	Start up date for DTT of PSB established	Switch off of analogue frequency set by the law
A	Finland	✓	✓	✓	✓	✓	✓	(3)
	Germany	✓	✓	✓	✓	✓	✓	✓
	Italy	✓	(6)	✓	✓	✓	✓	✓
	Netherlands	✓	✓	✓	✓	✓	✓	(4)
	Spain	✓	✓		✓	✓	✓	✓
	Sweden	✓	✓	✓	✓	✓	✓	✓
	Switzerland	✓	✓		✓		✓	
	United Kingdom	✓	✓		✓	✓	✓	(5)
B	Austria			✓	✓			
	Czech Republic							
	Denmark			✓	✓	✓	✓	
	Hungary	(1)			✓			
	Ireland			✓	✓	✓		
	Lithuania	(2)		✓	✓			
	Norway			✓	✓	✓	✓	
	Slovakia			✓	✓			
C	Bosnia and Herzegovina							
	Israel							
	Latvia							
	Malta							
	Montenegro							
	Poland							
	Portugal							
	Republic of Macedonia							
	Romania							
	Slovenia							

(1) DTT experimental channels launched in 1999
(2) DTT experimental channels launched
(3) Not yet officially set - presumably 31.8.2007
(4) ATO in preparation
(5) Not yet officially set - it will be probably set between 2006 and 2010
(6) Penetration above 0 but no official data available at 31 Dec 2003

In order to assess the state of advancement of digital transition in different countries, a mix of qualitative and quantitative variables have been considered.

Specifically, three different types of variables have been selected. First of all, market conditions were analyzed. In order to assess the degree of development of DTT, it is a prerequisite to verify in which countries such platforms have been commercially launched and whether their penetration is actually above 0%.

The other two categories of information deal with legislation/regulation. Column 3, 4 and 5 in table 1.1 consider whether preliminary steps essential for the launch of DTT have been taken: whether or not a legislative framework for DTT launch has been drafted, whether a frequency for the DTT have been planned and whether capacity for the start up of the network has already been allocated.

The last column (switch-off of analogue frequencies set by law) may be considered as an indicator for the commitment of government and regulators to the goal (DTT successful start-up). In a market driven environment or in a soft regulation approach, the lack of a date for analogue turn-off is not necessarily an indicator of the development of DTT, as such date may be introduced at a later stage.

Countries have therefore been classified not according to the number of "checks", but mostly according to the type of checks collected: a check in the first two columns, for instance, has been considered as a prerequisite for being included in the first group.

Tab. 1.2 - Status of transition to DTT in EPRA countries

Leaders	Intermediate	Followers
A group	B group	C group
		Bosnia-Herzegovina
Finland	Austria	Israel
Germany	Czech Republic	Latvia
Italy	Denmark	Malta
Netherlands	Hungary	Montenegro
Spain	Ireland	Poland
Sweden	Lithuania	Portugal
Switzerland	Norway	Republic of Macedonia
United Kingdom	Slovakia	Romania
		Slovenia

As a results of this preliminary analysis three clusters have emerged:

A. Countries that have a check in the first two columns and in most columns of the second block. These are the countries were DTT has already been launched and where the regulation and policies for the DTT start up and the switchover process have already been drafted.

B. Countries with checks in the second or third block. These are the countries that are getting ready to launch and where the regulatory framework is at a very advanced stage.

C. The third cluster includes the countries that have not yet established a regulatory framework for the launch of DTT; some of these countries have launched studies or working groups to evaluate different regulatory options, whereas other countries have not yet taken any initiative for regulating a future switchover process.

Data analysis shows a variability of situations within cluster A. Between Finland and United Kingdom, on one hand, and Italy, Switzerland and Spain, on the other, there is a remarkable difference that has to be pointed out.

The A group countries have therefore been analyzed according to one additional parameters, that is the penetration of DTT, considered both as a percentage of total TV households and as a percentage of "terrestrial only" households.

Tab. 1.3 – Penetration of DTT in total TV households and terrestrial households

	Countries	Total TV hh	hh with Terrestrial TV as main reception platform		DTT households			
			hh	*%*	*hh*	*% of total TV hh*	*% of terrestrial TV hh*	
A	Finland	2.200.000	673.000	30,59%	145.000	6,59%	21,55%	
	Germany	36.230.000	1.620.000	4,47%	160.000	0,44%	9,88%	(1)
	Sweden	4.075.000	1.281.500	31,45%	230.000	5,64%	17,95%	
	United Kingdom	24.500.000	14.100.000	57,55%	2.900.000	11,84%	20,57%	
	Netherlands	6.767.000	189.000	2,79%	20.000	0,30%	10,58%	
	Italy	21.500.000	18.750.000	87,21%	0	0,00%	0,00%	(2)
	Spain	13.408.000	10.737.621	80,08%	20.000	0,15%	0,19%	
	Switzerland	3.400.000	200.000	5,88%	1.000	0,03%	0,50%	

(1) Germany: DTT penetration refers to the Berlin area. Penetration as a percentage of the terrestrial households may actually be considered 100% as analogue tv has already been switched off.

(2) Italy: penetration beyond 0% but official data not available at 31 dec 2003.

This last parameter has been made under the assumption that most families that have adopted DTT receive TV exclusively via terrestrial platform and are not already subscribers to cable or satellite pay platforms. Although this assumption may not be totally true in some countries, this parameter gives a more accurate tool for measuring the state of the migration to a "whole" digital scenario.

If we consider the penetration level as a percentage of the total TV household, UK is definitely the country where DTT has the highest level of development.

If we consider instead the penetration level as a percentage of the terrestrial only TV households, Finland and Sweden - due to the very high penetration of cable and satellite TV - and Germany - due to the "island" migration model6 adopted and the very early switch off date for the Berlin region where DTT has been launched - have to be considered as the most successful business cases.

Tab. 1.4 – Classification of A group countries according to DTT penetration

% of total TV hh	A group countries		% of terrestrial hh
> 1	Finland Sweden United Kingdom	Finland Germany* Sweden United Kingdom	> 15
		Netherlands	10 < % ≤ 15
≤ 1	Germany Italy Netherlands Spain Switzerland	Italy Spain Switzerland	≤ 10

* Berlin region

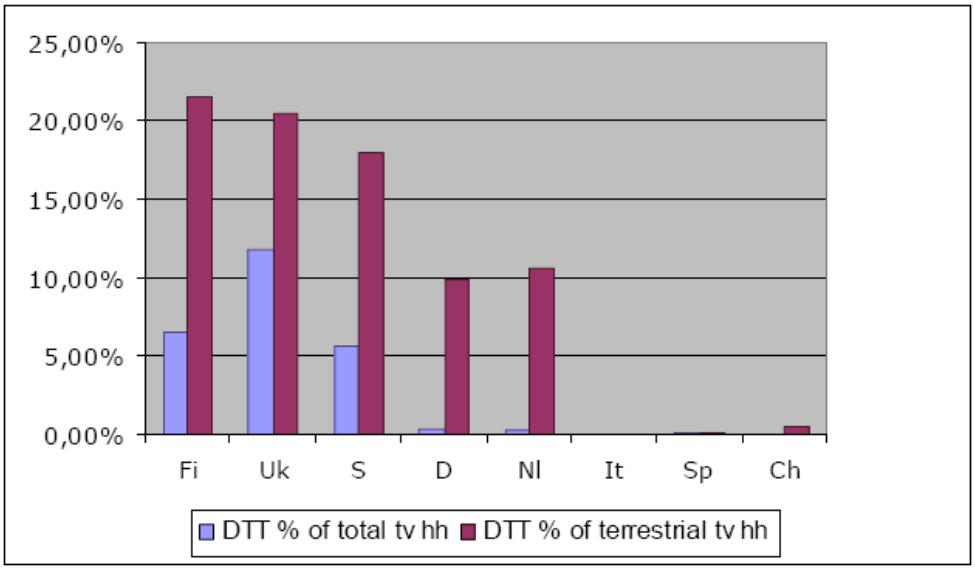
As a result of the analysis, countries in the A group have been classified into three sub-clusters.

