STUDY OF THE IMPACT OF MULTIPLE SYSTEMS FOR MOBILE/HANDHELD DIGITAL TELEVISION

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The National Association of Broadcasters (NAB), through its FASTROAD (Flexible Advanced Services for Television & Radio On All Devices) program is examining the impact of the possible introduction of multiple technology solutions for mobile/handheld DTV (M/H DTV) in the United States as compared to a single solution that may be standardized by the Advanced Television Standards Committee (ATSC). M/H DTV holds a tremendous potential for use of the digital spectrum by over-the-air television stations as these stations enter into an all-digital transmission environment and NAB is interested in whether the presence or lack of a single standard may impede the development of these services.

NAB commissioned BIA Financial Network (who also enlisted an expert from Law and Economics Consulting Group (LECG) on a subcontract basis) to conduct a study to analyze these issues. The main purpose of this report is to evaluate whether or not the television broadcasting industry will be better served with a single mobile/handheld standard for DTV, rather than having several competing systems, and to consider whether market success is sensitive to the timing of such M/H DTV standardization.

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After many years of development of digital television (DTV) technologies, combining several proposed systems into one standardized "Grand Alliance" system, planning for a transition period, and with many stations transmitting both analog and digital signals through that transition period (some for over ten years), over-the-air television broadcasting in the United States is poised for the scheduled shut-off date of all high power analog transmissions on February 17, 2009. Many broadcasters are excited about the many different uses of their spectrum bandwidth that are made possible with DTV. One potential additional usage of the digital channel is to broadcast directly to mobile and/or handheld receivers, often referred to as M/H DTV, and several potential technologies to enable this have been demonstrated or proposed.

Given these developments, the NAB FASTROAD technology advocacy program issued a Request for Proposal (RFP) to provide an analysis of the success for M/H DTV and examine the "potential impact of multiple mobile/handheld DTV reception technologies possibly being introduced into the U.S. broadcast market." The RFP specifically requested the study to "evaluate the marketplace consequences that may arise if, rather than a single M/H DTV system being introduced, the M/H DTV market in the United States is fragmented with multiple systems," and whether "ATSC standardization of one system is necessary for likely marketplace success." It also requested a perspective on the timeframe for successful marketplace introduction of an M/H DTV service and consideration of other relevant factors. The purpose of this report is to examine these issues. Through extensive executive interviews with companies involved in all aspects of this potential service, as well as a thorough review of all publicly available information, we provide our best assessments of the likelihood of success under various scenarios.

The report initially reviews the economic literature of standards and specifically examines recent examples of standard setting in related broadcast technologies and consumer equipments. From that review and analyses of these examples, we find it very clear that the likelihood of success will be greatly enhanced if the ATSC standard deadline is met. Too many examples of unsuccessful introductions of technologies/products without standards abound to arrive at any different conclusion.

In the next part of the analysis we review the mobile television marketplace, identify the companies that are already in that market and the companies that are planning to enter. From the interviews and analysis of existing literature, with respect to M/H DTV reception, of the four receiver categories discussed (cellular telephones, video screens in vehicles, laptop computers, and portable video players), broadcasters should assign a higher priority to: (1) cellular telephones; and (2) portable video players. The lower priority assigned to video screens in vehicles was due to the relatively long lead times associated with introducing new factory-installed options, combined with the video-receive capability being relegated to rear seat viewing. Laptops received an even lower priority because of a consensus that laptops should initially have digital tuners to receive the main OTA DTV signal as a near term opportunity, rather than wait for the M/H DTV service to develop.

Our next section covers the broadcasters' economic potential in this mobile television

marketplace. While there are other companies who have already entered this arena, it is clear that broadcasters offering M/H DTV services may have certain advantages. These are:

1. Substantially lower capital requirements
2. Low cost and routine access to content
3. Lower coverage cost per population
4. Access to advertising revenue

Given these advantages and the present status of the mobile television marketplace, we conclude this report by estimating the impact of a M/H DTV standard on the number of devices able to receive M/H DTV services by the year 2012 and the resulting additional revenues generated by the availability of those services. In order to estimate the impact of the standard we assess the likelihood of success under four different scenarios:

1. A single system is introduced into the marketplace and that system is the one the ATSC standardized.
2. Two systems are introduced into the marketplace and only one of those systems was standardized by ATSC.
3. Two systems are introduced into the marketplace and the ATSC was not able to agree upon a standard.
4. Three systems are introduced into the marketplace and the ATSC did not agree upon a standard.

The summary table below reports the results of modeling the four scenarios. While the assumptions used in developing the model are such that the results could certainly differ from what we show below in absolute terms, the relative results between the scenarios are not likely to change significantly.

Scenario	**Time Delay in Successful Introduction as Compared to Scenario 1**	**Number of Receivers by Year End 2012**	**Local Station Share of M/H DTV Advertising Revenue**
1	---	130 million cellular 25 million Portable M/H video devices	$1.1 billion
2	18 months	65 million cellular 12.5 million Portable M/H video devices	$0.6 billion
3	24 to 30 months	22 to 43 million cellular 4 to 8 million Portable M/H video devices	$0.2 to $0.4 billion
4	36 to 40 months	13 million cellular 2.5 million Portable M/H video devices	$0.1 billion

While we detail our analyses within the context of this report, a brief recap of our general conclusions is in order. First, there are several steps in addition to the standard-setting process that must be accomplished for M/H DTV to be successful. Second, if those steps are accomplished, this new service has the potential of noticeably increasing local television station revenues and values. Finally, it is vitally important that broadcasters should be able to announce M/H DTV services by February 2009 and this end will be greatly facilitated by an agreed upon ATSC standard for M/H DTV that is universally adopted for M/H broadcasting in the United States. Realizing that goal is necessary for maximizing the success of and resulting benefits of local television stations providing this new service.

The additional steps that must be taken in order to ensure broadcaster success in this marketplace include:

1. Companies must negotiate, with reasonable and non-discriminatory, (RAND) terms, rights to intellectual property associated with a candidate standard.
2. Broadcasters intending to offer M/H program services which are simulcasts of their main channels (HDTV or SDTV) must clarify their rights to do so with program owners.
3. Reliable audience measurement procedures must be put in place to measure the M/H DTV audiences in order for broadcasters to sell advertising on those services.
4. A significant number of broadcasters provide M/H DTV services by Christmas 2009.
5. CE and cellular service providers offer M/H DTV devices by holiday season 2009.

II. Introduction and Background

A. Digital TV Era

After many years of development of digital television (DTV) technologies, combining several proposed systems into one standardized "Grand Alliance" system, planning for a transition period, and with many stations transmitting both analog and digital signals through that transition period (some for over ten years), over-the-air television broadcasting in the United States is poised for the scheduled shut-off date of all high power analog transmissions on February 17, 2009. While there are still hurdles to overcome, broadcasters are looking forward to that day when they will become a digital-only media. A considerable amount of capital funds and person-hours have been invested by broadcasters to get them to that point where they can truly take advantage of the possibilities of digital broadcasting.

Many broadcasters are excited about the many different uses of their spectrum bandwidth that are possible with DTV. In addition to sending their main programming signal, television broadcasters are able to use the remainder of their 6 MHz channel for other purposes. Broadcasters are already taking advantage of that flexibility with multicasting several signals, datacasting, and other applications. These additional services now available are already providing noticeable revenues for some broadcasters, and the potential for further revenues is quite promising.

B. Mobile Broadcasting

One potential additional usage of the digital channel is to broadcast directly to mobile and/or handheld receivers, often referred to as M/H DTV. [1] Currently, receiving the over-the-air television signal in a mobile environment, using either the analog or digital signal, is possible but fraught with problems such as interruptions in service, leaving a potential market unserved by local broadcasters. At the same time, other entrants using different spectrum have entered into this marketplace and there are plans for others to enter as well.

What excite broadcasters about this application are the various mobile devices that could receive an M/H DTV signal in the future. These include mobile phones, laptop computers, and other video receivers in the hands of consumers (e.g., adapted video iPods, video receivers in automobiles). Additionally, broadcasters believe that the content that they are already aggregating and airing on their main signal provides a great supply of content that would be attractive to individuals using any of the above mentioned video devices. Finally, some over-the-air broadcasters are optimistic about this service as it may lead to additional revenues while also distinguishing the wireless nature of the broadcast service.[2] No intermediary (e.g., local cable system, DBS provider, phone company or cellular provider) is necessary for many of the applications envisioned for

[1] In this report, "M/H DTV" refers to the proposed ATSC M/H standard.

[2] One broadcaster interviewed characterized the potential introduction of M/H DTV services as "lighting up the spectrum with 400 million new video locations."

this M/H DTV service. However, there are a large number of stakeholders (e.g., cellular network operators, handset manufacturers, vehicle manufacturers) with whom broadcasters will have to interact successfully in order to develop material M/H DTV revenues.

An indication of the optimism and interest of the broadcasting industry for introducing this service is the creation and subsequent actions of the Open Mobile Video Coalition (OMVC). As of early December 2007, the OMVC has over 420 commercial television stations among its members as well as the support of broadcast trade organizations NAB and MSTV and representation of 360 public stations through APTS.[3] Its purpose is simply "to accelerate the development of mobile digital broadcast television ... in the United States."[4] This group has made great strides in moving this process along already such as sponsoring and leading an early testing of viability of several proposed systems in early 2008,[5] an important step in this process.

C. ATSC Standards Setting Process

Another important step is the development of technological standards for an M/H DTV system for use in the United States. The setting of standards is a complex process involving companies on many different sides of a particular technology – broadcasters, transmitter companies, consumer electronics companies, etc. When there are multiple candidate systems vying to become the standard, as in the case of M/H DTV, the process becomes even more involved and lengthy. Often a standard setting process from the initiation through the publication of the final standards can take 3-4 years, if not longer.

Through the Advanced Television Systems Committee (ATSC), this process of standard setting for an M/H DTV service has begun and includes all of the interested parties. Because of the interests of many of the parties involved, the standardization process has been "sped up" in order to have a system deployable in a shorter time. Some of the executives we interviewed strongly felt that broadcasters need to be in this mobile video market by 2009 or 2010 at the latest in order to compete with the existing and soon–to-enter players.[6] Without strong entry by broadcasters into the mobile video market soon, it will be very difficult to gain market share from those entering the market before them.

The ATSC has established a schedule for this M/H DTV standard setting that many have characterized in our research as quite aggressive, but "doable." From the issuance of the Request for Proposals for an M/H DTV system in June, 2007, the goal is to have a standard released in early 2009 to give broadcasters the opportunity to announce new ATSC mobile and handheld broadcast services around the time of the close of analog services in February 2009.

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3 See http://www.omvc.org/.

4 Ibid.

5 See letter from Brandon Burgess, President, Open Mobile Video Coalition, http://www.omvc.org/objects/docs/Aitken-ATSC-OMVC-10-8-07(3).pdf

6 Chapter IV will cover this mobile video marketplace in great detail.

In order to reach that goal, ATSC committees have been meeting and conducting research and evaluations on proposed systems on an expedited basis ever since the goal was announced. To further this process along, the OMVC will conduct "Independent Demonstration of Viability (IDOV)" tests beginning in February of 2008, followed by field demonstrations in the succeeding two months, resulting in an OMVC final report to be made available to ATSC.

These activities by OMVC are essential in ATSC reaching its goal of an M/H standard by February 2009. The intent is that, through the IDOV and subsequent demonstrations, combined with the assessment of documentation from the proponents, the most suitable system proposal will emerge by the spring or early summer of 2008. That winnowing down of multiple systems to a single choice by midyear 2008 will enable ATSC to conduct the validation tests it needs, leading to a Candidate Standard being published early in 2009. Further, the system selection by mid-year 2008 will enable other parties involved in the provision of an M/H DTV service (e.g., broadcasters, transmitter companies, consumer electronics manufacturers) to develop their products and services so that M/H DTV products and services can be available by Christmas 2009, early enough for this service to be competitive with existing and soon to be introduced other mobile video services. Having products and services available by Christmas 2009 is paramount in ensuring success for M/H DTV services in the increasingly competitive and changing mobile video marketplace. According to some broadcast executives interviewed, if the goal of having M/H DTV devices and services in the hands of Christmas 2009 is not met, both ATSC and OMVC will have failed. Others take a longer term view and do not see Christmas 2009 as the make-it-or-break-it deadline.

It should be pointed out that other non-standard setting activities must also be going on at the same time as the ATSC standard setting process in order to have M/H DTV become a meaningful source of broadcast revenues in the next five years. These include:

1. Companies must negotiate, with reasonable and non-discriminatory, (RAND) terms, rights to intellectual property associated with a candidate standard.

2. Broadcasters intending to offer M/H program services which are simulcasts of their main channels (HDTV or SDTV) must clarify their rights to do so with program owners.

3. Reliable audience measurement procedures must be put in place to measure the M/H DTV audiences in order for broadcasters to sell advertising on those services.

4. If there are consumer devices in the stores by the 2009 holiday season, broadcasters must have already had M/H services up and running to help stimulate consumer demand and this must be promoted to consumers. Ideally, at least the marketing efforts would tie in to the February 2009 digital transition date to give ample lead time. By the third quarter of 2009, or earlier if the transmission equipment is ready, a critical mass of

broadcasters must be transmitting M/H services to drive consumer demand.

D. Purposes of the Report

Given these developments, the NAB FASTROAD technology advocacy program issued a Request for Proposal (RFP) to provide an analysis of the success for M/H DTV and examine the "potential impact of multiple mobile/handheld DTV reception technologies possibly being introduced into the U.S. broadcast market."[7] The RFP specifically requested the study to "evaluate the marketplace consequences that may arise if, rather than a single M/H DTV system being introduced the M/H DTV market in the United States is fragmented with multiple systems,"[8] and whether "ATSC standardization of one system is necessary for likely marketplace success." It also requested a perspective on the timeframe for successful marketplace introduction of an M/H DTV service, and consideration of other relevant factors. The purpose of this report is to examine these issues. Through extensive executive interviews with companies involved in all aspects of this potential service,[9] as well as a thorough review of all publicly available information, we provide our best assessments of the likelihood of success under various situations.

This report assesses the likelihood of success under four different scenarios:

1. A single system is introduced into the marketplace and that system is the one the ATSC standardized.
2. Two systems are introduced into the marketplace and only one of those systems was an ATSC standard.
3. Two systems are introduced into the marketplace and the ATSC did not agree upon a standard.
4. Three systems are introduced into the marketplace and the ATSC did not agree upon a standard.

In analyzing all of these scenarios, we examine factors that will affect the success of the M/H DTV system(s). These factors include:

1. The timing of the ATSC standard (if any) and the subsequent introduction of consumer products in the marketplace.
2. The reactions of various affected industry segments (broadcasters, proponents, consumer electronics firms, advertisers, etc.) to the number of systems and the existence or lack of an ATSC standard.
3. The consumer products to be introduced that will receive M/H DTV services.

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7 See *Request for Proposal, Study of the Impact of Multiple Systems for Mobile/Handheld Digital Television*, National Association of Broadcasters, September 7, 2007, p.6. (hereafter referred to as M/H DTV RFP).

8 Ibid.

9 In an appendix we provide a listing of all individuals and companies with which we conducted these executive interviews.

4. The roll-out of competing mobile television services from telcos, WiMAX, etc.

5. Total population and distribution of markets covered by M/H DTV services

6. Sources of program content optimized for M/H broadcasting

We begin this examination of the success of M/H DTV services under various scenarios by first examining the importance of standards with new technologies. This review will provide a needed backdrop in assessing the impact of an M/H DTV standard. A considerable amount of research has been conducted as to the importance of such standards. In addition to reviewing that research, this section will also review recent examples of standard setting processes in related consumer technologies.

We then move to a review of the various M/H DTV stakeholders and the various markets in which this service will compete. It is important to understand the entire M/H DTV supply chain in order to assess the effects of having a standard or not. Also important is understanding the embedded base of receivers for existing and future mobile television services. Finally, in this section we will review the various global initiatives in mobile television in order to ground our later predictions on the success in the United States.

Our next section provides an assessment of the economics underlying the M/H DTV marketplace. We will review the overall market framework of the major components of this potential market as well as the existing and potential competing mobile television platforms. We provide market size estimates by sources for this mobile television market, leading to a baseline forecast for M/H DTV in the United States, as well as identify the competitive advantages that broadcasters have in competing for M/H DTV revenues.

We then evaluate the impact on our baseline forecasts of having standardized and/or competing M/H DTV systems. In those four scenarios, various events occur and the different stakeholders must make decisions, all of which affect the success of the M/H DTV service(s). Each scenario will be fully discussed and the financial and business implications analyzed.

E. Conclusion

While we detail our analyses within the context of this report, a brief recap of our general conclusions is in order. First, there are several steps in addition to the standard-setting process that must be accomplished for M/H DTV to be successful. Second, if those steps are accomplished, this new service has the potential of noticeably increasing local television station revenues and values. Finally, it is vitally important that broadcasters should be able to announce M/H DTV services by February 2009 and this end will be greatly facilitated by an agreed upon ATSC M/H DTV standard that is universally adopted for M/H broadcasting in the U.S. Realizing that goal is necessary for maximizing the success of and resulting benefits of local television stations providing this new service.