Al group countries are those were DTT appears more successful so far: the penetration among terrestrial households is above 15%. Finland, Sweden, UK and Germany are in this group.

A2 group countries are those were DTT penetration is between 10 and 15%. Netherlands is in this group.

A3 group countries are those where DTT has been launched commercially but its penetration is still below 10%. Italy, Spain and Switzerland are in this group.

Tab. 1.5 – Different DTT penetration rates



A further element that has been considered to double-check the results of this classification is the price range of available receivers (without considering subsidies) and the off the shelf price of the cheapest model on the market.

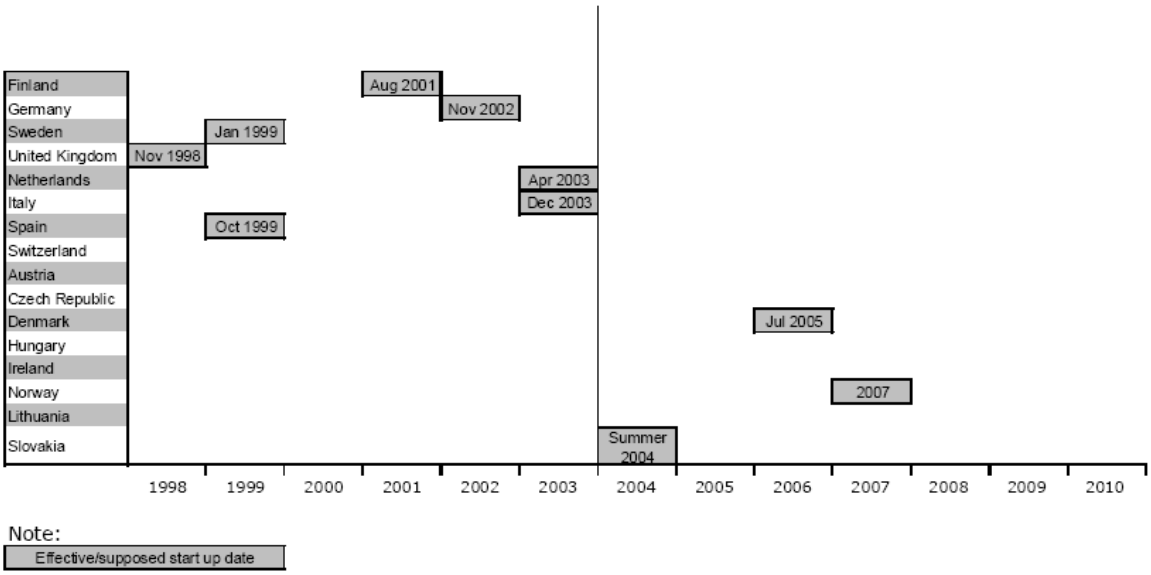
Although the price of the electronic consumer products may vary considerably and be influenced by a number of factors, it may be assumed that the prices of the electronic consumer goods are likely to decrease remarkably as these products become "mass product" as in the case experienced recently for DVD readers, mobile phones etc.

Three countries out of four in the Al group (Finland, Germany and UK) are also the countries where the cheapest receivers are available on the open market.

This test can further validate the three sub-groups and the inclusion of Finland, Germany and UK in the Al cluster.

It has though to be remarked that when DTT receivers will be available throughout Europe, their off the shelf cost may be influenced by different factors such as the general difference in price levels between western and central Europe countries. Therefore at a later stage and in a different and wider context, this datum may not be significant any longer.

Tab. 1.8 - DTT start-up dates



CHAPTER 4
GENERATIONS OF INNOVATIONS

Innovation Development Process

Innovation was previously defined "as an idea, practice, or object that is perceived as new to an individual or another unit of adoption."[1] Rogers insist that the innovation- development process "consists of all the decisions and activities, and their impacts, that occur from recognition of a need or a problem, through research, development, and commercialization of an innovation, through diffusion and adoption of the innovation by users, to its consequences."[2] The following are the three steps in the innovation- development process. First, Rogers states the process of innovation development starts by an individual or organization recognizing a problem or need.[3] Once the problem or need as been discovered, research is undertaken to create an innovation to solve the problem.[4] Second, the research is done in the sequence of "(1) basic research followed by (2) applied research leading to (3) development.[5] The third step is development.[6] Rogers defines development of innovations as the "process of putting a new idea in a form that is expected to meet the needs of an audience of potential adopters."[7]

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[1] Everett Rogers, Diffusion of Innovation (1995). at 132
[2] *Id.*
[3] *Id.*
[4] *Id.* at 135
[5] *Id.*
[6] *Id* at 137
[7] *Id.*

Technology Transfer

Rogers describes technology transfer as an exchange of technical information between development workers who create the innovation and users of the new product.[8] This transfer is a process through which the results of basic and applied research are applied.[9] Rogers is not satisfied with the way the modern countries deals with technology transfer of innovations.[10] Rogers writes, "In the past decade or so, technology transfer has become a very important policy issue for the United States government. In industry after industry, from cars to VCRs to semiconductor memory chips, Japanese high-technology companies have taken market share away from their American counterparts."[11] Rogers uses an example of the VCR to illustrate the inadequacies of American technology transfer compared the Japanese process.[12] Rogers explains that Ampex Corporation, a high-quality audiotape company, in Redwood City, California City, created the VCR in the 1950s.[13] Ampex sold the VCRs to television stations in the San Francisco Bay area who used the product to replace film with videotape.[14] These primitive VCRs used one-inch tape and were the size of an average refrigerator and cost approximately $ 50,000.[15] Development technicians at Ampex suggested that they should miniaturize the product for consumers to use in their homes.[16]

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[8] *Id.* at 140
[9] *Id.*
[10] *Id.* at 141
[11] *Id.*
[12] *Id.*
[13] *Id.*
[14] *Id.*
[15] *Id.*
[16] *Id.*

However, the company insisted they were not in that market and sold the idea and technology rights to Sony of Japan.[17] Eventually, Sony took the idea and made smaller units for home use.[18] As of today, Sony and other Japanese manufacturers have made billions of dollars in sales each year from the VCR and no American companies produce the product.[19]

Rogers uses this example to explain why the United States does a poor job of technology transfer.

To understand why nowadays modern countries have such a poor record in technology transfer, Rogers explains the three possible levels of technology transfer.[20] They are

- **Knowledge.** Here the receptor (receiver) knows about the technological innovation, perhaps as the result of mass communication messages about the new idea.
- **Use.** Here the receptor has put the technology into use in his or her organization. This type of technology transfer is much more complex than just knowing about the technology (above). The difference is equivalent to the knowledge stage in the innovation-decision process versus the implementation stage.
- **Commercialization**. Here the receptor has commercialized the technology into a product that is sold in the marketplace. For such commercialization to occur, a great deal of time and resources must be invested by the technology receptor. So commercialization requires interpersonal communication exchanges about the technology over an extended period of time, an even more intensive exchange of information than does the use level of technology transfer.[21]

Rogers insist that these three degrees of technology transfer have not often been recognized in the past, thus making it hard for the

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[17] *Id.*
[18] *Id.*
[19] *Id*
[20] *Id.* at 142
[21] *Id.*

United States to excel in the process.[22]

Diffusion and Adoption

Rogers insists that there are three key elements that lead from diffusion to adoption of an innovation.[23] These elements include *gatekeeping, innovation gatekeeping,* and *consensus development*.[24] First, Rogers describes gatekeeping as "controlling the flow of messages through a communication channel."[25] Second, innovation gatekeeping is defined as "controlling whether or not an innovation should be diffused to an audience."[26] Last, Rogers explains that consensus development "is a process that brings together scientists, practitioners, consumers, and others in an effort to reach general agreement on whether or not a given innovation is both safe and effective."[27]

Innovation-Decision Process

Rogers describes the innovation-decision process as the process through which an individual or another decision making unit passes "(1) from first knowledge of an innovation, (2) to forming an attitude toward the innovation, (3) to a decision to adopt or reject, (4) to implementation of the new idea, and (5) to confirmation of this decision."[28] He further explains that the innovation-decision process consists of a series of actions and choices over a period of time in which the individual decides to adopt or reject an

[22] *Id.*
[23] *Id.* at 148
[24] *Id.*
[25] *Id.*
[26] *Id.*
[27] *Id.*
[28] *Id.* at 161

innovation.[29] Then, Rogers provides a model of the innovation-decision process that includes the following five stages:[30]

- **Knowledge.** Occurs when an individual (or other decision-making unit) is exposed to an innovation's existence and gains some understanding of how it functions.
- **Persuasion**. Occurs when an individual (or some other decision-making unit) forms a favorable or unfavorable attitude toward the innovation.
- **Decision**. Occurs when an individual (or some other decision-making unit) engages in activities that lead to a choice to adopt or reject the innovation.
- **Implementation**. Occurs when an individual (or other decision-making unit) puts an innovation to use.
- **Confirmation**. Occurs when an individual (or some other decision-making unit) seeks reinforcement of an innovation-decision already made, or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation.[31]

The above section explains that an innovation must pass through the individual's decision to adopt or reject the idea.[32] Ultimately, stage three (decision) is the point at which an individual or group will decide to adopt an innovation.

Rate of Adoption

As previously mentioned, the rate of adoption is the relative speed in which members of society adopt an innovation.[33] It is usually measured as the number of people who adopt an innovation within a specified time-line.[34]

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[29] *Id.*
[30] *Id.*
[31] *Id.* at 162
[32] *Id.* at 197
[33] *Id.* at 206
[34] *Id.*

In addition to relative advantage, compatibility, complexity, trialability, and observability, there are other variables that affect the rate of adoption. [35] They include: "(1) the type of innovation, (2) the nature of communication channels diffusing the innovation, (3) the nature of the social system in which the innovation is diffusing, and (4) the extent of change agents' promotion efforts in diffusing the innovation, affect an innovation's rate of adoption."[36]

Rogers also explains that the economy is a very important factor in determining the rate of adoption.[37] He writes, "A new product may be based on a technological advance or advances that result in a reduced cost of production for the product, leading to a lower selling price to consumers."[38] Rogers, once again, uses the VCR as an example of how the economy affects the rate of adoption.[39] In 1980 a VCR sold for more than $1,200 in retail stores.[40]

However, in 1983, thanks to some technological improvements, a similar VCR sold for roughly $200.[41] Rogers explains that when the price of an innovation decreases so dramatically within its diffusion process, a rapid rate of adoption occurs.[42]

[35] *Id.* at 206
[36] *Id.*
[37] *Id.*
[38] *Id.*
[39] *Id.*
[40] *Id.*
[41] *Id.*
[42] *Id.*

Strategies for Spreading Innovations

Rogers describes this as the S-curve and the graph shows the best possible way for an innovation to be adopted by society and ultimately reach a critical mass.[43] First, the idea or innovation must be put through a series of experiments and pilot projects.[44]

Second, once the innovation has passed the series of test, companies can build support systems to stabilize the innovation for further development.[45] Next, the innovation needs to be properly advertised to gain popularity among society.[46] The electoral politics stage is in place for the innovations' opposition to be addressed and comfortable with furthering its role in society.[47]

Finally, for an innovation to be reached by a critical mass, regulation is the strategy utilized last.[48]

The diffusion of innovations follows a common life cycle.[49] However, the period over which this trend occurs varies greatly due to a number of factors.[50] By the end of the 20th century many of the following innovations were adopted by society at a much greater rate.[51]

For example, the PC, Internet, and cell phone, which are all relatively new products, have steeper gradients when compared to automobiles, electricity and traditional telephones.[52]

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[43] *Id.* at 266
[44] *Id.*
[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] *Id.* at 12
[50] *Id.*
[51] *Id.*
[52] *Id.*

To some extent, older innovations took longer to adopt due to the large infrastructures that needed to be developed before the innovations could succeed.[53] The rate of adoption in the relatively newer products can be somewhat contributed to increases in globalization and global communication.[54]

Consumer adoption patterns can be analyzed in terms of the criteria set out by Rogers.[55] For example, it required 70 years for the traditional telephone to be adopted by 50% of society.[56] However, one must take account that an extensive infrastructure was necessary for building the telephone network to each household.[57] Furthermore, the VCR gained a much faster rate of adoption because it did not require an extensive infrastructure to survive, and it was an add on device to the television which at the time was widely adopted.[58]

According to Rogers, price is one of the most important factors involved in adoption of consumer products. In 1998, the P.C. had still not been adopted by 50% of Americans.[59] Moreover, some research indicates that the growth rate for P.C's has been slowing down.[60] The apparent slowdown can be attributed to price.[61] Price is one of the most important factors involved in adoption of consumer products.[62] For example, with radios, black and white, and color television, the technology costs between 1.8 and 1.9 of the average Americans' household income when the products entered 50% of homes.[63] However, for the VCR, the price dropped

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[53] *Id.*
[54] *Id.*
[55] *Id.* at 14
[56] *Id.*
[57] *Id.*
[58] *Id.*
[59] *Id.*
[60] *Id*
[61] *Id.*
[62] *Id.*
[63] *Id* at 15

to approximately one week's household income when it entered 50% of U.S. homes.[64] This pricing policy pattern can be used to predict the rate of adoption of new innovations.[65] If applying earlier patterns to the present, P.C's should be able to reach a 50% penetration rate at a price of $1,000 to $1,200, if content and services are attractive enough to consumers.[66] However, if the pattern for the VCR is applied, personal computers may have to drop to under $750 to enter 50% of U.S. households.