III. THE IMPORTANCE OF STANDARDS

In this chapter we consider the impact of standards on the rate and breadth of the adoption of innovative consumer electronics technologies. In particular, we consider five major topics:

1. Why standards are important.
2. Chicken-egg problem in standards.
3. Mobile ecosystems and standards specific to the mobile television market and technology.
4. Case studies in "format wars."
5. ATSC process and possible outcomes.

The keystone question pursued in this study is to assess the relative impact of whether or not an ATSC M/H standard is developed by the February 2009 deadline. To consider this question, we examine standards from various perspectives and look at specific case studies before addressing the specifics of standards in the mobile television market and various ATSC scenarios.

A. Why Standards Are Important

As noted elsewhere by Ducey and Fratrik, standards are important to broadcasters for several economic and technological reasons.[10] The role of standards ranges from improved product quality and safety to enabling interfacing and interoperability among even competitors' products and services. Standards may be cooperatively set among collaborating firms (*de facto* standards) or set by a government or standard setting body through some formal process (*de jure* standards). There are hundreds of global standards setting bodies ranging from Underwriter's Laboratory (safety standards) to the International Telecommunications Union. According to the U.S. National Institute of Standards and Technology (NIST), 80% of global merchandise trade is influenced by testing and other measurement-related requirements of regulations and standards.[11]

Standards are a somewhat recent phenomenon. NIST estimated that there are about 800,000 global standards all of which evolved since the mid 1800s, beginning with the American machine tool industry's adoption of the "Sellers Screw" as the standard. Arguably, the battle for a standardized screw was the first successful standardization fight in history. The significance of this effort was summarized in these words, "The process of standardization is always a political struggle, with winners and losers. Had the screw not been standardized, the entire course of the American economy might look different."[12] In the second half of the 19th century, the American machine tool industry

[10] Richard V. Ducey and Mark R. Fratrik, "Broadcasting Industry Response to New Technologies," *Journal of Media Economics*, Fall 1989, pp. 67-87.

[11] National Institute of Standards and Technology, www.nist.gov/public_affairs/factsheet/NIST_Did_you_know.htm, viewed 12/14/07.

[12] James Surowiecki, "Turn of the Century," *Wired*, January 2002.

was a key driver of innovation. The benefits of uniformity and interchangeability, mass production efficiencies, quality and network effects realized by the standardization of the screw gave a boost to the economy.

In the 21st century, the technology-enabled information, communications, entertainment sectors are key innovation and productivity drivers in the economy.[13] To achieve the greatest promise of success, these technologies rely on standards, interfaces and industrial collaboration. Standards or "documented agreements containing technical guidelines to ensure that materials, products, processes, representations, and services are fit for their purpose" form a complex and dynamic relationship with innovation.[14]

One study of mobile service innovations identified ten factors which affect the supply of services in this market, including (1) expected demand and profit, (2) complementary products and services, (3) standardization, (4) the value network, (5) revenue model, (6) collaboration, (7) competition, (8) technology development, (9) frequency allocation and regulation and (10) international market development.[15] Here again we see that the themes of standards, collaboration and value network are central to the technology industry generally and specifically the innovative mobile television industry.

In a 2006 survey of CEOs, IBM found that 76% of corporate leaders supported open standards as a means of furthering business goals and the opportunity to succeed.[16] These goals included collaboration, particularly beyond company walls which is important to achieving:

1. Reduced costs
2. Higher quality
3. Increased customer satisfaction
4. Access to skills and products
5. Increased revenue

Craig Barrett, Intel's Chairman/CEO has strong views on the importance of standards which he expresses quite well:

> When you have common protocols, interfaces, and form factors, then the whole industry can evolve around those common characteristics and innovate on top of them. Standards allow the industry move forward without each individual company having to do the ground up implementation on its own. That's been

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13 See for example, Paschal Preston and Anthony Cawley, "Understanding the 'Knowledge Economy in the Early 21st Century: Lessons from Innovation in the Media Sector," *Communications and Strategies*, no. 55, 3rd Quarter 2004.

14 Robert H. Allen and Ram D. Siram, "The Role of Standards in Innovation," *Technological Forecasting and Social Change*, 64, 171-181 (2000).

15 Piia Karhua, "Emerging Mobile Service Innovation Markets: The Case of the Finnish Mobile TV Service Market," Dissertation of the University of St. Gallen, Graduate School of Business, January 22, 2007.

16 Adalio Sanchez, "Collaborative Innovation in an Era of Open Standards," IBM Systems and Technology Group, March 27, 2006.

> the success model for the personal computer, and it's been the success model for consumer electronics, to a large degree.
>
> Because of standards, everyone can innovate and everyone can interoperate. Companies can build their businesses, consumer can expand their choices, the technology move forward faster, and users get more benefit . . . I think the world should be focusing on the basic protocols and interoperability standards between devices.
>
> Anytime you bring technologies from different industries together, you have areas of overlap or interface between the two, and that's where you need to have common standards. So you need to have the computer and communications industries along with the consumer electronics industry get together and decide on common standards, on the baseline architecture that will enable their devices to interoperate.[17]

B. Costs and Benefits of Standards

Standards are particularly critical in digital media ecosystems where complementary products, services, devices, infrastructures, workflow and business processes must interoperate to create and support the consumer experience in a satisfactory manner. These complementary interdependencies are known in economics as the direct and indirect effects of network externalities. We will address these points in a moment. For now, suffice it to say that in an industry where there are network effects, relative compatibility across platforms is a key determinant of a technology's success. However, in the case of wireless telecommunications, the ability to interconnect with other relevant infrastructure via standard interconnection protocols can mediate this effect.[18]

Several of the key costs and benefits to establishing standards include:[19]

1. Standards may protect buyers from being stranded with obsolete products.
2. Standards may impose constraints on variety and innovation.
3. Standards support greater realization of network effects.

Buyers Protected From Stranding

One important benefit of a standard is that consumers do not face the need to pick between competing formats and risk ending up with the loser in a format war and thus be stranded with obsolescent hardware and software. Eight track audio tapes are not very useful these days, nor are Betamax videocassette recorders. We discuss format wars later on.

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[17] "Craig Barrett on the Importance of Global Standards," www.intel.com/standards/execqa/qa0904.htm, viewed 12/11/2007.

[18] Church and Gandal, 2004.

[19] Carl Shapiro, "Setting Compatibility Standards: Cooperation or Collusion?" University of California at Berkeley, June 8, 2000.

Constraints on Variety and Innovation

A negative to the standard setting process is that it can fix technology at a particular point of development. This can put a constraint on the variety and range of innovativeness available to the market from other technologies. On the other hand, even if what may come to be seen as a suboptimal technology is selected or wins as the de facto standard, variety and innovation relative to the chosen technology platform can continue and allow the market to benefit from differentiation in products and services. Overall, it appears that, "although standards can inhibit innovation by codifying inefficient or obsolete technology, and thus increase the resistance to change, standards generally spur innovation directly by codifying accumulated technological experience and forming a baseline from which new technologies can emerge."[20] Even with a standard, there can be plenty of room for competition. For example, there can be the issue of quality differentiation even if products are compliant with standards.

Standards can have anti-competitive effects by closing out rival firms from use of the standardized technology. A set of standards can become an "essential facility" or technological bottleneck for anyone seeking to connect to a network.[21] To prevent such a bottleneck occurring when a standard is based on proprietary and/or patented technology, a typical solution is for the standard owner to license its technology with a reasonable and non-discriminatory access (RAND) agreement.[22]

However, even with RAND and open standards, there may still be competitive complications. One example might be Verizon Wireless' decision to "open" its now closed CDMA network, i.e., allow any certified device to connect to its network (which would empower direct network efficiencies in the handset market). Previously, Verizon had a "closed network" to the extent that only handsets it sold could be used on its cellular network. Indeed, less than 2% of handsets today come from someone other than the carrier on which the handset is used. Only devices, not applications, will be certified.[23] Some have suggested this is in response to the 700 MHz spectrum bidding for 4G network capacity to be held in January 2008.[24]

Verizon has announced it will publish technical specifications for linking to its CDMA network by early 2008.[25] However, even then, Verizon could delay

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[20] Robert H. Allen and Ram D. Sriram, "The Role of Standards in Innovation," *Technological Forecasting and Social Change*, 64: 171-180, 2000.

[21] Richard N. Langlois, "Technological Standards, Innovation and Essential Facilities Toward a Schumpeterian Post-Chicago Approach," Department of Economics Working Paper 1999-07, University of Connecticut, December 1999.

[22] Michael Warnecke, "What the Heck is a "RAND' Agreement Anyway?" Blog posting, January 31, 2007, http://pblog.bna.com/techlaw/2007/01/what_the_heck_d.html.

[23] Rick Merritt, "First Crack in Mobile Carriers' Fortress?" *Electronic Engineering Times*, December 3, 2007, pp. 1, 16.

[24] Olga Kharif, "The Coming Wireless Wholesale Wave," *Business Week*, November 26, 2007.

[25] Grant Gross, "Update: Verizon Wireless Opens Up Network to Outside Devices," *InfoWorld*, November 27,

matters if it prolongs its device certification process. In addition to opening up its network to devices, Verizon Wireless has announced it will also support devices using the forthcoming Google operating system for mobile devices, "Android" which will compete with Windows Mobile, Symbian, Palm, Linux, Apple and Research In Motion (RIM) mobile operating systems. Devices will be tested and certified at a $20 million laboratory facility Verizon is building. Verizon will control its own certification process; it will not be conducted by third parties.[26]

It can be counterproductive to limit entrants to a standard setting process. In the Chinese cellular market, the duopoly firms are China Mobile and China Unicom. Neither of these firms is seen to be technologically innovative and they are focused on the Chinese 3G standard (TD-SCDMA), locking the market into 2.5G services. With a market size of 500 million users, scale certainly exists to support innovation but that is not the government's current approach.[27] In stark contrast, while such a large market as China struggles with entry into the 3G market, in the U.S. we see plans to bid for 700 MHz spectrum in January 2008 which would facilitate 4G services in an open network environment including wholesale access to spectrum which tackles the AT&T, Verizon Wireless and Sprint oligopoly.[28]

Network Effects

From an economic perspective, a "network industry"[29] is one in which the products and services produced and consumed are *systems of components*. In this case, the product that is consumed actually comprises a group of complementary products that provide the greatest value when consumed together. For these complementary products and services to work together as a system, some types of standards are required to achieve compatibility and interoperability. In a sense, the products and services become networked in a system to achieve the most value for an individual consumer. Further, it can be seen that as more consumers adopt the solution certain costs and benefits can be realized. These are "network effects" and are associated with both "direct networks" and "indirect networks."[30] One note on terminology may be useful here. The use of the term "network externalities" is sometimes confused with network effects. Technically, externalities occur only when participants in a market do not internalize the effect (i.e., cost or value is created that no one pays or receives).[31] Here we focus on network effects.

2007. See also Chapter IV for additional explanation of Verizon Wireless' strategy.

26 "Verizon to Support Google's Android," *The Online Reporter*, December 8-14, 2007, p 1.

27 "China's Misguided 3G Mobile Strategy," *Business Week*, August 8, 2007.

28 Olga Kharif, "The Coming Wireless Wholesale Wave," *Business Week*, November 26, 2007.

29 In this instance, we use the term "network" as an economic term, not a telecommunications or information technology term. In economics, "network" refers to a group of complementary products that typically must be consumed together for the greatest value. For example, a DVD player is one type of goods that does not have much value unless a DVD disc also is purchased to be played on the DVD machine.

30 Jeffrey Church and Neil Gandal, "Platform Competition in Telecommunication," published in *The Handbook of Telecommunications, volume 2*, edited by M. Cave, S. Majumdar and I. Vogelsang, July 22, 2004.

31 S. J. Liebowitz and Stephen E. Margolis, "Network Externalities (Effects)," University of Texas at Dallas, undated, www.utdallas.edu/~liebowit/palgrave/network.html.

Network effects are particularly important in technology based industries since the products typically are based on value created from complementary products and services. For these products and services to have the most value and derive both direct and indirect network effects benefits, standards play an important role. The choice of correct standards and network externalities has been explored in the economics literature.[32]

A "network effect" occurs when the value of joining a network by buying compatible products increases with the number of consumers who join that network. A very simple example is Instant Messaging. If one person uses Instant Messaging software, there is no value until a second person begins using that software (and associated networking). The value of having Instant Messaging software increases as more users are added to that network. Similarly, the value of having a DVD player increases as more consumers purchase DVD players because that creates the incentive to publish more DVD content for the owners of DVD machines to purchase or rent.

Direct networks consist of products linked together to form a network (e.g., phones, fax machines, email servers) and requires horizontal compatibility with other network nodes. An indirect network consists of the complementary goods and services that can be consumed only with a direct network and requires vertical compatibility through different layers. We will consider this concept of vertical layers in a moment. As the value of direct network effects gets larger, so too does the value of indirect network efforts as incentives are created to produce more goods and services complementing the direct network. Direct network effects are based on the number of purchasers of a product and how that impacts the value of the product (e.g., how many other people can I call on my cell phone?). Indirect network effects relate to mediated market effects such as the more readily available, higher quality or lower price complementary goods associated with the direct network effect (e.g., software I can use on my cell phone).

A direct network requires *horizontal compatibility* among similar products. Here the value of joining a network is based on the ability of products and services to conform to some type of standard such that they work together. For example, different types of cellular handsets have horizontal compatibility if they can connect users to the same mobile network.[33] A virtual or indirect network is a system that combines products such as printers and toner cartridges or hardware and software neither of which have high stand-alone value.[34] Continuing with our

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[32] See for example: Farrell, J. and Saloner, G., 1985, "Standardization, Compatibility and Innovation," *Rand Journal*, 16:70-83; Katz M. L. and Shapiro C., Network Externalities, Competition and Compatibility, *American Economic Review*, 75: 424-440; Besen, S. M. and Farrel, J. 1994, Choosing How to Compete: Strategies and Tactics in Standardization, *Journal of Economic Perspectives*, 8:117-131; Liebowitz, S. J. and Margolis, S. E., "The Fable of the Keys," *Journal of Law and Economics*, 33:1-26.

[33] Church and Gandal, 2004.

[34] Church and Gandal, 2004.

cellular handset example, in an indirect network two handsets may or may not have the ability to connect to the same service provider's network ("direct network") but may be able to use the same software such as Windows Mobile 5.0 which therefore creates a "network" of software users that rely on hardware but not necessarily a particular implementation of hardware ("indirect network").

Network Effects, Tipping Points and Web 2.0

The relationship between network effects and the marketplace is addressed in two other contexts – computer networking (Metcalfe's Law) and marketing (viral marketing). Robert Metcalfe, credited as one of the inventors of the Internet, states that the "value" or "power" of a network increases in proportion to the square of the number of nodes on the network. So, the value of an office local area network with four PCs on the network is 4^2 or 16. Adding one more user increases the value by more than 50% to 25. And so on. The "value" considered in Metcalfe's Law is a derivation of the direct and indirect network effects we spoke of earlier.

The marketing implementation of Metcalfe's Law derives from the efficiency of the viral nature of "word of mouth" marketing. An interesting case study is the great success of a start-up email company launched on July 4, 1996 (Hotmail).[35] With a marketing budget of less than $50,000, Hotmail grew to over 1 million registered users within six months, and 12 million within 18 months, a rate never seen before in subscriber based media.[36] This was accomplished by one user inviting another user to trial the free email service, i.e., *viral marketing*.

From a standards perspective, if the choice of a standard or network is dominated by natural monopoly elements, it is likely that only one standard will survive in the market or at least that any surviving standards would serve niche or submarkets.[37] One example here is the choice of operating systems. By far, Microsoft Windows is the dominant platform for PC operating systems, yet there is also a significant market for Apple's operating systems.

An important goal for a technology owner is to leverage network effects, Metcalfe's Law and viral marketing to reach a "tipping point" whereby its solution becomes the de facto standard. At that point, users will prefer that solution and abandon the "other" format in increasing numbers. We will see this explicitly when we examine the VCR format war case study. Much of the new value in digital media is now coming from what is called "Web 2.0" which is an imprecisely specified set of technologies and solutions that benefit from social linkages as network effects.[38] Some examples of format wars and eventual tipping point winners (in **bold**) are:

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35 Eric Ransdell, "Network Effects," *Fast Company*, August 1999, page 208.

36 Ransdell, 1999.

37 Liebowitz, undated.

38 James Hendler and Jennifer Golbeck, "Metcalfe's Law, Web 2.0 and the Semantic Web," undated paper, viewed 12/14/07, http://www.cs.umd.edu/~golbeck/downloads/Web20-SW-JWS-webVersion.pdf.