When it comes to consumers' rate of adoption to innovations, new technologies succeed at a faster rate than replacement technologies.[67] An example of this phenomenon comes in comparison of the penetration of CD players and video cassette recorders.[68] The CD player was a replacement technology for the tape cassette player, while the VCR was an innovation introduced as a new technology.[69] VCR, which was the new technology, had a greater market penetration earlier in the product life cycle than the CD player, which was a replacement technology.[70]

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[64] *Id*
[65] *Id.*
[66] *Id.*
[67] *Id.*
[68] *Id.*
[69] *Id.*
[70] *Id.*

Critical Mass in the Adoption of Innovations

The adoption rate of interactive electronic devices such as messaging systems, fax machines, and teleconferencing frequently displays a distinctive quality known as the critical mass.[71] Rogers explains that the critical mass occurs at the point when enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining.[72] The interactive qualities of the aforementioned innovations create a degree of interdependence among the adopters in a society.[73] These innovations are virtually useless to an adopting individual unless other individuals with whom the adopter communicates with also adopt the new product.[74] Rogers informs that, "a critical mass of individuals must adopt an interactive communication technology before it has utility for the average individual in the system."[75] Interactivity is defined by Rogers, as "the degree to which participants in a communication process can exchange roles in, and have control over, their mutual discourse."[76] Rogers further states, "as more individuals in a system adopt a noniteractive innovation, it is perceived as increasingly beneficial to future adopters." Moreover, Rogers writes, "in the case of an interactive innovation, the benefits from each additional adoption increase not only for all future adopters, but also for each previous adopter."

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[71] Everett Rogers, Diffusion of Innovation (1995). at 313
[72] *Id.*
[73] *Id.*
[74] *Id.*
[75] *Id.* at 318
[76] *Id.*

Examples of Diffusion

The following section will provide examples of ideas or innovations that have been diffused and adopted by society. This research includes studies on DTT and HDTV, DBS, and computers and the Internet.

DTT and HDTV

Bruce Huber Vice President of marketing at Zenith wanted to find the marketing potential for HDTV.[77] Zenith decided to use Frank Bass' model to help predict the demand for HDTV.[78] Zenith had conducted a number of studies of consumer behavior along with the Bass diffusion model, which led to the following general conclusions:

- Consumers looked for value in their money and stayed within their budgets. Most consumers were satisfied with their existing TVs.
- Product quality was the most important criterion for evaluating brands. Consumers generally preferred large screens to small screens and considered such product features as stereo, remote control, and style to be important as well.
- Consumers tended to shy away from the lowest priced brands because they were suspicious of poor quality.

By using the Bass Model, Huber predicted that HDTV would account for approximately 10 percent of total television sales by 1999.[79] However, because this study was conducted in 1990, these projections would only occur if (1) the FCC settled on a transmission standard, and if (2) broadcasters invested substantial amounts of money in new equipment.[80]

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[77] Lilien, Gary. *Diffusion Models: Managerial Applications and Software*. ISBM Report 7-1999. Institute for the Study of Business Markets. 20/05/99. Pg. 1-41
[78] *Id.*
[79] *Id.*
[80] *Id.*

In one HDTV study, Michael Dupagne used the diffusion of innovation theory to identify the characteristics of potential high definition television adopters.[81] The purpose of the research was to assess how consumers viewed HDTV and obtain a profile of potential HDTV adopters. Dupagne's dependent variables were awareness, interest, and purchase intent.[82] The profile was based on the following characteristics: demographics, mass media use, ownership of related home entertainment products, and perceived importance of HDTV enhancements.[83] Dupagne found that early adopters were young, technologically educated, and affluent.[84]

Direct Broadcast Satellite

Digital satellite provider DirecTV planned the launch of its subscription satellite television service.[85] DirecTV wanted to obtain pre-launch forecast over a five-year period.[86] The forecasts were based on the Bass diffusion model, and the values for its parameters were obtained from a survey of stated intentions combined with the history analogous products.[87] The study identified three research questions: (1) deciding on the pricing and programming to offer consumers, (2) who would be the first to adopt, and (3) how many would adopt first.[88] Upon review of the data collected, Bass forecast the number of DirecTV subscribers and when they would adopt the product.[89]

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[81] Dupagne, M. *Potential High Definition Television Adopters*. Journal of Media Economics, 12(1), 3 5-50.
[82] *Id.*
[83] *Id.*
[84] *Id.*
[85] Bass, Frank, *DIRECTV: Forecasting Diffusion of a New Technology Prior to Product Launch*," Interfaces 31:3 pp82-93.
[86] *Id.*
[87] *Id.*
[88] *Id.*
[89] *Id.*

The forecast Bass obtained proved to be very similar in comparison with actual subscriptions over the five-year period from 1994-1999.[90]

Computers and the Internet

Diffusion research that focus on computer and Internet adoption provide important studies explaining consumer adoption patterns that may be useful to assess potential HDTV adoption. Carolyn Lin presented an article on personal computer adoption to the Broadcast Education Association's (BEA) 43rd Annual Convention and Exhibit in Las Vegas, Nevada.[91] Lin's study focuses on what she believes to be the most important question facing the present phenomenon of the personal computer.[92] In 1997, the estimated adoption rate for the PC was 37 percent, but the adoption curve was projected to increase markedly within a 10-year period.[93] Lin's article examines the adoption rate and adopter types along with their relations to potential adoption barriers, media use patterns, existing communication technology ownership and social locators.[94] Lin's study assumes that varying degrees of innovativeness may help predict how long it takes for consumers to adopt an innovation.[95] Furthermore, Lin insists other variables including: demographic attributes, perceived adoption barriers, existing media use levels, and communication technology ownership patterns will help predict the rate of adoption along the time dimension.[96] Lin's study based upon the collection and analysis of data demonstrates that ownership of other communication technology devices primarily predicted the PC adoption rate.[97]

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[90] *Id.*
[91] Carolyn A. Lin, *Personal Computer,* Journal of Broadcasting & Electronic Media 42, 1998, pp. 95-112
[92] *Id.* at 95
[93] *Id.*
[94] *Id.*
[95] *Id.*
[96] *Id.*
[97] *Id.* at 110

Lin's study based upon the collection and analysis of data demonstrates that ownership of other communication technology devices primarily predicted the PC adoption rate. Lin found that technological enthusiasts with an above average national household income tended to adopt PC's sooner and had a greater need for innovativeness.[98] These enthusiasts also are more concerned with an innovation's practical advantages rather than costs.[99] Lin argues that as PC penetration reaches the critical mass, individual degree of innovativeness will be inconsequential to adoption.[100] Instead, a PC's perceived advantages and necessity might be a consumer's main reason for acquisition.[101] Lin states that while this study was preliminary, it should shed some light on the future adoption studies of PC-related technologies.[102]

Atkins and Jeffres produced an study that profiled Internet adopters by social locators, media use, and their adoption of new technologies. They found that communications needs were the most important predictor for consumer adoption of the Internet. Furthermore, the authors found that Internet adopters are typically young, affluent, and educated. The authors explained there were two limitations. First, the Internet was still in its infancy. Second, the authors believed that further research was required to determine consumer's measure of cosmopoliteness and localiteness.

Atkin, Jeffres, and Neuendorf published research examining Internet adoption as telecommunications behavior. The study profiles Internet adopters in terms of social locators, media use habits, and their orientation toward adopting new technologies. The findings were measured in terms of demographics, social locators, media use, new

[98] *Id.*
[99] *Id.*
[100] *Id.*
[101] *Id.*
[102] *Id.*

media adoption, and communication needs. The study conforms to prior diffusion research in that early adopters were generally affluent, educated, and young. The study found that demographics, technology adoption patterns, and orientations were key factors that influenced Internet adoption of informational services. However, the study failed to confirm their expectations that attitudinal variables were more explanatory than demographics. Moreover, the authors believed that exploring the psychological motivations driving Internet adoption would be useful for future research.