1. PC operating systems (**Windows**, OS/2, Mac)
2. Word processors (**Word**, WordPerfect)
3. Web browsers (**Explorer**, Netscape, Firefox)
4. Streaming media (**Windows Media**, Real)
5. Video player/recorder: (**VHS**, Beta)

Some of the determinants of what it takes to reach the tipping point include:[39]

- *Variety versus quality* (e.g., variety of content available to VHS owners was more important than the possibly higher quality Betamax machines).
- *Transparency* (how visible the complementary supply of goods is to market participants, especially consumers, such as the number of movies available on VHS vs. Betamax).
- *Third party* applications and other relevant standards that standards owners cannot control and degree to which reasonable and non-discriminatory access is available.

Let us make one further note on network effects, ecosystems and tipping points. As can be seen from the list above, from the examples selected Microsoft emerges as an actor common to many of the marketplace victories. A common strategy for Web-based business, if not always successful, is to grow market share by "giving" away products and services for free and then seeking some means of monetizing users. Typically, this is by seeking advertising revenue or up selling a newly entrenched user base to premium or professional versions of the entry level free version. This approach has been used in several product categories ranging from web hosting services to web conferencing services.

An interesting battle now is emerging between Microsoft and Google perhaps to be aided and abetted by Intel to some degree.[40] In this case the "format war" goes to whether future computing will be network-centric or PC-centric.

With over 500 million users (better than 90% market share) for its personal productivity software (e.g., Microsoft Office), Microsoft's view of future technology tends to be PC-centric. Since Microsoft's business depends on this (its business model of selling software and operating systems is premised on streams based on PC unit sales and software licensing), this makes sense. However, the mix of technology and resulting economics of computing are changing what is

[39] Joel West, "Reconsidering the Assumptions for 'Tipping' in Network Markets,: published in Kai Jakobs and Robin Williams, eds., *Standardization and Innovation in Information Technology Proceedings*, 1999, pp. 163-168.

[40] Steve Lohr and Miguel Helft, "Clash of the Titans," *New York Times*, December 16, 2007.

possible. So-called "cloud computing" and increasing bandwidth to the home and office make it possible to participate in what had been known as distributed computing but has now evolved into cloud computing as popularized and advanced by Google.

Essentially, Google has introduced its version of personal productivity software ("Google Apps") which is free to users and provides functionality similar to the Microsoft Office suite. Google's end game is to seek advertising revenues and seek up sells of its services by leveraging broadband connections which now support the ability to move computational power from the PC to computers around the world working together in a "cloud" of connectivity all driven by Google's orchestration software.

We are at the beginning of a new standards battle as Google aims at Microsoft and some feel that since Microsoft's ascendancy to the de facto standard in much of personal and corporate productivity software, the Google threat is the most real. Google is able to innovate and deploy very quickly, using development cycles of only four to five months versus more typical 24-36 software development cycles.

In the context of this report, Google is particularly relevant since it is targeting not only personal productivity software and Microsoft but also the mobile market with its Android mobile operating system. Android is a "software stack" (please refer to the "Mobile Ecosystems" exhibit) for mobile devices that includes an operating system, middleware and key applications. Google's Android initiative seeks to become a market player both by leveraging existing standards as well as new development efforts supported by the Open Handset Alliance.[41]

Google is pursuing its cloud computing paradigm as the next generation successor to PC based computing. However, there is another Microsoft chapter being written based on what is happening on the microprocessor front. Whereas Google's vision is driven by network based computing, Microsoft looks to more powerful PC chip sets. Microsoft's vision relies in part ever faster and multi-core chip sets coming out can be harnessed with newer parallel software engineering Microsoft has been acquiring talent with super computer and parallel software expertise.[42]

While desktop and laptop computing is an early focus for Google and Microsoft they both are active in the mobile space so it will be interesting to see what implications parallel computing whether by cloud computing or multi-core PC computing holds for mobile video and related applications. A similar strategy was pursued by Intel which in 2006 announced the release of its "Viiv" brand on Internet video programming and devices connected to TV sets but has now dropped that initiative for a new one called "MIDs" for Mobile Internet Devices.

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41 http://code.google.com/android/.

42 John Markoff, "Faster Chips Are Leaving Programmers in Their Dust," *New York Times*, December 17, 2007.

MIDs are meant to be higher performing devices for mobile video than cell phones and only slightly larger. These dual processor chips will have on-board flash storage of only 2-4 gigabytes but Intel claims that will be sufficient.[43]

One of the gating factors in launching mobile video services in the marketplace has been the challenging of breaking into the cellphone carriers' networks which is gated by access to the carrier-controlled handset industry (i.e., carriers have tended to control which handsets work in their closed networks and which applications run on those handsets).

Even with access to handsets, there are many models of handsets with different operating systems and device drivers. For example, developers have to write applications specific not only to the RIM, Symbian, Palm or Microsoft Mobile operating systems, but also specific to individual handset models, for example the Motorola Q versus the LG Voyager. Each of these handset platforms requires a coding effort unique to that environment. However, the Google Android effort could change much of this by allowing developers to focus on the Android platform which in theory allows applications to run on any Android handset.

The technological and economic efficiencies of Google's Android and generally the Open Handset Alliance may change the impact of current de facto standards in the mobile marketplace. The ATSC TSG/S4 effort on the Mobile/Handheld standard will in theory be largely independent of this level of effort given the layered approach to software development, but Android could have great significance in terms of giving M/H DTV broadcasters and their business models access to the mobile video market.

In summary, the importance of standards, whether de facto or de jure, is that they can facilitate the benefits and minimize the negative externalities of direct and indirect network effects. Without standards, format wars and prolonged competition are likely and can have a negative impact on how fast and how fast markets develop. Seeing this, firms particularly in technology industries such as media, information and communications, have become increasingly motivated to either collaborate in standard setting processes or else provide reasonable and non-discriminatory access to proprietary standards and technologies to achieve a rising tide whereby network effects allow even competitors to increase revenues and market share.

B. Chicken-Egg Problem

Which comes first, the supply side or the consumption side? The market or the product? The content or receivers? The technology or the standard?

There are several potential chicken-egg conundrums in the technology market, one of which is the standards decision. The risk of picking a standard too soon is that it can

[43] Don Clark, "Intel Scales Back Plans for Living Room Brand," *Wall Street Journal*, December 15, 2007.

arrest the state of development in that technology, particularly in an industry that is characterized by fast breaking developments. One solution proposed is to develop the standard side by side with the technology as it develops. Wireless networking is one such example.[44] At one time several technologies vied to become the standard, including HomeRF, Wi-Fi (802.11), Bluetooth, WiMAX and Wireless USB. Wi-Fi is now the preferred approach as an IEEE specified standard for home networks. Bluetooth has taken up residence largely in mobile devices.

The evidence is mixed on whether the early adoption of a standard hinders or facilitates the rate and extent of eventual market take-up. However, in the case of 2G mobile phones services, the experience is that in Europe where a single standard (GSM) was selected, take-up was faster than in other countries such as the U.S. where multiple standards exist.[45] Accelerated take-up rates allow revenues to accumulate to stakeholders sooner whereas slower take-up rates push out the revenue curves into the future. Additionally, there is a critical mass phenomenon such that unless take-up reaches a certain minimum level, the product may not "cross the chasm" into mass market acceptance and not only fast accumulating revenues but higher revenues overall.[46]

Another chicken-egg challenge in innovative technology markets is the old saw, "if you have no competition, there is no market." There are advantages to the "first mover," i.e., a company that introduces a product that ends up creating its own market segment. TiVo or even Apple TV devices are examples of products that ended up or may end up creating their own markets.[47] However, first movers often also face the uphill battle of creating a new product category in consumers' perceptions. This can consume significant marketing and advertising resources. The concept of a wireless home network was fairly alien not that long ago and now it is common place. Trying to sell the first 802.11b routers was a lot harder in the early days than it is now.

From the perspective of broadcasters, there is another chicken-egg problem. In the case where both broadcasters and audiences must adopt new complementary technologies, who blinks first in this game? As we will see in the case of AM stereo, the players were the automotive industry, the broadcast industry and the listeners, each of whom had to make an investment in purchasing AM stereo hardware before the market could develop. Other examples include color TV, TV stereo, FM stereo and now ATSC M/H mobile television.

In cases where several segments of a marketplace must relatively simultaneously embrace a new technology as noted above, the presence of a standard historically has shown to lead to more efficient functioning. The lesson from several such broadcasting related innovations were introduced is that, "when broadcasters, receiver manufacturers

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[44] Michael Warnecke, "At Internet Speed Sometimes the Chicken is Waiting for the Egg," blog entry, viewed on 12/3/07, http://pblog.bna.com/techlaw/2007/02/at_internet_spe.html.

[45] Church and Gandal, 2004.

[46] Geoffrey A. Moore, *Crossing the Chasm: Marketing and Selling High Tech Products to Mainstream Consumers*, HarperCollins Publishers, New York, NY, 1999.

[47] Richard Menta, "Apple TV: Chicken or Egg," MP3 Newswire.net, March 23, 2007, www.mp3newswire.net/stories/7002/AppleTV.html.

and audiences must all make decisions designed to maximize their own welfare, in an environment of complex and changing technical information, relatively high economic stakes, uncertain consumer demand, and different levels of expertise, the role of a standard-setting authority (governmental or private interest) can be a welcome addition to the process.[48]

Beyond mere standard setting, a more recent case of government action to stimulate consumer take-up of new technologies is to actually subsidize the consumer purchase. The National Telecommunications and Information Administration (NTIA) pursued exactly this tactic based on Congressional action to partially support consumer adoption of digital television technology since the analog system will be turned of by February 2009. NTIA announced in December 2007, that it has certified more than 100 different retailers—big and small, with some 15,000 or so outlets altogether—as eligible to accept $40 government coupons from consumers for digital-to-analog converter boxes.[49]

C. Digital Media Ecosystems

Before we move on to digital television mobile standards, it might be helpful to establish some broader context for these standards. As we have seen in network economies, both direct and indirect effect exist and there is a great incentive, as Intel's Craig Barrett so eloquently argued, for firms in the information, telecommunications and entertainment industries to collaborate on common protocols, interfaces, and form factors for the greater good of individual companies, competitors and the industry as a whole. This may or not be altruism, but collaborative behaviors are definitely motivated by indirect network effects or the reality that the value of part of a network system is contingent upon the presence and relative functioning of other parts of the system.

[48] Richard V. Ducey and Mark R. Fratrik, "Broadcasting Industry Response to New Technologies," *Journal of Media Economics*, Fall 1989, pp. 67-87.

[49] See "Digital to Analog Converter Box Coupon Program," www.ntia.doc.gov/dtvcoupon/index.html.

In effect, this describes an *ecosystem* of mutual dependency for assured survival and reproduction. Such an ecosystem has interdependent yet separable functions and actors. In a technology ecosystem, usually a *layered paradigm* is used to describe these relationships. These layered relationships are captured in the Open System Interconnection (OSI) Reference Model released in 1983 by the International Standards Organization. The OSI Model comprises seven layers of functionality each of which is independent in its distinct functioning but complementary to the overall functioning of a network. This means at any particular layer there can be horizontal compatibility without the need to achieve vertical compatibility with higher or lower layers since they function independently.[50]

Mobile Networking Ecosystem

We can apply this same layered paradigm to the case of the mobile networking ecosystem. One view of the mobile media ecosystem is presented in Exhibit 1. The point of showing this ecosystem is that for all these technologies to work together to provide the end game of an acceptable user experience there must be specific conditions for achieving interoperability. As shown in the exhibit, there is a variety of relevant standards for each of the layers in the mobile networking ecosystem.

In the case of M/H DTV standards, technologies must interoperate at least in the Layer 1 (Network backbone) and Layer 5 (Client devices) portions to achieve compatibility. The other layers can operate independently.

[50] Open Systems Interconnection – The OSI Reference Model, www.laynetworks.com/osi.htm, viewed 12/14/07.

Exhibit 1

BIAfn Mobile Ecosystem Reference Model

Layer	Function	Description	Products & Services-Examples	Companies – Examples
1	Network	Mobile backbone	2.5G, 3G (GSM, GPRS, EDGE, UMTS, HSDPA, CDMA, CDMA2000 1x, EV-DO, iDEN, DVB-H, MediaFLO, D-AMPS	Verizon Wireless, Sprint/Nextel, AT&T, T-Mobile,
2	Gateway	Routing, management and security.	IMS, SIP, FMC, VoIP, SMS, MMS, FTP, TCP/IP	Helix, NewBay, Intercasting, Proxicast, Quattro Wireless, Synchronica, BlueBlitz, Cisco, Juniper
3	Middleware	Application, SOAs	Codecs, EPGs, transcoders, e-commerce, location based services, IMS, SIP	Airwide, Helix, NewBay, Intercasting, Quattro Wireless, Loopt
4	Service Providers	Customer facing retail, wholesale services	Voice, data, video plans.	Verizon Wireless, Sprint/Nextel, AT&T, T-Mobile,
5	Application	Managed network services	CRM, OSS, email, voice mail, call forwarding , mobile video social networking	Verizon Wireless, Sprint/Nextel, AT&T, Helio, 3, Boost Mobile
5	Client	Devices and client-side applications	Handsets and mobile devices, players, GUIs, components, drivers, client-side applications, OSs (BREW, WAP, Symbian, Windows Mobile)	Motorola, Nokia, Apple, Freescale, Qualcomm, Real, ComVu, Comet Technologies, NewBay, Microsoft, Thin Multimedia
6	Servers	Server-side applications, digital asset management, storage, file servers, streaming server, databases, CDNs	IPTV	Helix, NewBay, 3Guppies, ON2, Pixsense, Quattro Wireless, Thin Multimedia
7	Content	Aggregators, social networking, video sharing, user generated content (UGC), streaming, creation, editing, web publishers, web sites, advertising, ad networks	Video, music, EPG,	Real, Helix, MySpace, Facebook, Eyespot, Nareos, YouTube, Ziddio, AdMob, Yahoo

D. Standards in Mobile Television

In our interviews with CE companies we heard the view expressed that while standards, such as the ATSC M/H standard, are useful to reduce risk, ultimately the decision to enter a market is up to companies' individual visions, strategies and understanding of marketplace dynamics, including their assessments of consumer demand. Further, companies must determine how successfully they can develop their own ecosystem strategies since companies must work together to create technology solutions. In the U.S., the choice for mobile television systems is up to the market. The government has not shown an inclination to become involved. As we will see in our examination of the AM Stereo case, this is likely to be good news. This is unlike the case of Europe which has now ended up selecting an EU recommended standard, though some have argued this was a counter-productive move that may not serve consumers' interest.[51]

Some argue that mobile data services, including mobile television, has much more complex technical requirements throughout the mobile ecosystem than voice and messaging requiring a "significantly higher degree of coordination and integration between more participants in the value chain…standardization is important but not sufficient to synchronize and integrate these technology and business choices."[52]

Given the interplay between national policy, technological innovation, business strategy and economics, it is entirely expected that we see several major standards for mobile television throughout the world. This includes "in band" systems using existing cellular network infrastructure and "out of band" systems requiring new infrastructure (e.g., 700 MHz or ATSC digital television spectrum). As we discuss in Chapter II, there are several technological approaches to providing mobile television services including unicast, multicast and broadcast. Typically, broadcast mobile television requires out of band infrastructure including both the transmission and handset components.

The ATSC DTV Standard has been adopted by the governments of Canada (November 8, 1997), South Korea (November 21, 1997), Argentina (October 22, 1998), Mexico (July 2, 2004), and Honduras (January 16, 2007).[53] As shown in Exhibit 2, Korea has adopted DMB for its mobile television standard. Japan has gone with ISDB-T. The European Union (EU) just announced that preferred standard is DVB-H.[54]

While other regions have already picked their mobile television standard, in the U.S. the "standards war" still has some life in it among DVB-H (if AT&T goes with the DVB-H standard in the Aloha spectrum it just purchased) and Qualcomm's MediaFLO technology. In addition to these broadcast mobile television standards, mobile video unicasting is available over CDMA (e.g., EV-DO) and GSM (e.g., HSDPA) systems.

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51 Sue Marek, "Should Mobile TV Be Standardized?" *Fierce Mobile Content*, November 27, 2007, www.fiercemobilecontent.com/node/4618/print.

52 Bauer, Johannes M., Im Sook Ha, Dan Saustrup, "Mobile Television: Challenges of Advanced Service Design," Global Mobility Roundtable, Los Angeles, CA, June 1-2, 2007.

53 See: www.atsc.org/aboutatsc.html.

54 Richard Wilson, "Europe Votes for DVB-H as Mobile TV Standard," *Electronics Weekly*, November 29, 2007.

Exhibit 2
Major Mobile TV Standards

Standard	ATSC M/H*	DVB-H	FLO	ISDB-T	DMB
Major Regions	US	Europe, Asia	US	Japan	Korea
Physical Layer	8 VSB	OFDM	OFDM	OFDM (sub banded)	OFDM
Service Availability	Demos	Deployed	Deployed	Deployed	Deployed
Handset	Demos	Multiple OEMs	Verizon approved handsets	Multiple OEMs	Multiple OEMs

*In development by ATSC TSG/S4, expected February 2009 completion.

One industry response to a situation where there are multiple standards but a desire to create scale economies by facilitating market growth is to break the logjam by offering multi-standard chipsets. At least two companies, Samsung and Maxim Integrated Products have done this.[55] According to our interviews, it may be difficult to integrate OFDM and ATSC on the same chip set. Multistandard chip sets add to the cost and complexity of the business and technology. Intellectual property rights have to be negotiated and technology of power requirements all addressed.

E. Case Studies of Standards Conflicts

While standards can facilitate collaboration among firms to the mutual benefit of both suppliers and consumers, there are instances where companies determine they have more to gain by not collaborating and bringing their technology to market and not collaborating with one or more rivals. The goal can be to reach the "tipping point" sooner than the rivals by capturing first move advantages in gaining market share sufficient to become the de facto standard. This allows the winning firm in a standards or format war to set the rules earns higher margins and enjoy the larger revenue streams that come with a larger market share.

Experience shows that to win a standards war, seven key assets are often determinative:[56]

1. Intellectual property rights.
2. Control over an installed base of users.
3. Ability to innovate
4. First mover advantages

[55] "Single Conversion Tuner for Mobile TV Achieves Low BOM," *Electronic Engineering Times*, December 3, 2007; "Samsung Announces Advanced Multi-Standard, Multi-Band Mobile TV Chipset," www.physorg.com/printnews.php?newsid=102179311.

[56] "The Art of War," *Wired*, October 1998.

5. Manufacturing abilities
6. Strength in complements
7. Brand name and reputation.

We will examine how these seven factors played into three "format wars"[57]. We will consider the cases of perhaps one of the more famous format wars at the dawn of the home video market between Betamax and VHS formats. We will also look at the AM Stereo format war and the current battle between HD DVD and Blu-ray HDTV discs. In each of these cases, the seven key assets listed above play some role in the outcome of these format wars and may hold lessons for the ATSC M/H DTV process.

AM Stereo

Broadcast radio typically is not thought of as a technological hotbed of innovation and even less so in the AM band. Nonetheless, AM radio makes an interesting case study among technology innovations and the role of standard setting because it is a situation where the government could not seem to decide if it should set a de jure standard for AM stereo or if it should let the marketplace set the de facto standard.

The beginnings of AM stereo can be traced to 1925 in New Haven, CT when WPAY-AM broadcast its signal on two frequencies using two transmitters.[58] In the 1950s, the FCC considered upgrading AM, FM and TV to stereo transmissions. The FCC approved FM stereo eventually (to give it a boost against AM) but withheld it from AM and TV. In TV's case, the FCC concluded that, "stereo sound mated with the small screen pictures of a typical TV set would be too distracting and unsatisfying."[59] Leonard Kahn, head of Kahn Communications and advocate of an AM stereo system, pushed against FCC's AM stereo delays. The Commission did eventually permit AM stereo beginning in 1982.[60]

Regulators were interested in improving AM services and were convinced that coherence would be added to the marketplace by identifying a single AM stereo standard. However, AM broadcasters would be not be required to broadcast stereo signals. But the FCC flip flopped by first adopting a standard and then deciding to not pick a standard itself in favor of a marketplace solution. The FCC did approve a standard for FM stereo but not for AM stereo concluding, "FM was considered to have higher fidelity broadcast service with a greater chance of success in providing stereo."[61] This was during a period when a major audience migration

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57 See "Format War" entry in Wikipedia: http://en.wikipedia.org/wiki/Format_war for a compact overview of competition between incompatible proprietary formats.

58 W. A. Kelly Huff, "FM Stereo and AM Stereo: Government Standard Setting Vs. the Marketplace," AEJMC/Mass Communication and Society Division, Portland, OR, July 2-5, 1988.

59 Huff, 1988.

60 Federal Communications Commission, "In the Matter of AM Stereophonic Broadcasting: Report and Order (proceeding terminated)", Docket N. 21313, FCC 82-111, March 18, 1982.

61 Mass Media Bureau, Federal Communications Commission, "Report of the Status of AM Broadcasting Rules," 26, Report No. MM-128, April 3, 1986.

from AM to FM radio was in process inverting the audience share split from AM's favor to FM's favor. In 1973, 70% of the radio audience was tuned to AM but by 1985 it was the FM band that had 70% of the listenership.[62]

In June 1977 the FCC adopted its Notice of Inquiry for AM Stereo and then a Notice of Proposed Rulemaking in 1978 collecting 90 responses and in particular, comments from five companies offering different and incompatible AM stereo technologies: Belar Electronics, Harris Corporation, Magnavox, Motorola and Kahn. The FCC voted on April 9, 1990 to tentatively select Magnavox as the single AM stereo standard.[63] Just a few short months later, the FCC faced threats of litigation should it upgrade its "tentative" selection of Magnavox to a permanent choice. In its Further Notice of Proposed Rulemaking issued on July 31, 1980, the Commission cancelled its selection of Magnavox.

The FCC's decided not to pick one AM stereo standard but instead authorize five different and incompatible systems, leaving it up to the marketplace. As one researcher noted, "…the decision appeared to be a collective throwing up of hands as the Commission staff admitted its inability to make a clear cut choice among the systems, all of which were compatible with existing AM technology…a constantly recurring issue has been the proper role of the FCC in a time of dramatic technical, economic and political change."[64]

Three of the manufacturers eventually took their systems off the market leaving just the Motorola C-Quam and Kahn Communications systems. These two companies decided to face off in the market, unable or unwilling to seek a collaborative solution.

In 1987, five years after the introduction of AM stereo to the market, the National Telecommunications and Information Administration decided to undertake its own study of AM stereo. After a six month study, NTIA released a report concluding that, "governmental decisions have exacerbated the audience migration from AM to FM by promoting the growth of high fidelity FM without authorizing comparable performance for AM."[65] NTIA found that even though AM stereo had been on the market for over five years, less than 100 AM stations had adopted one or the other of the AM stereo systems because of two reasons: (1) broadcasters feared choosing the wrong system (less than $50,000) and (2) there were no AM stereo receivers on the market for consumers to purchase. For their part, manufacturers were reluctant to produce receivers because they saw little commitment from broadcasters and no indications of consumer demand (in fact with the fast eroding AM audience share, quite the opposite).

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62 W. A. Kelly Huff, "FM Stereo and AM Stereo: Government Standard Setting Vs. the Marketplace," AEJMC/Mass Comm and Society Division, Portland, OR, July 2-5, 1988.

63 Kelly, 1988, page. 12.

64 C. H. Sterling, "The FCC and Changing Technological Standards," *Journal of Communication*, Autumn 1982.

65 "AM Stereo and the Future of AM Radio," National Telecommunications and Information Administration, U.S. Department of Commerce, February 1987.

AM stereo was a party to which no one came. It became a three-way stalemate, the ultimate chicken-egg situation with none of the major stakeholders – broadcasters, consumers or manufacturers – willing or able to take the first step. NTIA recognized that one way to end this format war between the incompatible Motorola C-Quam and Kahn AM stereo systems was to promote multisystem receivers and undertook a feasibility study. NTIA determined in August 1987 that while there could be technical viability for a multisystem decoder chip it would not be a practical solution.[66] At the time, Sanyo was marketing multisystem AM stereo chips for about $2.50 but that incremental cost combined with weak market acceptance from both broadcasters and the audience was sufficient disincentive to keep radio manufacturers from building receivers.

NTIA's advice on a practical solution for breaking the logjam in its August 1987 report was to call upon the FCC to recognize "substantial consumer acceptance" and protect the "pilot tone of systems" or in other words, the Motorola C-Quam system.[67] Ultimately, the automotive electronics industry took the bet and began installing AM stereo receivers in cars. However, broadcasters never followed suit to any large degree.

In 1992, the U.S. Congress passed a law requiring the FCC to establish an AM stereo standard even though it had refused to do so a decade earlier when it may have made more of a difference.[68] Ultimately, the auto industry appeared to be the most committed to AM stereo by installing receivers in several lines of cars. But consumers and broadcasters never followed in sufficient numbers to make this an interesting market. Today, AM broadcasters are holding out their hopes for digital audio broadcasting as their technological savior rather than AM stereo.

If any lessons were learned from the AM stereo experience, four big ones are that:

1. The government is hard put to make justifiable standards decisions in a confusing, fast moving, technology driven market,
2. If the industry elements critical to create an end-to-end system have trouble collaborating, the resulting format war is a high risk venture in which no one may win,
3. If consumers are not impressed, a market will not emerge, and
4. In a format war, multisystem receivers may solve a technical issue but cannot change the unfavorable economics.

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66 "AM Stereo and Multi-system Compatibility," National Telecommunications and Information Administration, U.S. Department of Commerce, August 1987.

67 Ducey and Fratrik, p. 78.

68 Richard V. Ducey, "Riding Radio's Technological Wave," published in Edward C. Pease and Everette E. Dennis (eds.), *Radio – The Forgotten Medium*, Transaction Publishers, New Brunswick, NJ, 1995, pp. 159-164.

Betamax versus VHS

The Sony Betamax versus the Japan Victor Company (JVC) VHS systems for home video recording and playback story is a classic standards war tale. Sony, a major consumer electronics technology leader, tried to use its power and prestige to forestall a standards war by approaching other Japanese electronics companies to convince them that their technology was best. Sony chairman, Akio Morita himself, showed the new Betamax machine to executives from Matsushita, JVC and RCA in an attempt to preemptively impress them away from market entry with their own competitive products. However, JVC decided to launch its VHS format anyway.[69]

Unlike the case of AM stereo where the government tried to play a role, other than an important enabling decision in 1984 by the U.S. Supreme Court[70] to allow "fair use" applications of home video recording, the government did not play a significant role and even this decision occurred after the standards war had been fought and lost in the marketplace by Sony.

Sony spent 15-20 years developing its Betamax product launched in 1974. JVC followed a couple of years later in 1976 with its VHS product. The videocassette recorder (VCR) format wars thus began in force. Actually, it is slightly more complicated, as with AM stereo, and the initial crowd of competitors was larger with six incompatible solutions on the market. From 1974 to 1976, four of these technologies failed. In 1975, Sony had the clear lead and momentum and just beginning to face the challenge from JVC.

On its side, Sony had first mover advantage which offered "lock-in" (or threat of being stranded) to initial adopters who could not use tapes with the incompatible VHS, allowed them to obtain above average profits while a monopoly and gave them the ability to define a product market. Sony's Betamax also offered higher quality pictures. However, JVC adopted a quick follower strategy and countered Sony's advantages by bettering the recording time (two hours versus one hour – enough to record movies) and developed a broader ecosystem of partners. By 1977, JVC's VHS product was set to frontally challenge Sony's Betamax product from the perspectives of product cost, quality and functionality and in terms of market power. By 1978, Sony started to fall behind in market share.[71]

JVC utilized another important business strategy that helped drive the final nail into the coffin of Sony's Betamax technology. Whereas Sony initially was reluctant to share the wealth by licensing its technology and tightly controlled access to its intellectual property, JVC's strategy was to open up its family or

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69 "Betamax and VHS," Leonard N. Stern School of Business, New York University, Firms and Markets Mini-Case, August 28, 2002.

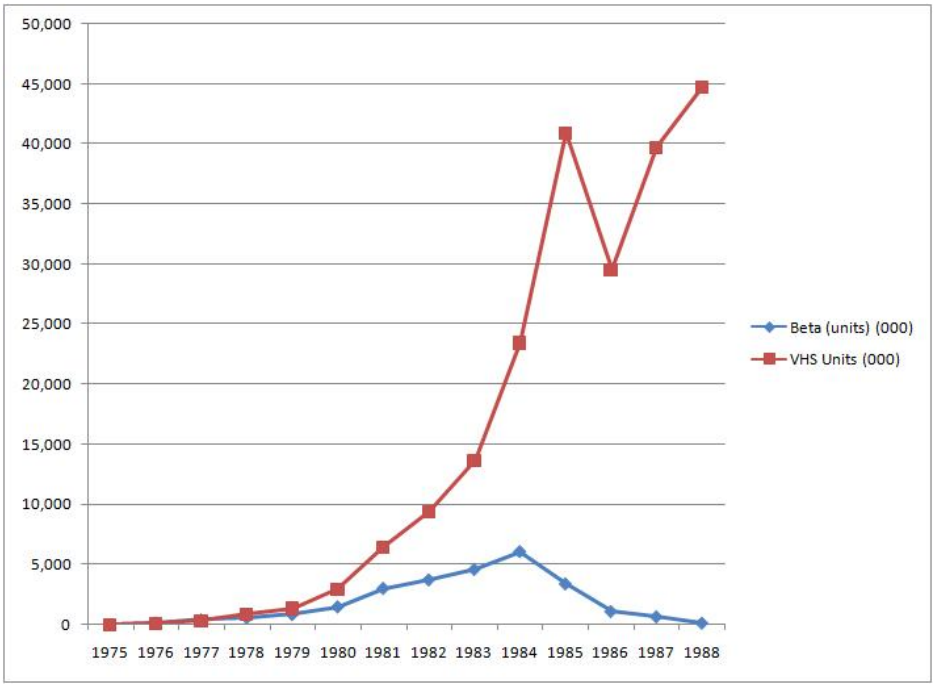
70 Sony Corp. of America v. Universal City Studios, 464 U.S. 417 (1984)

71 Michael A. Cusumano, Yigoros Mylonadis and Richard Rosenbloom, "Strategic Maneuvering and Mass Market Dynamics: The Triumph of VHS Over Beta," Massachusetts Institute of Technology, MIT Japan Program, MITJP 91-08, 1992.

ecosystem of partners. Two key benefits accrued to JVC based on this strategy. First, there was a huge bandwagon effect from JVC's groundswell of support from 40 major companies including most of the major consumer electronics firms. With this large group of firms, JVC's extended "family" all contributed to product differentiation and innovation, occupied competitive shelf space, leveraged their own brand equity, and had their own sales and marketing presence in the market which collectively became an overwhelming competitive force against Sony. This led to a consumer tipping point because of the implied credibility, brand equity and easier access to a variety of choices for VHS. In contract, even by 1984 Sony had only five companies utilizing its intellectual property. This led Morita to conclude of his company's failure in this product category, "We didn't put enough effort into making a family . . . the other side, coming later, made a family."[72]

Exhibit 3 provides the story in one picture. For a five year period 1975 to 1980, VHS and Betamax battled in the market but thereafter it was all VHS. Sony created this product category but in just a few short years watched its competitor walk away with the prize. The VCR was a very successful consumer electronics product category, but the format war may well have pushed out the demand curve by five years.

Exhibit 3
Annual Sales of Betamax and VHS: 1975-1988



Source: http://klondikeconsulting.com/blog/?cat=7&paged=2

[72] NYU Stern, 2002.

Several lessons from the classic Betamax versus VHS format war include:

1. Even with a technological advantage (picture quality), other attributes (longer recording ability for movie length programming) can tip the market and undo the first mover's advantage.
2. A follower strategy can take advantage of more recent technology and efficiencies, even those made possible by the leader.
3. A "go it alone" strategy to win market share and keep high margins is high risk, ultimately contributing to Sony's fall versus the JVC strategy of "sharing the wealth" and building its ecosystem family of companies each of which took shelf space away from Sony and offered their own branding, product innovations and variety and sales and marketing efforts in the market becoming irresistible to consumers.
4. The format war suppressed consumer demand and marketplace success for the category from 1975-1980 when VHS reached the tipping point.
5. The VCR format wars may have suppressed latent consumer demand for as long as five years. In other word, mass market penetration may have been achieved up to five years earlier if a format war had been avoided.

HD DVD versus Blu-ray

A contemporary standards battle even now is being waged in the market, in the high definition home video recording and playback disk category. This story does not yet have an ending. In fact, one of the opening questions posed at an industry conference was "What if somebody started a format war and nobody came?"[73]

As we just discussed, the VHS VCR format became the standard for home video. By the late 1990s however, VHS gave way to a newer format for home video, the DVD.[74] The DVD was introduced to the market in 1997. Its superior technical qualities of digital pictures, random search and access, smaller, more durable physical attributes, production efficiencies and other qualities overwhelmed the video tape format.

The quick end to an early DVD format war came about because of an agreement among industry players to settle their differences and join forces to grow a "rising tide" market where multiple companies could win. Beginning in the 1970s, Sony and Philips collaborated to develop an audio CD called the Multimedia Compact Disc. About the same time Toshiba and others including JVC and Pioneer worked on a rival DVD format called the SuperDensity Disc. After years of development, there was a brief 18 month test of wills in the marketplace. By 1995 these groups

[73] Erica Ogg, "Blu-Ray vs. HD DVD: War Without End," *C|Net News*, www.news.com/2102-1041_3-6212782.html?ag=st.util.print, November 27, 2007.