Atkin and Jeffres examined the use of technologies for communication and consumer needs. The purpose of this study is to distinguish between the use of new technologies for consumer purposes and use in two communication roles, the traditional role of media audiences receiving and sending messages. The research examined bivariate relationships between three dependent measures and groups of independent variables: social categories (education, income, gender), mass media exposure, assessments of media, the relationship people have with technology, and measures of people's need for interpersonal communication and the need to send mass messages. The study found that adoption intentions for ISDN services were not dependent on education or income. Furthermore, the study's findings mitigate the assumption that heavy media users might be more interested in adopting ISDN applications.

The above section identified modern scholarship that has utilized diffusion theory to provide information on consumer adoption, awareness, and understanding of technological innovations. The research included studies on DTV and HDTV, cable, DBS, and computers and the Internet. The key trends that are generally most apparent in the aforementioned literature prove that most early adopters of innovations are affluent, educated, and young.

CHAPTER 5
RESEARCH FRAMEWORK AND ANALYSIS

Framework

This work uses policy analysis, which is a social and political activity, as a tool to examine how the Diffusion of Innovation Theory can be employed to expedite the transition of DTT. First, the problem had to be identified. As explained in Chapter 3, policy-makers and legislation have not adequately addressed and informed the public to make educated decisions related to consumer adoption of DTT. Furthermore, Chapter 3 provided implications of DTT history, technology, regulation, and the market that have had or will have an affect on policy issues regarding digital television.

The implications that will have the most apparent affect on consumer adoption of digital television are related to: the differences in technology, the cost of switching to digital, the programming available for consumer consumption, consumer understanding and knowledge of DTT, and regulation of DTT. First, policy needs to help inform consumers of the technological differences between analog and digital systems. Second, policy needs to provide incentives that will detour the cost of switching to a new system. Third, policy should address industry and provide incentives for increasing the available programming. Fourth, the adoption of digital television will not occur until consumers understand the digital system. Policy needs to address this issue by providing industry will the appropriate information to relay information and knowledge to consumers. Finally, regulation has already been implemented in regards to DTT. Policy needs to address this regulation and create regulations that will increase consumer adoption of digital television.

The above implications are important to realizing that policy has so

far failed to widely introduce digital television to the public. In Spain beginning with the Telecommunications Regulation of 1999, Government mandated a framework to implement digital television to the public. Acting on this framework, the Government imposed a timeline that required stations to return their analog signals and broadcast digitally by April 04, 2010, providing that 95% of television households in the market have access to local broadcast DTT. Given the strong possibility that this deadline won't be met, this study employs diffusion theory as a way to better understand consumer adoption of DTT.

Within this policy analysis, the underlying framework for this study assumes that the Diffusion of Innovation Theory is the most relative social theory available to understand the consumer adoption of new ideas and innovations. As discussed in chapter 4, Diffusion of Innovation Theory has been widely excepted in a variety of fields, including education, anthropology, public health, marketing, and communications as a tool to understand what variables influence the adoption patterns of society. It is important to understand why Diffusion of Innovation Theory is useful for DTT and policy. Diffusion of Innovation Theory can trace its roots back to the European beginning of social science.[1] This theory has been used for over 100 years as a tool to understand why innovations may or may not be diffused by a particular individual or other unit of adoption.[2]

Unfortunately for DTT consumers and the public, the key components and variables of Diffusion of Innovation theory have been neglected thus far by policy- makers. To reiterate, beginning with the Telecommunications Regulation of 1999, Government imposed the overall framework on how DTT would be

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[1] Everett Rogers, Diffusion of Innovation (1995). at 137

[2] *Id.* at 11

implemented in Spain and installed a timetable for stations to transition from analog to digital by April 04, 2010. This government entities provided rules for DTT without fully appreciating diffusion of innovations and the variables that exists for consumers to adopt digital television. The following paragraphs explain and identify the key variables of diffusion theory that may be used to understand consumer adoption of DTT.

The research framework incorporates items that operatationalize many of the variables included in Diffusion of Innovation Theory in regards to the effect they will have on the consumer adoption of DTT that may be employed to inform policy based on the analysis. Beyond Rogers' scholarship, modern scholarship involving DTT and HDTV, cable, DBS, and computer and the Internet have been explained to provide further possibilities of variables that may be utilized to inform policy to increase consumer adoption of digital television. Some of the variables include demographics, age, education, and income. These variables are important aspects of diffusion theory and will be included within the present analysis.

Specifically, the research framework includes the following key variables of diffusion theory and why they may be employed to better understand consumer adoption of digital television.

- **DTT's Hardware and Software Components** A technology usually has two components. These are: a hardware aspect that consists of the tools that allow the technology to be a tangible physical object, and the software components that consist of the informational base of the technology.[3] The knowledge of digital television's hardware and software components are important for consumer adoption because the technology exists within DTT can help explain whether or not the product will be desirable to consumers.

[3] Everett Rogers, Diffusion of Innovation (1995). At 12

- **Characteristics that Influence Adoption**. Diffusion of Innovation theory provides five characteristics that influence adoption and ultimately are necessary for a new technology to reach a critical mass. These characteristics are relative advantage, compatibility, complexity, trialability, and observability.[4] These characteristics are useful in determining if purchasing components of DTT will benefit society and lead to consumer adoption of digital television. Zenith's study incorporating the Bass diffusion model to discover consumer behavior will be beneficial.

- **Identification of Social System and Key Players**. A social system is defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal."[5] The common goal of individuals involved in DTT is to achieve widespread consumer adoption of digital television. Chapter 4 will identify the units that are involved in gaining consumer adoption of DTT.

- **Consumer Awareness of DTT**. Consumer awareness of DTT will be explained by providing statistics and studies from a number of consumer surveys and academic research.

- **Consumer Understanding of DTT**. Consumer understanding of DTT will be explained similarly to the category identified in the above paragraph. Consumer understanding and awareness of DTT is vital in helping explain DTT's rate of adoption.

- **Innovation Development Process**. Innovation development begins by an individual or organization recognizing a problem or a need.[6] Once the problem or need has been discovered, research is undertaken to create an innovation to solve the problem.[7] Development of an innovation is the process of putting the new idea in a form that will meet the needs of potential adopters. This process is important in understanding whether DTT has been driven by policy or necessity and how this will affect consumer adoption of digital television. The analysis will explain whether policy has properly situated DTT to meet the needs or problems of the European countries.

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[4] *Id.* at 15
[5] *Id.* at 23
[6] Everett Rogers, Diffusion of Innovation (1995). at 137
[7] *Id.*

- **Technology Transfer of DTT**. Technology transfer is the exchange of technical information between R&D and the users of an innovation.[8] According to Rogers modern countries have had a poor track record when it comes to technology transfer.[9] Technology transfer consists of three levels, including knowledge, use, and commercialization.[10] These three levels are vital aspects of diffusion theory that will help determine realistic rates of consumer adoption of DTT. This analysis will shed light onto how technology transfer has been utilized in DTT.