[74] Summer Banks, "Is Blu-Ray or HD the Next Betamax?" *Associated Content*, March 6, 2007.

threw in the towel and combined forces by forming the DVD Consortium (later called the DVD Forum) to promote the new technology. This worked extremely well with DVDs achieving the fastest and broadest consumer take-up rates in the consumer electronics market to date rising from near zero to 80% in just ten years.[75]

A key to the DVD success story is that DVDs use ISO standard MPEG-2 video compression and digital audio. This platform of standard, interoperable formats based on patent pools from market leaders offering reasonable and non-discriminatory licensing helped the new single DVD format rapidly gain adoption.[76]

High definition or next generation players now are entering the market to compete with DVDs, one of the most successful consumer electronics products. The two incompatible next generation players – HD DVD and Blu-ray sold for as little as $100 during the 2007 holiday season.. HD DVD is backed by Toshiba along with LG, Thomson/RCA, Onkyo and Samsung for home theater and Microsoft, Intel, HP, NEC and Toshiba for computer storage. Blu-ray has Hitachi, Mitsubishi, LG, Sharp, Sony, Panasonic, Samsung, Phillips and Thomson/RCA for manufacturing partners and Apple, Dell, Beng, HP, LG, Panasonic, Philips, Pioneer, Samsung, Sony and TDK for computer storage. Both players are backwards compatible, Blu-ray has more capacity (up to 8.5 hours of HD programming versus up to 3.3 for HD DVD), similar numbers of titles available (still a pittance with several hundred versus 50,000 plus for DVD), Blu-ray players are more expensive (approximately $299 versus $199 for HD DVD).[77]

At this point, there is no clear winner but it appears that Blu-ray is gaining the edge. Adoption of these next generation players is still in the early stage. Some companies are starting to choose sides. Alignment of content owners with the HD player platforms can be critical in determining the outcome. Most recently, Time Warner's Warner Bros. announced its intent to release HD movies only in Blu-ray.[78] That leaves only GE's Universal Pictures and Viacom's Paramount Pictures as the only two major studios backing HD DVD. Sony, Disney and Twentieth Century Fox are backing Blu-ray.

Research firm NPD forecasts sales of one million HD players in 2008 with 400 movie titles to be released in one or both formats. NPD reports that 66% of their sample indicates they are "not likely to buy a high definition player in the next six months."[79] According to Ross Rubin, NPD's director of consumer electronics industry analysis, "The format war continues to be a primary operative issue when

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75 "Origins of the Blu-Ray vs. HD-DVD War," *Roughly Drafted Magazine*, August 29, 2007, www.roughlydrafted.com/2007/08/29/origins-of-the-blu-ray-vs-hd-dvd-war/.

76 *Roughly Drafted*, August 29, 2007.

77 "Blu-Ray, HD DVD and DVD Formats Compared," *C|Net Reviews*, www.reviews.cnet.com/4520-131817_7-6462511-2.html?tag=arw, viewed December 4, 2007.

78 Wall St. Journal, January 5, 2008.

79 Ogg, 2007.

it comes to determining the long-term viability for high definition DVD technology . . . however, there are other more basic short term obstacles blocking acceptance. One of our interviewees from a consumer electronics firm estimated that without the format war, five times as many players and twice as many titles would be on the market by now. As HDTV penetration continues to grow, manufacturers and studios will need to do a better job imparting the benefits of these formats to a consumer base that still reports a high satisfaction with the current DVD standard."[80]

Indeed, some consumer electronics writers are urging people to hold off on their purchasing decision unless they are gamers while this mess settles out.[81] Gamers are different because their HD movie function is secondary to the gaming function. Even writers targeting the corporate market are advising their readers to, "wait until the market shakes out before making an investment" in Blu-ray or HD-DVD.[82]

By the late 1990s, High Definition Television (HDTV) sets began appearing in larger numbers in homes. This began the drive toward a HDTV version of the DVD technology resulting in two formats – HD DVD led by the Toshiba camp and Blu-ray led by Sony. In less than ten years, the DVD has begun its transition from category killer to seeing the beginning of its own end. The bad news is that consumers are facing yet another format war.

The Blu-Ray Disc Association claims that its format is backwards compatible with DVDs, offers 5 times the capacity of a DVD with 7.1 audio channels and claims support from 90% of major Hollywood studios, nearly all major leading consumer electronics companies, four of the top computer brands, the world's two largest music companies and the leading game companies, including Sony's PS3 of course.[83]

Blockbuster, Inc. announced in June 2007 that it would begin renting and selling only Blu-ray Discs in 1,700 of its 4,000 outlets. Blockbuster justified this move by indicating that 70% of its rentals are Blu-ray discs and it reads this as a sign the marketplace has spoken even though only a small percentage of homes have purchased either Blu-ray or HD DVD players. Further, Blockbuster did not distinguish Blu-ray rentals in terms of movie titles versus Playstation 3 games (2.6 million PS3 game players sold in the U.S. came with Blu-ray drives). Sony indicates it has sold 100,000 standalone Blu-ray players versus an HD DVD player population of perhaps 150,000, so the race to the tipping point may not be

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80 "High-Definition Discs and Video Players: Industry Must Do More to Motivate Consumers, But Opportunity for Growth is Abundant," Press Release, The NPD Group, Port Washington, NY, September 19, 2007.

81 See e.g., John P. Falcone,
HD DVD vs. Blu-Ray," C|Net Reviews, http://reviews.cnet.com/4520-13817_7-6462511-1.html, September 5, 2007.

82 Steven J. Shuchart, Jr., "Optical Illusions," *Network Computing*, June 25, 2007.

83 http://www.blu-raydisc.com/bluray_site.htm

quite as close as Blockbuster thinks.[84] This PS3 strategy by Sony seems to be making sense. Since putting Blu-ray drives into PS3 players, Blu-ray movie sales increased more than sevenfold and attaining 70% of the market.[85] In Spring 2007 a Blu-ray title hit the 100,000 mark for the first time with the release of *Casino Royale*.

Another point to be made is that these next generation players featuring high definition video obviously are better suited to HDTV television sets. The diffusion rate of HD players faces a dependency on the diffusion rate of HDTV sets and therefore limits the upside growth rate potential. The HDTV diffusion rate will be assisted both by the superior quality of HDTV devices and also by the forced completion of the transition to over the air digital television by February 17, 2009. However, the digital transition is still news to nearly half the country. According to a poll by the Cable & Telecommunications Association for Marketing (CTAM), 47% of TV viewers do not know when this transition will occur.[86]

While the next generation/high definition player market is in its early stages, we can already see some lessons shaping up for this format war, including:

1. Even with the availability of standards, patent pools, reasonable non-discriminatory cross-licensing giving studios, manufacturers, PC storage companies and others the option to support one or both formats, the market is not moving forward as quickly as it might with one standard. The Sony Betamax lesson of "we should have had a bigger family" observed by then chairman Morito has been applied this time around, but that is not enough.
2. The Blu-ray versus HD DVD format war again appears to be pushing out the consumer demand curve as buyers, with encouragement from consumer electronics writers, adopt a "wait and see" who wins attitude. Just having two or more formats itself is a market retardant. It appears that consumer demand may be suppressed until consumers perceive a winner, this may slow uptake for perhaps 18 months.
3. High definition players face an important and pace-setting dependency of appealing most to those with HDTV sets, facing its own diffusion curve. That limits the upside growth rate and breadth of these players.
4. Consumers will not quickly abandon another popular technology (DVDs) without a clear and compelling value proposition which

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84 "Blockbuster Taps Blu-Ray Over HD DVD," *TV Technology*, July 11, 2007.

85 "Blu-Ray Outselling HD DVD 70% to 30%," *PC World*, Emru Townsend blog posting, http://blogs.pcworld.com/digitalworld/archives/2007/03/bluray_outselli.html.

86 John Eggerton, "CTAM Study Finds Confusion About DTV Transition," *Broadcasting and Cable*, December 10, 2007.

arguably has yet to be established by either Blu-ray or HD DVD proponents.

F. ATSC Process and Potential Outcomes

The Advanced Television Systems Committee (ATSC)[87] is a member-based non-profit organization devoted to developing industry standards[88] for digital television to ensure functioning and interoperability. ATSC has created a family of twenty-six published ATSC digital television standards and recommended practices ranging in function from audio coding to datacasting as shown in Exhibit 4. The ATSC work in the mobile/handheld area intends to add one more row to this exhibit. In addition to these standards, the ATSC also publishes a number of Recommended Practices, which are specifications or criteria that are not strictly necessary for effective implementation and interoperability, but may improve the efficiency of implementation or reduce the probability of implementation errors.

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87 The Advanced Television Systems Committee, Inc., is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organizations represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries. ATSC creates and fosters implementation of voluntary Standards and Recommended Practices to advance terrestrial digital television broadcasting, and to facilitate interoperability with other media. See the organization's web site at www.atsc.org for additional information.

88 An ATSC "standard" is a document that states basic specifications or criteria that are necessary for effective implementation and interoperability of Advanced Television Systems. For details on these standards documents, see www.atsc.org/standards.html.

Exhibit 4
ATSC Primary/Related Standards and Recommended Practices

Function or Service	Primary Standard	Related Standards and RPs
DTV Audio Coding	A/52: Digital Audio Compression Standard (AC-3, E-AC-3)	A/53: ATSC DTV StandardA/54: Guide to the Use of the ATSC Digital Television Standard
DTV Video Coding	A/53: ATSC Digital Television Standard	A/54: Guide to the Use of the ATSC Digital Television Standard A/63: Standard for Coding 25/50 Hz Video
DTV Transmission System	A/53: ATSC Digital Television Standard	A/54: Guide to the Use of the ATSC Digital Television Standard A/64: Transmission Measurement and Compliance For Digital Television A/74: Receiver Performance Guidelines A/75: ATSC Recommended Practice for Developing DTV Field Test Plans A/110: Synchronization Standard for Distributed Transmission A/111: Design Of Synchronized Multiple Transmitter Networks A/112: E-VSB Implementation Guidelines
Program and System Information	A/65: Program and System Information Protocol for Terrestrial Broadcast and Cable	A/57: Program/Episode/Version Identification A/68: Use of ATSC A/65A PSIP Standard in Taiwan A/69: PSIP Implementation Guidelines Recommended Practice A/70: Conditional Access System for Terrestrial Broadcast A/71: ATSC Parameterized Services Standard A/76: Programming Metadata Communication Protocol Standard A/78: Transport Stream Verification
Data Broadcasting	A/90:ATSC Data Broadcast Standard	A/91: Implementation Guidelines for the ATSC Data Broadcast Standard A/92: Delivery of IP Multicast Sessions over ATSC Data Broadcast A/93: Synchronized/Asynchronous Trigger Standard A/94: Data Application Reference Model A/95: Transport Stream File System A/96: ATSC Interaction Channel Protocols A/97: Software Download Data Service A/98: System Renewability Message Transport
Interactive Television	A/101: Advanced Common Application Platform (ACAP)	A/100: DTV Application Software Environment - Level 1 (DASE-1) A/102: ACAP Service Signaling and Announcement
Satellite Systems	ATSC Satellite Transmission Standards	A/80: Modulation And Coding Requirements For Digital TV (DTV) Applications Over Satellite A/81: Direct-to-Home Satellite Broadcast Standard

ATSC Process for the M/H Standard

The intent of the M/H standard is to "support a variety of services including free (advertiser supported) television and interactive services delivered in real-time, subscription-based TV and non real-time content for storage and playback at a later time. It may also be used for new data broadcasting services such as real-time navigation data for in-vehicle use."[89]

The ATSC is governed by a board of directors. Reporting to the board are two functional branches, the Technology and Standards Group (TSG) and the Planning Committee (PC).

The TSG develops and recommends voluntary, international technical standards for the distribution of television programs to the public using advanced television technology in light of existing standards organizations and activities such as CableLabs, IEEE, IETF, SMPTE and so on. TSG work is guided by specific ATSC policy guidelines.[90]

The PC considers business opportunities, with a focus on new applications that may be enabled by digital television standards. The PC may make recommendations to the Board of Directors and also provide business and marketing input to the TSG work efforts. It was the PC which submitted a "New Work Item Proposal" (NWIP) for a mobile/handheld standard to the Board of Directors, consistent with Section 10.4 of the ATSC's bylaws.[91]

Specialist group TSG/S4 is responsible for the development of the ATSC Mobile/Handheld (ATSC-M/H DTV) standard. This standard is to be backwards compatible with existing ATSC services and devices. Within ATSC, the specific work flow to create the M/H standard is as follows:

1. New work is assigned to a Technology and Standards Group by the Board of Directors.

2. The Technology and Standards Group (TSG) assigns the work to a Specialist Group, in this case, TSG/S4.

3. The Specialist Group (TSG/S4) develops specifications by consensus and forwards the documents to the TSG.

4. TSG must approve the document by a two-thirds majority.

5. The full committee (ATSC) must approve the document by a two-thirds majority.

89 "ATSC to Develop Standard for Mobile and Handheld Services," ATSC News Release, April 9, 2007.
90 See "Procedures for Technology Group and Specialist Group Operation of the ATSC," May 11, 2005.
91 "ATSC New Work Item Proposal: ATSC Standard for Mobile and Handheld Services," PC-149r6, April 2007

The expected time line for the ATSC process to culminate in an M/H standard is shown in Exhibit 5.

Exhibit 5

ATSC M/H Timeline

Event	Date
ATSC strategic retreat identified the development of a mobile/handheld standard as a priority.	Jul 2006
ATSC Board approves revised strategic plan, including M/H priority.	Sep 26, 2006
Planning Committee submits NWIP for M/H standard to ATSC Board of Directors.	Apr 3, 2007
ATSC Press Release issued, "ATSC to Develop Standard for Mobile and Handheld Services"	Apr 9, 2007
ATSC Issues Request for Proposals (RFP) for Mobile and Handheld Specifications	May 21, 2007
Preliminary Responses to ATSC M/H RFP Due	Jun 21, 2007
ATSC issues news release indicating it received 10 submissions to its M/H RFP	Jun 22, 2007
Detailed responses to M/H RFP due	Jul 6, 2007
Open Mobile Video Coalition (OMVC) meeting with proponents for "substantial agreement" on IDOV	Nov 14, 2007
OMVC "IDOV" (Independent Demonstration of Viability) activity	Feb 4-29, 2008
OMVC "field demonstration" with MSTV data collection	Feb 18-Apr 4, 2008
OMVC prepares report for OMVC Board for review and action	Mar-Apr 2008
OMVC presents report to ATSC TSG/S4	May 2008
System/technology choice agreed by TSG/S4	Summer 2008
ATSC goal for releasing M/H standard (candidate standard).	Feb 19, 2009

In the ATSC-M/H Request for Proposals the following criteria were specified to potential respondents.[92]

1. ATSC-M/H services shall be carried in DTV broadcast channels. The presence of these services shall not preclude or prevent operation of current ATSC services in the same RF channel or have any adverse impact on legacy receiving equipment.
2. Current ATSC receivers are not expected to be able to decode or display ATSC-M/H services.
3. Any M/H solution should have sufficient flexibility to offer a viable service with bitrates that do not devalue existing DTV services, inclusive of HDTV. No specific bit-rate allocation restriction exists except that U.S. broadcasters are to provide a service that continues to conform to FCC requirements.
4. Service area for mobile and handheld services shall, at a minimum, correspond as closely as possible to the service area for DTV using 8-VSB. Larger service areas are desirable.
5. Reliability of service for devices operating within the ATSC-M/H service area should be comparable to or exceed that of cell phone and other handheld devices enabling similar services.
6. Service area, reliability of service, and other technical considerations shall take account of practical antennas for mobile and handheld devices, which differ significantly from traditional 30-foot antenna assumptions.

How important is it whether the ATSC releases an M/H standard by February 2009? What would happen if it does not release a standard by then, if indeed not substantially earlier? And what if, whether or not ATSC does release an M/H standard, one or more rival systems decide to launch in the market? These questions are a major concern to broadcasters who see the mobile/handheld market as a potential source of high growth, incremental revenues to complement their current business models. We pursue this in Chapter VI.

[92] ATSC Technology and Standards Group (TSG), "Request for Proposal for ATSC-M/H: A Backward Compatible Mobile and Handheld Standards," TSG Doc. #750.

IV. MOBILE TELEVISION: STAKEHOLDERS AND MARKETS

This chapter has three objectives: (1) identify the major stakeholders in the mobile television marketplace; (2) describe the general market structure expected to develop around potential mobile television receivers; and (3) begin to define the role(s) that local broadcasters may play in this emerging business. For purposes of comparison, the chapter concludes with a summary of market trials and mobile television service launches outside the United States.

Mobile television involves the transmission of video content to, and reception by, mobile/ handheld (M/H) devices such as TV-capable cellular phones, vehicle-mounted TV systems, laptop computers, and/or handheld video players. The content may be traditional TV programming, traditional programming re-formatted for small screens, and/or new formats such as user-generated content.[93]

Mobile television differs from ordinary over-the-air (OTA) television.[94] The current ATSC digital standard for OTA DTV broadcasts was engineered to deliver a digital signal to fixed locations. The proposed M/H DTV standard will be designed for broadcasters to transmit to M/H devices moving up to vehicular speed.

With respect to program distribution to mobile users, there are three potential modes, each of which is relevant under specific circumstances:[95]

1. **Unicast Mode:** Designed to deliver user-selected programs on a one-on-one basis (e.g., video-on-demand, such as access to a database containing previously broadcast prime time programs); usually has limitations on the number of users that may be supported simultaneously, especially on bandwidth-limited networks such as 3G cellular systems; requires some degree of interactivity.

2. **Multicast Mode:** Involves the transmission from a source to all devices in a group (i.e., one-to-some such as a subscription dedicated to sports programming); may require some degree of interactivity; does require conditional access.

3. **Broadcast Mode:** Allows the same content to be received by an unlimited number of users (one-to-many) in the geographic area covered by the transmission (as is OTA television today); ideal for the delivery of TV

[93] Sometimes abbreviated as UGC; consists of a mix of personal content uploaded for sharing, sites dedicated to social networking, and dating services with personal preferences/characteristics uploaded. UGC is expected to include a mix of uploads and downloads that HP denotes as "personal video channels." Such channels provide opportunities for mobile marketing so long as they appear tailored to the recipient. See HP's "Accelerating 3G Mobile Video Communications" (November 2007).

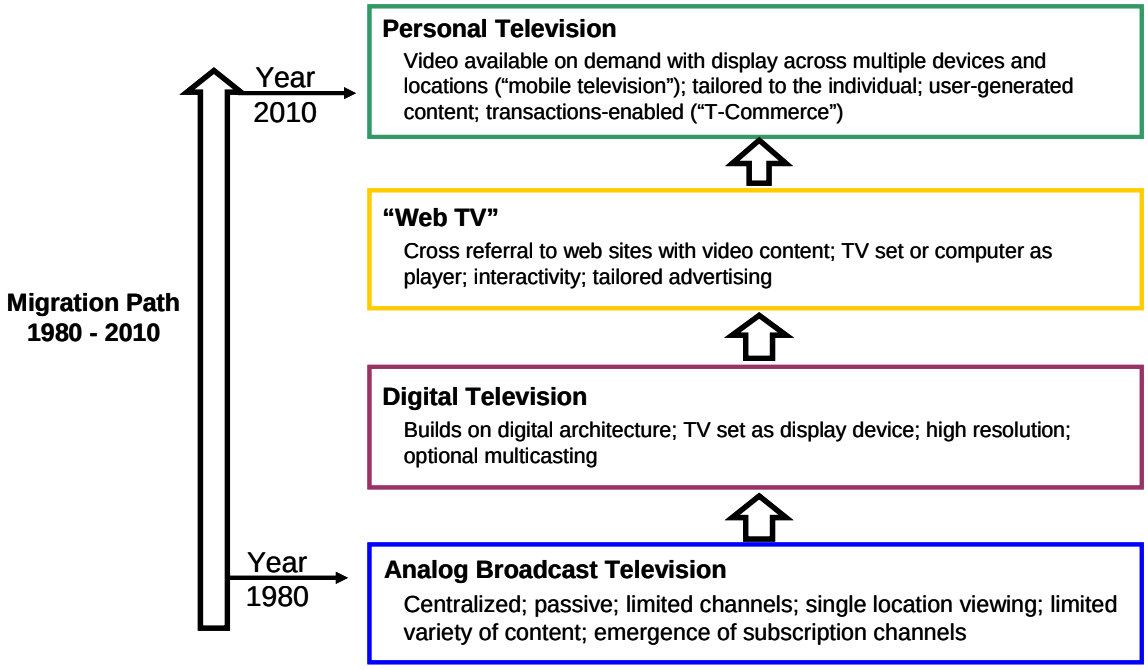
[94] In this paper, "OTA" refers to free-to-air broadcasts sent by local broadcasters. As of February 2009, such broadcasts will be entirely digital using the ATSC standard.

[95] Amitabh Kumar, *Mobile TV: DVB-H, DMB, 3G Systems and Rich Media Applications*, Focal Press (2007), Section 5-7, p. 130.

programs to a mass market on a free-to-air, advertiser supported business model; requires no interactivity.

Finally, and most importantly, M/H digital television (DTV) is a logical extension of the in-process digitally-driven development of television from passive entertainment to an interactive, high value, versatile medium (often referred to as "personal TV") (see Exhibit 6).[96] Each stage builds upon the set of earlier stages. "Personal television" adds functionality and value to "web TV" which did the same to "digital television" which, in turn, did the same to "analog broadcast television." The development process is additive and cumulative. Although critically important, M/H DTV is just one aspect of the evolving "personal TV" stage.

Exhibit 6
30 Years Of Change and Challenge



A. Mobile Television Industry Structure and Supply Chain

There are multiple, overlapping layers of the television industry supply chain (see Exhibit 7). These stages remain the same in concept, but may differ in execution, for OTA television versus mobile television.

1. **Program/Content Production:** Creates programming for sale to, or under contract from, content aggregators/networks/local stations; negotiates with and organizes talent; may or may not retain an ownership interest; includes first run and off-network syndication, may be national or local (e.g., news); emerging sources include user-generated content.

[96] "Television" in this context refers to video carried over all local distribution platforms (e.g., OTA, cable, microwave, telco, and satellite).

2. **Network Packaging/Content Aggregation:** Includes acquisition and scheduling of programming; traditionally sent to a single affiliate in a market for local redistribution; usually includes marketing and sale of national/regional advertising; includes broadcast, cable, satellite, and web-based networks; may be subscriber-supported and/or advertiser-supported; new entrants include Internet-based "packagers" like YouTube (owned by Google).

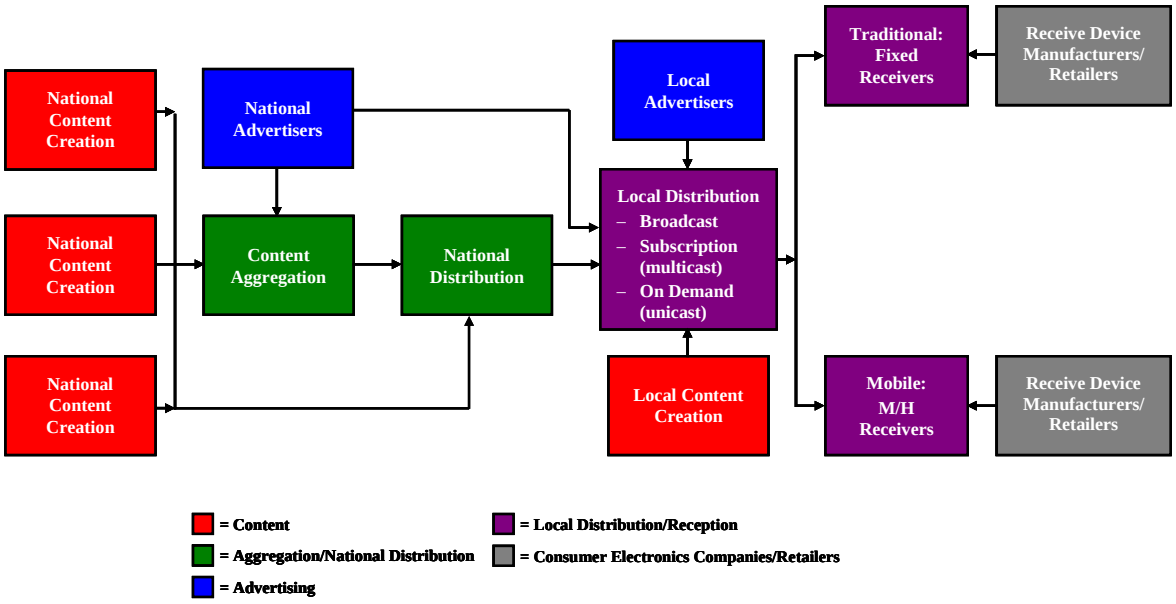
3. **Local Distribution:** Involves delivery of one or more video channels to a fixed or mobile receiver; often includes some local production, as well as marketing and sale of local advertising and/or subscriptions; local infrastructure distribution may be OTA, microwave, satellite (i.e., 'local-into-local') or wired; Internet-based distribution has also emerged.

4. **National/Local Advertisers:** Pay local/national distributors for access to audiences; usually use agents to negotiate with distributors; source of ads and product placements that are inserted into programs; the major source of revenue for OTA broadcasters.[97]

5. **Receive Device Manufacturers:** Produce devices (e.g., televisions, laptop computers, cellular phones, handheld video players) used by consumers to view video content; prefer a single standard against which to manufacturer; classified as "consumer electronics" companies; operate as high volume, economies-of-scale producers; usually sell through national and local retail stores, both online and offline; includes companies that provide software that operates on M/H devices.

[97] Other revenue sources may include: (a) retransmission fees; and (b) advertising revenues from station web sites.

Exhibit 7
Stages Of The Local Television Supply Chain



Participants may be active at one or more levels in the supply chain (i.e., vertical integration). For example, the television broadcast networks operate as content aggregators but own and operate TV stations (i.e., local distribution) and develop/own programs (i.e., content creation). Likewise, local broadcast stations often produce programs (primarily news) for broadcast on the station, as well as occasional feeds to an affiliated broadcast network, a local cable news channel, or a co-owned local station.

Local distribution to M/H receivers is just emerging. The potential local network options are:

1. Local broadcasters using a portion of their DTV signal that is optimized for M/H receivers;

2. Cellular telephone networks that carry video through their digital networks;

3. Other terrestrial networks (e.g., MediaFLO operating on channel 55 in the 700 MHz band) that operate outside the traditional networks of either local OTA broadcasters or the cellular operators; and

4. Distribution by satellite to terrestrial mobile receivers.[98]

[98] A distribution option that is being used more in Asia than the U.S. In the U.S., satellites have been proposed for use as a national distribution channel to interconnect terrestrial local distribution systems (e.g., HiWire with SES Americom, Clearwire with ICO Global).

The local distribution of mobile television to M/H receivers remains in flux. **Distribution of video programs in the broadcast mode to a mass audience via cellular networks appears wasteful of bandwidth, would lead to network congestion, and may result in lower-than-required quality of service for more profitable products, such as text messaging.**[99] To avoid that problem, and leave the economics of cellular networks intact and unburdened by mass audience broadcast video, cellular operators, such as Verizon Wireless, have negotiated for network capacity outside their core cellular network.

B. Receiver Categories

The Open Mobile Video Coalition (OMVC) has identified four general categories of "portable video devices" (i.e., M/H devices) in the U.S. market.[100] These four are: (a) cellular telephones; (b) vehicles (private and mass transit); (c) laptop computers; and (d) portable video players. Each of the four categories is expanded upon below.

1. Cellular Telephones

The number of U.S. cellular phone subscribers is estimated at 250 million (Exhibit 8) with an overall population penetration rate of 83%[101] and a subscription rate of 90%+ for the U.S. population segment between 20 and 49 years of age. Using multiple sources, OMVC estimates that 100 million cellular handsets are sold annually in the U.S,[102] while worldwide annual handset sales are approaching one billion.[103]

There are four major U.S. cellular network operators:[104]

a. **AT&T** (61 million subscribers);

b. **Verizon Wireless** (59 million subscribers);

c. **Sprint/Nextel** (46 million subscribers); and

d. **T-Mobile** (25 million subscribers).

In addition, there is a set of primarily regional carriers, such as Alltel Wireless (12 million subscribers).

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99 Yoram Solomon, "The Economics of Mobile Broadcast TV." Solomon is President of the Mobile DTV Alliance, an organization that advocates use of the DTV-H standard. For additional data on the current and expected future consumer spend patterns on mobile services, see the Veronis Shuler Stevenson *Communications Industry Forecast 2007-2011*, pp. 151, 299, and Chart 11.30 (pp. 330-31).

100 "Roadmap to Mobile Broadcast DTV," OMVC presentation to the NAB Board (June 13, 2007), pp. 4-5.

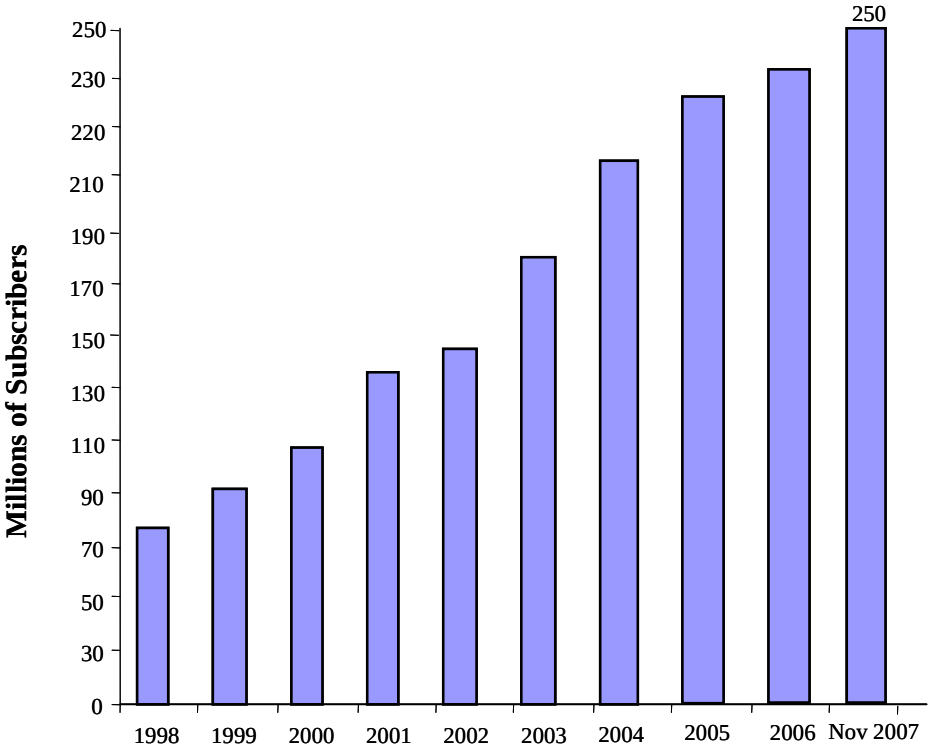
101 U.S. population estimated at 303 million based on November 2007 data available from the U.S. Census Bureau. This penetration calculation may overstate actual penetration because of second phones, data-only devices, and other services, such as GM's OnStar.

102 OMVC, "Roadmap," p. 4. The Consumer Electronics Association estimates that sales of cellular telephones are somewhat higher at about 127 million units (factory sales) in 2006. See CEA's *Digital America 2007*, p. 66.

103 Dr. R. Wiefeldt, "Handset Architectures for Mobile DTV," published as an IEEC paper (2006), abstract, p. 1.

104 Subscriber counts based on 2006 Annual Reports or other operator filings/news releases, and are as of year-end 2006.

Exhibit 8
U.S. Cellular Subscribers



Note: All figures are end of year except 2007; Net U.S. subscriber add rate (2007) = 2.0M/month
Source: Cellular Telecommunications & Internet Association

As background, it is important to understand that cellular operators in the U.S. have deployed two incompatible cellular telephone technologies: CDMA (Verizon Wireless and Sprint) and GSM (AT&T and T-Mobile). Phones that use one of these two technologies cannot work on a network using the other technology, unless dual mode CDMA/GSM handsets are used. Furthermore, in general, cellular network operators will not permit consumers to use their phones even when switching between two carriers that use the same network technology (e.g., from Sprint to Verizon or vice versa).[105] The operators require consumers to purchase new phones that are authorized for use on their network. The carriers justify these restrictions because they subsidize the price of handsets, a practice that began in the late 1980s and early 1990s, when unsubsidized handset prices were high and constituted a barrier to a mass market for cellular service.

The U.S. "closed" cellular network model is becoming more "open."[106] There are three reasons, all interrelated, that are pushing existing network

[105] For additional detail, see the article by Walter Mossberg, "Free My Phone," *Wall Street Journal* (October 22, 2007), p. R1.

[106] "Closed" is used in the sense that the cellular operators control the functionality of handsets that are authorized for use on their networks. An "open" network model would be one in which handset functionality is driven by consumer demand and handset device manufacturers responding to that demand, as well as testing new

operators toward a more open model. These are: (a) the Federal Communications Commission is requiring an open model for a key spectrum block in the Q1 2008 spectrum auctions; (b) Google has announced the "Android," a Google-designed open model handset and has indicated that it will bid on the aforementioned FCC-designated spectrum block, Yahoo followed suit in January 2008 announced it too will support an open mobile network;[107] and (c) Verizon has announced that it will "open" its wireless network.[108] The movement towards an open cellular network model favors broadcasters in that it decreases the control of the current cellular operators, and it increases the relative probability that a deal can be negotiated with handset manufacturers to build M/H DTV tuners into certain handset models to allow OTA reception.[109]

The cellular industry is competitive. Operators compete on price, network coverage, customer service, and functionality (e.g., voice, data, music, video). The average monthly cellular bill has remained in the $48-$50 range since 2003.[110] However, the voice component of operator revenue has been decreasing while the non-voice component (primarily data, especially text messages) has been increasing. For example, Verizon reported that Verizon Wireless experienced "a 72% increase in data revenue per customer in 2006… driven by increased use of our messaging, *VZAccess* and other data services."[111] Similarly, AT&T reported a 44.8% increase in 2006 in data revenue per wireless customer.[112] Verizon also noted that voice service (e.g., Verizon Wireless' Family Share program) suffered from "downward pressure on average service revenue per customer during 2006,"[113] a theme repeated in the public reports of the other major operators.[114]

What is important here is that non-voice services are the growth area for U.S. cellular operators, while voice services are decreasing as a percentage of the average subscriber's monthly spend. Consequently, cellular operators are competing to increase their range of non-voice (including video) network services.[115]

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functionalities in the market. In the open model, handset subsidies by network operators are reduced substantially over their current levels or eliminated entirely.