- **Innovation Decision Process of DTT**. The innovation decision process is a process through which an individual or other decision making unit passes.[11] This process consists of a series of actions and choices over a period of time in which the individual decides to accept or reject an innovation.[12] Five stages are involved in the innovation decision process, they are knowledge, persuasion, decision, implementation, and confirmation.[13] This process is important in explaining if DTT will be adopted by society. Each of these stages will be identified in the following chapter.

- **The Variable of Price** Costs is one of the main factors when choosing whether to purchase products. Price could be a huge factor the consumer adoption of DTT. The analysis will attempt to make a relation with price and the rate of adoption with other products to see if DTT would follow the same model.

- **Innovator and Adopter Categories**. These categories are ideal types. Ideal types are defined as "conceptualization based on observations of reality that are designed to make comparisons possible."[14] These categories provided information regarding consumer adoption of DTT. The analysis will explain what steps are needed for DTT to reach a critical mass. Michael Dupagne's study on HDTV will be useful for providing characteristics of HDTV adopters.

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[8] *Id.* at 140
[9] *Id.* at 142
[10] *Id.*
[11] *Id.* at 162
[12] *Id.*
[13] *Id.*
[14] *Id.* at 263

Based on the above research framework, the final section of this chapter will provide some policy recommendations based upon the diffusion analysis of DTT consumer adoption and the technological, regulatory, and marketing variables surrounding DTT.

Analysis

Rogers uses many characteristics and categories to of an adopter in conjunction with the key elements of diffusion to explain why one product may be adopted an another may be forgotten.[15] Rogers describes that with the inclusion of these elements and characteristics, diffusion is defined as a process by which an innovation is communicated through certain channels over time among members of a social system.[16] Additionally, many scholars have used diffusion research that has been applied to technologies such as the fax machine, refrigerators, cellular telephones, Nintendo, personal computers, and many other innovations. Furthermore, certain elements of Rogers' theory have been used to recently explain consumer awareness and adoption of DTT.

Characteristics of DTT that will Influence Adoption

The characteristics of innovations that influence adoption include **relative advantage**, **compatibility**, **complexity**, **trialability**, *and* **observability**. The following DTT attributes, if recognized by consumers, could influence DTT's rate of adoption.

- **Relative Advantage**. Consumer awareness studies have proven that respondents did not perceive DTT to be better than

[15] *Id.*
[16] *Id.* at 5

their existing television. Furthermore, these studies have found that the respondents believed DTT to be complex and unsure of the possible advantages. However, the following are benefits policy needs to address. One of the main benefits of DTT is that HDTV provides almost ten times the picture resolution of an analog picture. Another advantage DTT provides is multi-casting. Multi-casting allows a broadcaster to air either four standard- definition programs; two SD and one HDTV program; or two HDTV programs at the same time. DTT also provides a much higher quality of sound than analog television. The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound. Furthermore, HDTV provides a better aspect ratio. The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture. HDTV's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewers line of sight.

- **Compatibility**. DTT is compatible to some existing forms of consumer electronics that are currently used with an analog TV set. A consumer would have to acquire a digital VCR that is compatible with digital television. Furthermore, a consumer may not receive the same benefits from a converter box for an analog television as they would with an HDTV set.
- **Complexity**. From a user's perspective, DTT operates exactly the same as an analog television, making it unnecessary to learn hardly any new skills. Digital television includes enhancements such as DVR's that may require the consumer to learn the necessary operation skills. Also, a consumer will need a digital set top box if the television is not cable ready.
- **Observability**. HDTVs are place in many retail outlets, including Carrefour and El Corte Inglés displaying examples of DTT. However, an individual must be in these particular stores or know someone with DTT to see how it works. The innovation is observable, but in limited areas.
- **Trialability**. An individual may try out DTT at one of the aforementioned outlets or may see a HDTV set in a restaurant, bar, or friends home. However, it is improbable that a consumer would be able to take a HDTV set home and have DTT for trial use. Furthermore, consumers believe current pricing of DTT related products to outweigh the rewards.

As a result of the aforementioned characteristics of DTT that will influence adoption, there are prevalent issues regarding policy. First, how can policy inform consumers about the technological advancements of digital television and the new skills they may need

to acquire? Second, how can policy be implemented to detour some of the financial burdens that will occur due to drastic changes that have been made to technology by switching to a digital system? Third, how can policy ensure proper steps be taken to provide retailers with the correct information to relay to consumers so adoption will occur? Forth, what steps could be taken to ensure DTT is observable and gain public interest? Policy has many hurdles to overcome; if these questions are properly addressed consumer adoption will occur at a more rapid pace.

Consumer Awareness and Understanding of DTT

Rogers states that the essence of diffusing ideas and innovations into society is the information exchange from an individual to another.[17] Furthermore, Rogers implies that the use of mass media channels provides the fastest and most efficient way to inform potential adopters of an innovation.[18]

Sylvia Chan-Olmstead's study analyzes the current status of consumer awareness and knowledge of DTV in the United States. As to DTV related electronics, "52% of the respondents own DVD players, 28% own large screen TV sets, 21% own home theater systems, and 31% high speed Internet access at home, but only 7% have a Digital Video Recorder (DVR)." Few of the respondents had adopted forms of DTV, only 6% owned HDTV sets, with 5% owning DTV sets, and 4% had acquired DTV converter boxes. The term HDTV was recognized by 84% of the people questioned, while only 10% of the respondents could identify all seven DTV terms. The terms presented in the questionnaire were HDTV, DTV, ITV, ETV, SDTV, multicasting, and EDTV. The average respondent recognized 3 of the provided DTV terms.

[17] Everett Rogers, Diffusion of Innovation (1995). at 18
[18] *Id.*

Chan-Olmstead's study reveals that the U.S. audience is extremely unfamiliar with DTV. In total, only 141 usable responses were received, an 18% response rate for 780 people questioned. Chan-Olmstead said this was due to a lack of topic salience. A low response rate is a common occurrence when respondents are unfamiliar with the topic. Of the 18% response rate, only 6% owned HDTV sets, with 5% owning DTV sets, and 4% had acquired DTV converter boxes. Thus, by using the presented figures, only eight people out of 780 questioned claimed to have owned a HDTV set. The numbers for DTV sets and converter boxes are less than eight people.

In a similar study, the United States General Accounting Office found through a telephone survey of 1,000 randomly selected American households that very few people understood DTV transition and its implications.[19] Additionally, the study found that consumers have not been adopting DTV at a rapid enough pace that would allow 85% market penetration by December 31, 2006.[20] Furthermore, the GAO found that the information DTV retailers were providing to consumers was inaccurate.[21]

The GAO study found that 40% of respondents have never heard about the transition to DTT and another 43% were only somewhat aware of the digital transition.[22] Additionally, 20% stated they were very unaware of the digital transition.[23] The study revealed that 50% of the consumers questioned did not know the difference between an analog television set and a HDTV set.[24]

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[19] United States General Accounting Office, *Report to the Ranking Minority Member, Subcommittee on Telecommunications and the Internet, Committee on Energy and Commerce, House of Representatives*: *Additional Federal Efforts Could Help Advance Digital Television Transition*, November 2002, GAO-03-7
[20] *Id.* at 15
[21] *Id.*
[23] *Id.*
[23] *Id.*
[24] *Id.* at 16

Also, 68% of the respondents were unaware that their current analog sets will require a converter box to receive digital over-the-air broadcasts.[25]

On 2003, the Consumer Electronics Association (CEA) released a study regarding consumer awareness of DTT.[26] The study consisted of surveying 1,000 American consumers.[27] The survey found that consumers were very confused about DTT and HDTV products.[28] For instance, 74% of the consumers surveyed did not know that a set-top box was required to watch HDTV programming and 78% were unaware that a HDTV-enabled recorder was required to record programming.[29] Additionally, 54% of consumers were unaware that they can not watch all shows in HDTV format because many programs are not yet available.

Collectively, the above studies reveal that the U.S. public is extremely unaware of digital television and lacks enough knowledge of DTT to make an educated decision to adopt the innovation. The studies strongly suggest that communication channels, perceived need of an innovation, and the knowledge of DTT's relative advantage are vital aspects to improve consumer adoption of DTT.

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[25] *Id.*
[26] Consumer Electronics Association, *CEA Survey Reveals 9 million Plan to Purchase HDTV Over Next 18 Months*, October 14, 2003.
[27] *Id.*
[28] *Id.*
[29] *Id.*

Innovation Decision Process of DTT

Because consumers will ultimately popularize DTT through acquiring new sets, analyzing their decision making process is vital to furthering DTT adoption. Rogers describes the innovation-decision process consists of a series of actions and choices over a period of time in which the individual decides to adopt or reject an innovation. Rogers' framework for analyzing the individual consumer's decision making process on whether to adopt DTT consists of the following five steps.

- **Knowledge**. Based on consumer awareness studies, the American public has little or no knowledge of DTT.
- **Persuasion**. Without knowledge of the innovation, persuasion cannot properly occur. The public has not been able to form a favorable attitude towards DTT. However, industry has advertised and promoted DTT and HDTV related products.
- **Decision**. The lack of consumer awareness has affected the public in making adequate decisions which lead towards choosing to adopt or reject DTT.
- **Implementation**. Currently, Spain in the early adopter category for the adoption of DTT. Only 5% of the Spanish public has acquired DTT and put it to use.
- **Confirmation**. Confirmation of DTT will not occur until the public gains knowledge of the innovation. Thus, decisions have not been made to adopt the product, therefore individuals can not possibly seek any sort of reinforcement that the innovation will be permanent.

Obviously the lack of consumer awareness will affect DTT's rate of adoption. Without the government and industry adequately informing the public of DTT, the ability for consumers to exercise decision-making will be void.

Rate of Adoption and Price

As previously mentioned, the rate of adoption is the relative speed in which members of society adopt an innovation.[30] In addition to relative advantage, compatibility, complexity, trialability, and observability, cost can be a significant variable that affects the rate of adoption.

In analyzing the DTT market, price of sets are significant factors for consumer adoption of DTT. In 2004, only 1.8 million HDTV's were sold.[31] This number makes up only small percent of total television sales in the last years.[32] One reason for this is that most TVs capable of pulling in HDTV broadcast are big-screen units that cost over €2000—almost three times the average price of an analog set.[33] Lisa Pickelsimer, manager of video product development for COX Communications, predicts that widespread adoption of HDTV will not occur until the average price falls below €1500. This in itself presents a problem because as high prices keep the numbers of buyers small, it makes it hard for set manufacturers to gain the economies of scale that will allow them to reduce prices.

Digital Television's Hardware and Software Component

Digital television is a technological innovation with both hardware and software components. High definition television (HDTV) sets and converter boxes make up the hardware aspect of DTT. The software aspect is the transmission of the digital signal, which is the informational base of the innovation, to the television. Scanning formats, such as 480p standard definition STD along with 720p and 1080i HDTV help make-up the software component of DTT.

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[30] Everett Rogers, Diffusion of Innovation (1995). at 206
[31] Working Group on Digital terrestrial Television in EPRA Countries.2004
[32] *Id.*
[33] *Id.*

Consumers must have HDTV or DTT sets to receive HDTV or multi-cast broadcasts and programming. Rogers defines an innovation as "an idea, practice, or object that is perceived as "new" by an individual or other unit of adoption". He also explains that it should not be assumed that the diffusion and adoption of every innovation are necessarily desirable. For the most part, the illustrated examples were technologies that were new innovations. Consumers perceived these innovations as desirable. However, DTT is an enhancement of a current technology and may not be perceived as a necessity or desirable to adopt by consumers.

While consumers may not have an expressed or overwhelming desire to obtain the hardware necessary for DTT, the following section will illustrate the characteristics of an innovation that can be used to explain their rate of adoption. Such characteristics may provide information regarding consumers' desirability for DTT.

What Will it Take for DTT to Reach a Critical Mass

The critical mass occurs at the point when enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining.[34] Rogers states that "a critical mass of individuals must adopt an interactive communication technology before it has utility for the average individual in the system."[35] However, for a non-interactive innovation, the more people who adopt the innovation make it more appealing and increasingly beneficial to future adopters.[36] Rogers offers some possible strategies that may be used to reach critical mass for an innovation in a social system. They include:

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[34] Everett Rogers, Diffusion of Innovation (1995). at 313
[35] *Id.*
[36] *Id.*

- Target top officials in an organization's hierarchy for initial adoption of the innovation.
- Shaping individuals' perceptions of the innovation.
- Introducing the innovation to intact groups in the system whose members are likely to adopt at once.
- Provide incentives for early adoption of the innovation, at least until the critical mass is reached.

The following section will utilize these four strategies for an innovation to reach a critical mass to provide policy recommendations based on the analysis of digital television and ultimately encourage government to take action to spur growth of DTT.

Policy Recommendations

The first strategy that should be utilized when pushing an innovation towards reaching a critical mass is the targeting of top officials in an organization for initial adoption of the innovation.

Manufacturers and retail outlets have begun to sell DTT related products and provide information to potential adopting consumers. However, more programming could be made available to entice consumers to adopt DTT. The more programs that are available, the more consumers become interested.

The second strategy that is important for an innovation to reach a critical mass is to shape an individual's perception of the product. Based upon the lack of consumer awareness and understanding of DTT, policy and government has not adequately implemented this strategy. The policy recommendation based on this strategy would be for the government to fund and initiate a public information campaign to inform consumers of DTT. The most effective way to initiate this plan would be to flood tools of mass media with

propaganda related to digital television. This plan would inform the public of digital television through television, radio, newspaper, and magazine advertisements. The following paragraph will explain the information the government should provide to encourage widespread consumer adoption of DTT.

First, the campaign should provide a thorough explanation of the technology behind DTT. The most layman approach would be to begin with digital television's hardware and software components, so the consumer can get an idea of what products would enable them to view DTT programming. Second, the campaign should focus on the characteristics that influence adoption. The provided information should include the following details.

- **Relative Advantage**. One of the main benefits of DTT is that it provides almost ten times the picture resolution of an analog picture. Another advantage DTT provides is multi-casting. Multi-casting allows a broadcaster to air either four standard-definition programs; two SD and one HDTV program; or two HDTV programs at the same time. DTT also provides a much higher quality of sound than analog television. The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound. Furthermore, DTT provides a better aspect ratio. The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture. DTT's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewers line of sight.
- **Compatibility**. DTT is compatible to all existing forms of consumer electronics that are currently used with an analog TV set.
- **Complexity**. From a user's perspective, DTT operates exactly the same as an analog television, making it unnecessary to learn any new skills. For consumers without cable ready sets, a digital cable set top box may be purchased.
- **Observability**. HDTVs are place in many retail outlets, including Circuit City and Best Buy displaying examples of DTT. However, an individual must be in these particular stores or know someone with DTT to see how it works. The innovation is observable, but in limited areas.