107 *The New York Times*, "For Google, Advertising and Phones Go Together" (October 8, 2007).

108 *Wall Street Journal*, "Verizon to Open Cell Network to Others' Phones" (November 28, 2007), p. B1.

109 An analysis of the U.S. market for cellular telephone handsets concluded that "advanced functionality" was the primary driver of handset prices. Therefore, it would seem that handset manufacturers could position OTA DTV M/H receive capability as a new "function" and, therefore, sell such phones at a premium. See "Mapping Your Competitive Position" by Richard D'Aveni, *Harvard Business Review* (November 2007).

110 Cellular Telecommunications and Internet Association (CTIA), 2007 Mid-Year Survey (June 2007).

111 Verizon Communications, Inc., Form 10-K for the fiscal year ended December 31, 2006 (p. 57).

112 AT&T, Form 10-K for the fiscal year ended December 31, 2006 (p. 11).

113 Verizon Communications, Inc., Form 10-K for the fiscal year ended December 31, 2006 (p. 57).

114 In order to increase wireless voice revenues, operators are increasing competition to sign up "low income wireless consumers," a market strategy that involves a high degree of risk.

115 While younger consumers (up to age 25) make up a large portion of cellular data/video service usage, there is an increasing number of older mobile Internet users with high-end "smartphones," including Blackberry and Palm handsets. See the Mobile Marketing Association's "Understanding Mobile Marketing" (May 2007).

Under the current (late 2007) market structure, if local broadcasters develop an M/H DTV strategy that requires OTA reception of local broadcasts on cellular phone handsets, then broadcasters must develop a business relationship with the network operators, as well as the handset manufacturers and other stakeholders, such as Google.

Cellular network operators remain critical to broadcaster success because under the current closed model, cellular operators subsidize the handsets that are sold to subscribers. In very simple terms, if a handset manufacturer prices a handset at $200 that is sold to a subscriber by a network operator at $60 (with a commitment to a 24-month service contract), the $140 difference is a subsidy by the operator that must be amortized (i.e., recovered) over the subscriber's life. The total amount of the handset subsidy is not trivial. For example, for 2006, Sprint/Nextel reported an "equipment net subsidy" (i.e., cost of equipment sold in excess of payments received) of $1.7 billion.[116]

Because of the subsidy structure, network operators generally have no interest in subsidizing handset capabilities that do not generate revenue for the operators.[117] Therefore, in order to have M/H DTV receive capabilities built into cellular handsets, local broadcasters must be prepared to go to the operators with a package that demonstrates: (a) that cellular subscribers want to receive OTA local broadcast video programs on their handsets (thereby allowing an operator to maintain or increase subscriber totals); and (b) how operators can benefit financially (e.g., a share of incremental ad revenues resulting from reception by the mobile audience).

Cellular operators' financial concern is not just the handset price. There is also the issue that cellular telephone users may substitute time watching free OTA M/H DTV services that would otherwise be spent on activities (e.g., text messaging) that generate revenue for the cellular operators. At least with subscription mobile television service, the cellular operators derive revenue from video.

The cellular handset market has three tiers: (a) the high end top tier in which there is little or no operator subsidy for handsets (approximate price point = $500 and above for a handset); (b) a middle tier with subsidy and price points at or above $150; and (c) a "low end, basic" tier. Today, network operators have less control over, and interest in, the functionality in the top tier phones which is where handset manufacturers introduce functionality (e.g., cameras) that the operators will not subsidize initially. Regardless of whether the model is "open" or "closed," most likely, the progression for M/H DTV capability would be introduction into the top tier[118] and then, if the functionality proves popular with cellular subscribers, the M/H DTV functionality would be moved down into the

[116] Sprint, Form 10-K, for the fiscal year ended December 31, 2006 (p. 46).
[117] Interviews with operator and handset manufacturer representatives.
[118] With the acquiescence but not the enthusiasm/subsidy of the network operators (under the closed model).

middle tier where the network operators may then be providing a subsidy. In the event that subscribers did not buy handsets when available in the top tier, then movement into the more mass market middle tier would be problematical.

Cellular operators have launched mobile video services. At this point in time, the services seem to be in the advanced beta test business model stage with operators experimenting with a mix of content, subscription price, subscriber contract terms, handset functionality/price, and incentives/subsidizes. The general consensus of observers interviewed is: (a) the current price (around $20 per month) for mobile video service is aimed at early adopters (i.e., not sustainable for a mass market); (b) the coverage not ubiquitous; and (c) churn (i.e., customers abandoning the service as a percentage of total service takers) is too high (allegedly in double digits per month). There also appears to be a consensus that over the long term, the ultimate penetration for a mobile television service among cellular users will be approximately 20% at a price point in the $5-$10 range.[119]

2. Vehicles

Total 2007 U.S. sales for new vehicles are estimated to be 16.2 million with General Motors having the largest share of the market (about 25%).[120] Toyota and Ford are expected to be #2 and #3, respectively. Factory-installed video players (primarily for DVDs) have been optional equipment in certain new vehicles for a number of years. Such players are not visible by the driver and are located in the rear passenger area as an in-vehicle entertainment center, most often to be used by children. The fact that video screens are not to be visible by the driver means that M/H DTV receivers would not be a general, all-vehicle option, but would be an option on a limited number of models within each manufacturer's total set of models.

For factory installed options ("fully integrated" by a manufacturer at the assembly plant), there are usually two "launch windows" in each model year. The absolute best case elapsed time to be included in one of these windows would be 18 months (from the time the new product proposal is presented, through the evaluation process, incorporation into the manufacturing process and concluding when available as an option to dealers). The more likely elapsed time would be 24 to 30 months.

Another route to introduce M/H DTV receive capability into vehicles would be as a dealer or third party-installed option.[121] This still may require a manufacturer to

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[119] For example, Mercer Management Consulting projected average revenue per unit (ARPU) per month of $4.90 for users of "mobile TV" over cellular networks. Mercer expects the revenue to be sourced 50-50 between advertisers and subscribers with revenue sharing among network operators and content providers.

[120] "2007 Will Be Another Year of Struggle for U.S. Carmakers," Kiplinger Business Resource Center (January 3, 2007).

[121] To provide some perspective, the projected after market for automobile sound systems is approximately $2.0 billion, an amount that is 40% of the forecast for factory-installed optional automobile sound systems. See

evaluate the new product and may involve design work in the manufacturing process. For example, with respect to a television, a manufacturer may have to design in a mount or allow for room in a wiring harness even though the actual installation is done by the dealer or a third party installer.

The party proposing the integration of a new product into a manufacturer's vehicles must know the precise market for the product which translates into the exact set of cars and/or trucks for which the product would be considered (e.g., if the buyers are expected to be middle class women with children then the relevant vehicle set would be vans and certain SUVs).

This is very important because the ultimate decision is based on financial criteria that relate to the economics of each vehicle segment.[122] For example, if the production level of the relevant vehicle is near the company's production capacity, then the decision to include a vehicle enhancement is based on return on variable cost per vehicle (e.g., cost of $200 must return $220 in wholesale dealer price). If the production level of the relevant vehicle is below capacity, then the decision will involve an assessment of whether the new product will increase sales towards capacity in which case the decision is not based on incremental cost but on stimulating overall sales and recovery of fixed vehicle costs.

There is resistance to incorporating new products into current vehicle lines. This is because the manufacturing process is very complex. For example, the Ford Focus has 34,000 "build combinations" that reflect the different vehicles that could be produced given the range of options, colors, and extras available as factory installs. Using the Focus as an example, if installing a television with OTA capability became an option, then the number of build combinations would increase to 68,000 (i.e., the previously cited 34,000 each now with and without the TV option).

The absolutely critical issue is: 'What is in this for the manufacturer?' If the answer is either unclear or not much, then incorporation of the new product is a dead issue. In a situation where there is a subscription service linked to the new vehicle enhancement (e.g., subscription TV), then the manufacturer would most likely expect to share in the revenues, including and especially renewals.

Both Ford and GM are known to be experimenting with increasing the digital-functionality available to drivers. For example, working with Microsoft, Ford has introduced a $395 option (named SYNC) that integrates cellular telephones and portable music players in cars so that a driver can use voice recognition to call up songs and make/receive calls.[123] GM already has relevant experience in this area because of its On Star service that is now available in all new GM vehicles with

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CEA's *Digital America 2007*, p. 47.

122 Based on interviews with automobile industry representatives.

123 "Ford, Microsoft Create Car System That Lets You Ask for a Song," *Wall Street Journal* (November 8, 2007), p. B1.

Qualcomm as a business partner. GM also has an equity interest in, and works with, XM Radio, while Ford has an equity interest in Sirius Satellite Radio.

In addition to video reception by a vehicle, there is also datacasting to vehicles. While not requiring much bandwidth, datacasting would require that the transmission technology be robust such that it could be received reliably by vehicles moving at high speed.

During an interview for this report, a GM representative discussed a specific datacasting venture that has been undergoing refinement and testing for two years. Since 2005, GM has been developing a business case for a *datacasting* service to GM vehicles. In order to execute the business plan, GM needs a business partner that has the capability to broadcast local content (e.g., weather, traffic, gas prices by location) to on-the-road vehicles with relatively robust reception and ubiquitous in-market coverage.[124]

GM has estimated that the service would require only approximately 100 kbps. Therefore, from a bandwidth perspective, there are multiple potential partners for GM, such as local TV broadcasters, FM/HD radio stations, Qualcomm's MediaFLO service, and, potentially, satellite. However, local broadcasters are the preferred partner because they not only have bandwidth, but also have access to relevant, local content. However, in the initial approaches to broadcasters, GM has identified two issues: (a) broadcasters appear preoccupied with delivering video to handsets (not a data stream to vehicles); and (b) tests in which a data carrier was inserted in the DTV signal have shown that in-motion reception of the data stream is not robust enough to support the service at the quality-of-service level desired by GM. Because of the latter issue, GM has been interested in and monitoring the ATSC's M/H DTV standardization process.

While the business model is somewhat in flux, after both market and technical tests GM believes that the model should have the following attributes:

a. A "vehicle information center" to be built into each of the four million new vehicles sold by GM in the U.S. (the up-front cost to do so being recovered in the wholesale price of the vehicles to the dealers);

b. No required subscription fee from the owner/lessee for basic service for the life of the vehicle (but potentially fees for higher level type services);

c. Fees to be paid by advertisers for access to the in-vehicle population in each separate market in the U.S.;

[124] GM rejected a "streaming video service" because there appeared to be no ongoing revenue stream. For GM, the "rear seat [video] entertainment center" was strictly one more option for certain types of vehicles purchased by a specific segment of buyers as opposed to a driver information data *service* that would generate monthly revenues after the vehicle was sold from potentially all buyers of the 4 million new vehicles sold in the U.S. annually by GM. This revenue stream would be by vehicle for potentially the entire useful life of each vehicle.

d. A local partner that would ideally have specialized local content (e.g., weather and traffic) and a local sales force that could sell to advertisers and other parties interested in accessing the in-vehicle population;

e. Conditional access would be in place so that GM would act as gatekeeper and control the access to the vehicle (i.e., not a free-to-air, received-by-all situation);[125]

f. Fees to be paid/revenues to be shared between the local partner and GM; and

g. (Potential) interactivity via a cell phone return channel.

Of all the potential partners, from the perspective of GM the local TV broadcasters appear to be the most suitable. GM has analyzed the coverage of the station groups and believes that 90% of the desired coverage for their proposed datacasting service could be achieved by partnering with three or four station groups. However, a prerequisite would be deployment of a more robust M/H DTV capability by the TV stations, hence the interest of GM in the current M/H DTV standards setting process.

3. Laptop Computers

Another M/H receiver device category is laptop computers.[126] At present in the U.S., the penetration of analog TV tuners in laptops is minimal. Only two to three percent of laptops today have TV tuners.[127]

There is an issue as to whether laptops would be optimized to receive the main OTA digital signal (therefore not being able to receive while moving) or the broadcast M/H signal (that may/may not be a simulcast of the main signal) or both the main and the M/H signal with some type of rule-based selection process that allowed the system logic to make the selection without user intervention. It may be that some of the issues in this space have not

[125] In effect, GM would control access to an in-vehicle population that after five years would approximate 20 million vehicles each with an average of 1.5 occupants.

[126] The potential for mobile reception of video by laptops was analyzed extensively in a January 2007 report, prepared privately for NAB. The discussion here summarizes and updates the key points and issues from the 2007 report. The January 2007 report was based on reception of the main broadcast OTA DTV signal, but noted the need for a more robust reception system so that laptops could receive reliably broadcast video while in motion. See *NAB Technology Advocacy Program: Scenario Assessment & Economic Framework* (January 2007), prepared by Law & Economics Consulting Group (LECG), Chapter V ("Reception of DTV Broadcasts on Laptop Computers").

[127] This situation contrasts strongly with the situation abroad where cable penetration is less and industry-wide efforts to deploy TV reception capabilities in laptops exist. For example, 50 percent of laptops in Germany have OTA DTV reception capabilities as do 100 percent of Japanese laptops.

been thought through and may have implications for the M/H DTV standard.

Laptops are replacing desktops as the personal computer of choice,[128] particularly in the home market, and are acquiring capabilities to support wireless Internet access and multimedia applications. Moreover, laptop users are upscale, with attractive demographics. By facilitating laptop reception of DTV—and potentially developing interactive applications to take advantage of laptops' processing power and Internet connectivity—broadcasters may be able to gain audience share.

Laptop computers are expected to be a growing platform for video entertainment. Overall laptop penetration is projected to reach 54 percent of U.S. households by 2011 (up from an estimated 41 percent in 2007).[129]

Intel predicts that 20 million laptops purchased specifically for the home will be used for viewing video content by 2010, a 20 percent annual growth rate.[130] Laptops with video capabilities and issued by corporations to their employees (and available for out-of-office use) are in addition to Intel's forecast. Also, by 2009, 93 percent of all laptops in use are expected to have wireless Internet connectivity.[131]

It is important to note that the expected useful life of a laptop is approximately three years (vs. almost three times that for a conventional television). This means that the embedded base of laptops turns over three times as fast as the base of television sets. Therefore, a new functionality can spread further and faster in the base of U.S. household laptops than would be possible, for example, in the base of U.S. household televisions.

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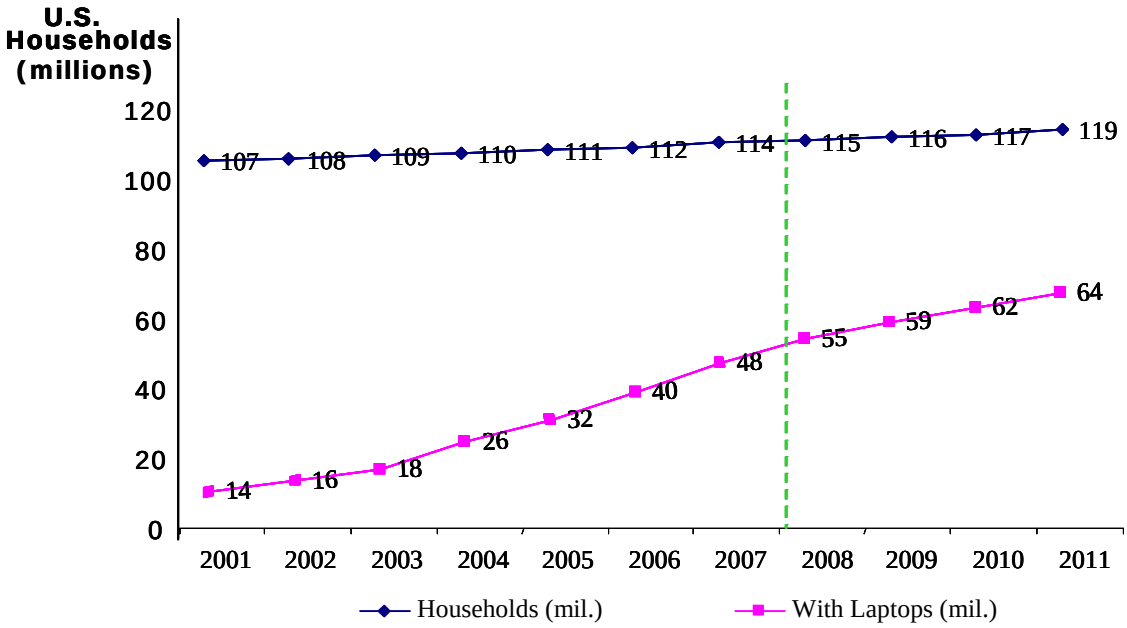
128 "Desktops are so Twentieth Century," *Business Week* (December 18, 2006).

129 Using multiple sources, OMVC estimates that 30 million laptops that are "video-capable" are sold annually in the U.S. OMVC, "Roadmap," p. 4.