- **Trialability**. An individual may experience DTT at one of the aforementioned outlets or may see a HDTV set in a restaurant, bar, or friends home. However, it is improbable that a consumer would be able to take a HDTV set home and have DTT for trial use.

Furthermore, the information should focus on the first four attributes because they are all conceivable. There would be no point to mentioning trialability because it would only undermine the point that DTT is advantageous, compatible, operational, and observable.[37]

The advertisements should also focus on the programming that is available for consumption. It will be important to capture consumer interest. By letting the public know they can view their favorite show in this advanced format, whether it be comedy, drama, or sports will spark interest. The implementation of an informational advertising plan of this nature should help correct the mistake of the government and policy-makers not popularizing DTT in the necessary time-frame. Popularization of an innovation is the most important strategy for spreading innovations and should be completed before electoral politics or regulation get in the way.

Step three of possible strategies used for an innovation to reach a critical mass is to introduce the innovation to intact groups in the system whose members are likely to adopt at once.[38] If the aforementioned informational advertising campaign is initialized and made available to all citizens via modes of mass communications, innovators will adopt the product at a faster rate.[39] Once this is achieved, the innovator adopter categories will fall into place. The next group, early adopters, will begin to see the innovation as

[37] Everett Rogers, Diffusion of Innovation (1995). at 16
[38] *Id* at 318
[39] *Id.* at 263

as beneficial.[40] The campaign should provide enough information to allow potential consumers to be completely certain that the innovation is permanent and will not fail. By achieving this, the last category of adopters, the laggards, should be influenced to adopt DTT.[41]

Finally, the last strategy used to reach a critical mass is to offer incentives for the early adoption of the innovation.[42] Neither policy nor government has initiated this key strategy. The policy recommendation for this strategy would be for the government to offer tax incentives to industry, manufactures, and consumers. This would allow each group to detour some financial burdens associated with switching to a digital system. Furthermore, this will speed adoption and benefit the government by reclaiming the valuable spectrum in a timely manner. This would allow the government to use the spectrum as they desire, possibly auctioning off the space to increase money in the federal treasury.

The above policy recommendations are based on Rogers' strategies for an innovation to reach a critical mass. By understanding Diffusion of Innovation Theory and incorporating historical, technological, market, and regulatory aspects of DTT, these recommendations will increase digital television's rate of adoption and ensure consumers that the innovation is permanent. Without the implementations of these policy recommendations, 95% penetration of digital television will not occur in most markets by the April 04, 2010 transition.

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[40] *Id.*

[41] *Id.* at 265

[42] *Id.* at 318

In summary, the research framework has employed the diffusion of innovation theory to better understand how consumers may adopt DTT. The analysis has been made based on Rogers' diffusion of innovation theory along with variables and findings from modern scholarship that included technological innovations closely associated with DTT. To increase adoption of DTT the following must be achieved. First, consumers need to fully understand the hardware and software components that make-up DTT and gain more awareness of the innovation. Second, if consumers recognize the characteristics of DTT that influence adoption, adoption will occur at a greater rate. Third, if the policy recommendations are utilized, DTT may achieve the point of critical mass at a far greater rate than if ignored.

CHAPTER 6
CONCLUSION

Television in Spain is nearing an important change. Broadcasters are beginning to disseminate their messages via digital transmissions. When this convergence from an analog to a digital signal is fully complete, citizens will be exposed to the greatest revolution in television history. In fact, television will never be viewed the same way again. The most commonly known advantage of digital television (DTT) is the enhanced quality of picture and sound, better known as high definition television (HDTV). However, digital television has the potential to serve the spanish public in a variety of ways, including each broadcaster being able to use their station to multi-cast four simultaneous streams of DTT programming to the viewer.

While DTT provides many enhancements over analog television, consumer adoption has been very minimal. The lack of diffusion can be attributed to a variety of variables that exists within the technology, market, and regulation of the innovation of DTT. For instance, many consumers feel that they are receiving quality television from their current analog sets. Furthermore, the cost of an HDTV set is still very high for the average consumer and there are currently no benefits, such as tax credits or deductions to entice a consumer to spend a large sum of money for a product they feel is not a necessity. Additionally, the goverment has imposed a mandatory deadline of April 04, 2010 for full transition of analog to digital transmissions. Considering the variables that are present with DTT, it is very unlikely that this deadline will be met without some provisions to policy and regulation for digital television.

This work has explained the diffusion of innovation theory and digital television from a technological, market, and regulatory

perspective. Digital television is a new and exciting innovation that will enhance both the television and the consumers' way of receiving information. Until now, there has been insufficient literature pertaining to digital television enhancements and contributions that DTT will bring to society. Also, diffusion of innovation studies have not included digital television.

Chapter 2 provided the methodology of the research. The work used policy analysis, which is a social and political activity, to examine how the diffusion of innovation theory could be employed to have public policy expedite the transition of digital television.

Chapter 3 thoroughly explained the historical, technological, policy and market variables surrounding digital television.

Chapter 4 served as the literature review, providing a basic overall understanding of Everett M. Rogers' diffusion of innovation theory as well as offering modern scholarship that incorporated Rogers theory to better understand consumer awareness and adoption of particular technological innovations.

Furthermore, Chapter 5 analyzed DTT using Rogers' diffusion of innovation theory as well as modern scholarship related to the adoption of recent technological innovations. Also, Chapter 5 presented various policy recommendations that could be implemented to increase consumer awareness and adoption and ultimately help digital television reach a critical mass.

The work did have limitations. There was an inadequate number of studies that reflected consumer adoption and awareness of DTT. However, the work used the diffusion of innovation theory and studies of recent innovations to analyze how the variables of DTT

that affect adoption. For future research, it is suggested that after Spain completes the full transition to DTT, a comparison should be made between the rate of adoption of digital television and other technological innovations. Another idea for future research would be to compare the rate of adoption between color television and DTT. The transition from black and white television to color television is comparable to the transition from analog to digital. The study would be useful in determining if Spain has progressed over several decades in informing consumers of new technologies, more importantly comparable technologies.

The analysis found that public policy and industry has not adequately informed consumers to the adoption of digital television. Consumers are unaware and lack salient knowledge of almost every aspect of DTT. This stems from the understanding of DTT's hardware and software components to the awareness of DTT related products and how to receive broadcast. Second, consumers have not been informed of the characteristics of DTT that influence adoption. The characteristics include relative advantage, compatibility, complexity, trialability, and observability. Third, Spain has been successful in technology transfer and the innovation decision process of DTT. However, regardless of how knowledgeable the government and industry are about DTT, widespread consumer adoption will not occur until public policy addresses consumer awareness. Finally, the analysis provided policy recommendations that, if initiated, should alleviate DTT's slow rate of adoption. The policy recommendations included a public information campaign to inform consumers of DTT. The initiation of this campaign will explain the technology behind DTT as well as focus on the beneficial characteristics of DTT that will influence adoption. Moreover, consumer incentives, such as tax credits, have been explained to further a consumers desire to adopt DTT.

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