130 Note that "video" content is projected to be viewed. Television is one form of video content with a subset of television programs being provided by broadcasters. "Video" viewing is an opportunity for broadcasters, but does not *automatically* benefit broadcasters since there are many sources of video content.

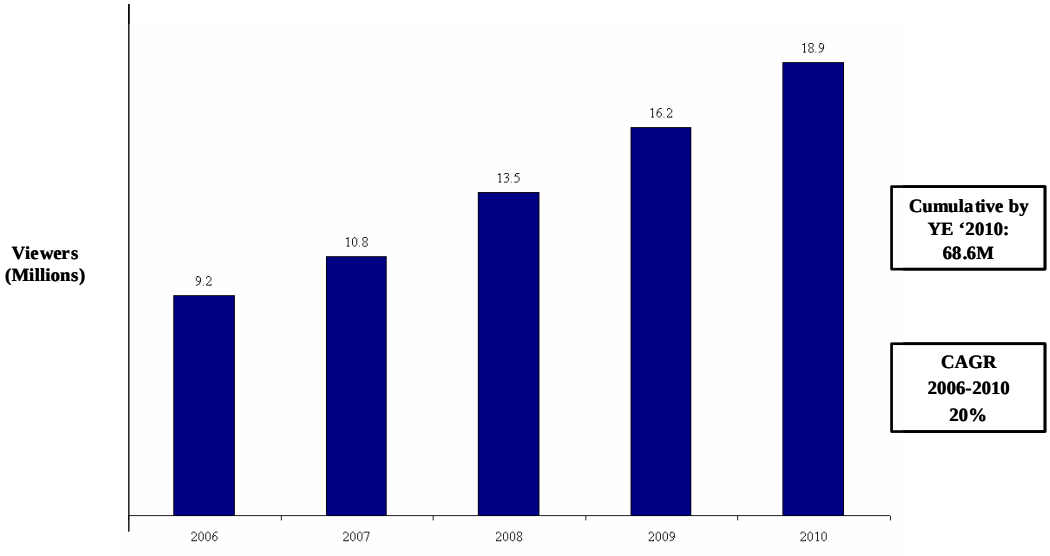
131 Laptops are also capable of wired Internet connectivity (e.g., via an Ethernet port).

Exhibit 9
Household Laptop Penetration



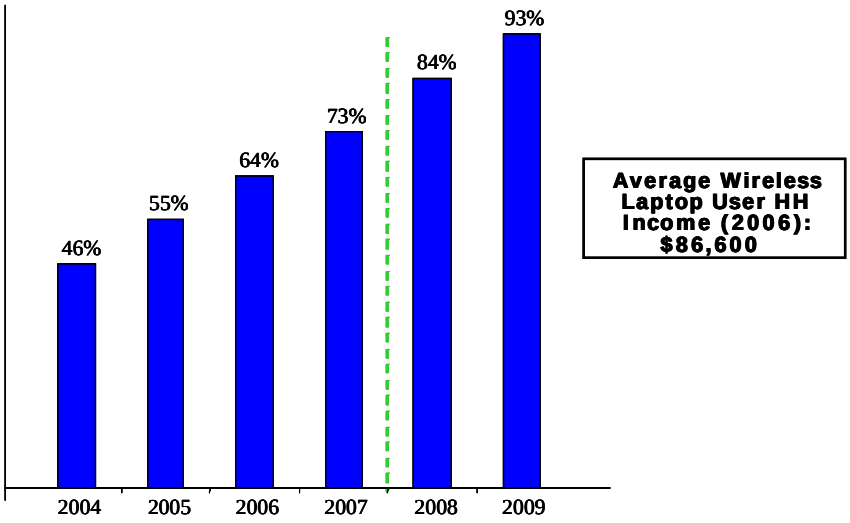
Source: Forrester Research, *The State of Consumers and Technology: Benchmark 2006*

Exhibit 10
Forecasted Laptop Users Viewing Video At Home



Assumptions:
90% of people w/laptops watch video; one person/laptop
Laptops specifically for the home are 10.2M as of Q4'06
CAGR = Compound Annual Growth Rate
Source: Intel Corporation

Exhibit 11
Laptop Wireless Connectivity



Source: Gartner Group, *Telephony* (October 23, 2006)

The demographics of laptop users appear to make them a favorable target for advertisers. For example, wireless laptop users have an average household income of $86,600, compared to $60,300 for online users generally.

Broadcast DTV (especially HDTV) has the highest quality video of any non-wired applications when compared to wireless Internet downloads and the services currently being designed for reception on cell phone-like devices. Moreover, more of its content is local (compared to other distribution platforms), a characteristic of demonstrable value in the traditional broadcast environment. The marriage of these OTA DTV characteristics with the storage and processing power of the laptop enables collaborative development of potentially compelling applications that can deliver value to both viewers and advertisers.[132]

The broadcast industry (and those laptop manufacturers that may partner with broadcasters) face several challenges. These challenges include:

> **Reception quality**. Problematic environments include not just moving platforms, but also places such as airport lounges in which there may be significant movement of people and things that destabilize a standard OTA video signal to the point that it is unacceptable to viewers. Therefore, the widespread inclusion of OTA broadcast tuners in laptops is dependent most likely on adoption by broadcasters of a more robust modulation format.

[132] Just as significant, if laptop manufacturers and others in their supply chain partner with broadcasters as a source of in-home networked content and interactivity outside the control of cable operators, then laptop-delivered programming into a home network could be a stimulus to shift the audience toward broadcast sources and away from competing content.

Competition from other wireless services. A laptop may not be able to efficiently support antennas and tuners for *multiple* services, so there may be competition among program suppliers to have a laptop support their services or modulation schemes (e.g., DVB-H), potentially on an exclusive basis.

Repeaters. Locations with a potentially high volume of laptop users (e.g., airports) may be at a significant distance from transmitters. In-building reception may be possible only with a repeater, potentially using DTV single-frequency procedures. The cost of such repeaters could be borne by building owners/facility operators, but that has yet to be determined.

Multiple frequencies for intercity viewers. A traveler watching a program on a train between New York and Washington might have to switch between New York, Philadelphia, Baltimore, and Washington broadcasters to maintain continuous viewing and might not be knowledgeable about the identity of all the stations.[133] One solution could be a smart program guide that, along with coordination data sent by broadcasters, would redirect the tuner based on an inter-city traveler's proposed path moving between/among broadcast markets.[134]

4. Portable M/H Video Devices

A portable video M/H device is defined as a device that can receive OTA broadcast video directly. This device category is not a cellular telephone nor a laptop, but is an M/H device that can receive OTA broadcast television. This type of device is a subset of the MP3 category of electronic devices that, according to the Consumer Electronics Association (CEA), "let consumers listen to music, watch TV programs or movies, and access… content whenever and wherever they want."[135] MP3 sales in 2006 (measured in dollars), increased 31.5% over those in 2005.[136] In addition, U.S. sales of "video-capable" MP3 devices are projected to increase at a compounded annual growth rate of 65.9% (2006-2010).[137] The terms "portable video player" and "MP3 player," used elsewhere in this report, both refer to this same general category of M/H device.

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133 This contrasts with MediaFLO, which provides its service on a uniform national frequency.

134 This solution could apply to both national and local programming, but would require a process to update and maintain the program guide.

135 *Digital America 2007*, p. 1.

136 *Digital America 2007*, p. 9.

137 *Digital America 2007*, p. 16.

M/H devices continue to benefit from rapid advances in maturization and the decreasing cost of storage technology. One example would be the i-series[138] devices from Apple. The iPod is a single purpose portable music player that sold 39.4 million units in 2006, and accounted for $7.7 billion in 2006 net sales revenue.[139] In 2005-2006, cellular operators introduced proprietary music download services that combined music and telephone functionality in a single device (the cellular telephone handset). Although none of these cellular download services achieved the success of the iPod, Apple responded to the competitive threat by introducing (2007) the iPhone that also combined music and telephone functionalities. The bottom line was that Apple's management believed that there was a material competitive threat from the cellular operators and responded with entry into the telephone handset business.[140]

Another near example would be the Nokia N92 that works in conjunction with DVB-H technology. The N92 can:[141] (a) receive OTA broadcasts; (b) download video content from a computer; (c) record and store broadcast TV programs; (d) download programs from the Internet via a wireless LAN-type connection; (e) provide limited interactivity, such as requesting VoD service downloads; (f) make/send videos using an integrated video camera; and (g) play music by means of a player or receive OTA radio stations by means of an integrated FM tuner. Nokia claims that the N92's battery can support four hours of TV viewing without recharging.

With respect to M/H DTV reception, of the four receiver categories discussed above, based on interviews, broadcasters seem to assign a higher priority to: (1) cellular telephones; and (2) portable video players. The lower priority assigned to vehicles was due to the relatively long lead times associated with introducing new factory-installed options, combined with the video-receive capability being relegated to rear seat viewing. Laptops received an even lower priority because of a consensus that laptops should have tuners to receive the main OTA DTV signal, rather than be optimized for the M/H DTV signal.

C. Transmission Options: Europe and Asia

The digitalization of broadcast television is taking place simultaneously around the world. Regardless of location and as noted previously, there are four general sources of local infrastructure for distribution for mobile television: (1) local television broadcast facilities; (2) cellular telephone facilities; (3) other terrestrial facilities (e.g., MediaFLO); and (4) satellites. Trials and service offerings in all four have been, or are, underway

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138 MP3 devices began as audio players, but now have audio, photograph, and video play-back capabilities. FM radio broadcasters already work with Apple in that OTA songs are "tagged" for later download to iPods.

139 Apple Inc., Annual Report (Form 10-K) for the fiscal year ended September 30, 2006 (p. 54). iPod sales revenue includes music downloads and ancillary equipment, as well as the iPods themselves.

140 For additional detail, read the Harvard Business School case, "iPod vs. Cell Phone: A Mobile Music Revolution?" (August 2006).

141 Nokia, "One Device; Many Opportunities," A Descriptive Brochure on the N92 (2006). The N92 also serves as a GSM phone that, in Europe, can roam across national networks.

around the world. This section of the report describes some, but not by any means all, of the trials and service launches in two areas: (1) Europe; and (2) Asia.[142]

Among different countries, there are different transmission standards in-trial or in-use. The U.S., Canada, and South Korea use the 8-Level Vestigial Sideband (8VSB) modulation standard chosen by ATSC. Europe and some Asian countries use the DVB-T standard that is based upon Coded Orthogonal Frequency Division Multiplexing (COFDM).

In addition, Japan has developed its own standard, Integrated Services Digital Broadcasting, as its terrestrial digital standard (ISDB-T). As part of its digital television policy, the government of Japan has allocated approximately eight percent of its digital television terrestrial network capacity for transmission to M/H devices.[143] ISDB-T also uses COFDM modulation.

A review of mobile television developments in Europe and Asia leads to two major conclusions: (1) there is no agreement/consensus on the appropriate business model that would generate consistent revenue and profit for broadcasters; and (2) there is substantially more government intervention in the mobile television business in Europe and Asia than in the U.S. With respect to the business model, two major revenue source options (with country-specific variations) are in trial – (1) free-to-air reception with broadcasters generating revenue from advertisers; and (2) broadcasters selling content to cellular network operators that is then repackaged and resold by the operators to their subscribers. As for public policy intervention, that is almost always justified as being necessary to accelerate the start-up phase of mobile television, which, in turn, is usually justified as facilitating the economies of scale at home necessary to compete to sell mobile television technology and devices internationally.

1. Europe

The European Union (EU) issued a paper (July 2007) that described mobile TV as "a new opportunity for the EU."[144] According to that paper, "mobile TV is at the crossroads of two powerful social trends, greater mobility and new forms of accessing media content" and "could become one of the next high growth consumer technologies." In its introduction, this EU paper expressed a concern that "competitors… mainly from Asia and the U.S., have made significant progress [on mobile TV] and Europe risks losing its competitive edge in mobile service." This EU paper is indicative of the potential attributed to mobile television worldwide.

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[142] The discussion of Asian developments focuses on Korea and Japan, where both terrestrial and satellite mobile television services have been deployed. With respect to China, it is known that China is in the process of deploying a mobile television service (started in September 2006) in time for the 2008 Olympics. The service is based on a Chinese standard called DMB-T/H that is related to the Korea DMB-T mobile digital standard but has additional features designed to enable it to transmit HD television programs to receivers moving at over 100 km/hr.

[143] Kumar, *Mobile TV*, p. 150.

[144] The EU uses the term "mobile TV" to denote only broadcast terrestrial mobile television services. See Commission of the European Communities, "Strengthening the Internal Market for Mobile TV" (July 18, 2007), pp. 2-3.

Broadcast mobile TV in Europe is developing. "The main technology used for pilots and commercial launches of digital broadcast mobile television in Europe is DVB-H (Digital Video Broadcast Transmission to Handheld Terminals…" The EU Commission has identified trials and/or service launches using DVB-H in 15 European countries.

However, DVB-H is not the only standard being used for trials in Europe. Other standards include: (a) Qualcomm's MediaFLO technology; (b) Terrestrial Digital Multimedia Broadcasting (DMB-T);[145] and (c) even hybrid satellite-terrestrial systems, such as DVB-SH.[146]

In March 2007, the European Mobile Broadcasting Council (EMBC), composed of all the major European stakeholders in mobile TV,[147] issued a report that recommended that the EU not intervene to select a European mobile television standard (i.e., a "technology neutral" governmental approach).[148] The EMBC's official position was that "…the market should decide which technologies in which frequency bands provide the best and most economically viable [mobile TV] services."[149]

However, the EU disregarded the EMBC's position and issued its July 2007 report that endorsed DVB-H as the standard to be used in the EU operating in the UHF spectrum that will become available after the European analog-to-digital OTA transition is completed in 2012.[150] In addition, the EU Report recommended that some L-band (1452-1492 MHz) frequencies be made available for mobile TV services as a "fall-back" safety valve in the event that there are national markets with no other available spectrum for mobile television (e.g., if the analog-to-digital conversion in a specific country is delayed).[151].

The report stated that "the problem we face is potential market fragmentation arising from the multitude of technical options for mobile TV."[152] The report went on to state that a fragmented European market for mobile television would be "…likely to result in loss of economies of scale, slower service take-up, and more expensive equipment," all of which in combination would have adverse economic effects.[153]

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145 Digital Multimedia Broadcasting (DMB) is a European Telecommunications Standard Institute (ETSI) standard that is a modification of the digital audio broadcasting standard. DMB services were first launched in Korea.

146 DVB-SH is an adaptation of the DVB standard for use in satellite transmissions (DVB-S) that was subsequently modified for satellite broadcast to mobile devices.

147 Including broadcasters, cellular telephone network operators, technology manufacturers, and content providers.

148 European Mobile Broadcasting Council (EMBC), "Final Recommendations" (March 2007).

149 EMBC Recommendations, Section B.14.

150 EU Report, p. 7.

151 EU Report, p. 8. The U.K. has announced plans to auction L-Band spectrum in Q1 2008, with "mobile TV" cited as one of the potential uses for the spectrum.

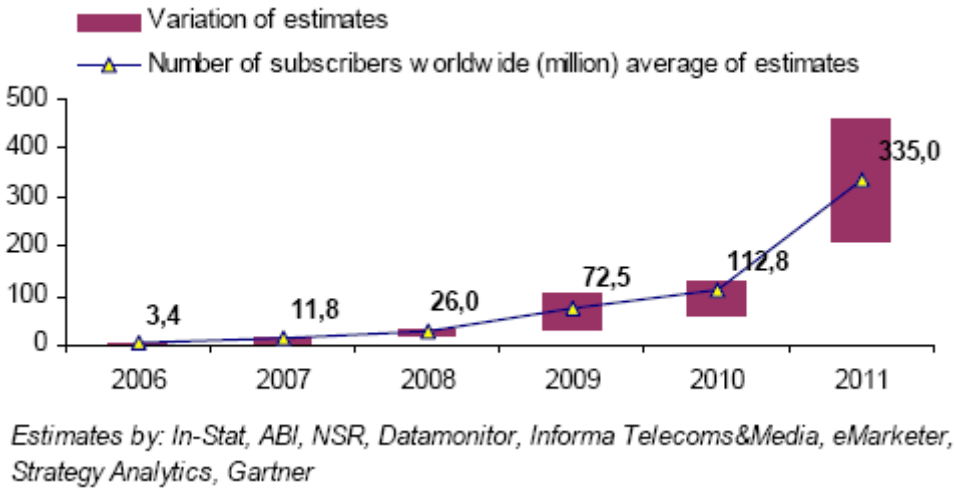
152 EU Report, p. 4.

153 EU Report, p. 4.

The Staff Report that accompanied the EU Report[154] noted that "mobile TV (M-TV) represents an emerging service for which economic forecasts are widely diverging but generally optimistic."[155] Staff analysis of multiple forecasts shows a general expectation of "a steep increase in demand [for mobile television] in 2009…" with increases from 73 million subscribers in 2009, to 113 million subscribers in 2010 (+55%) and to 335 million in 2011 (+196%).[156]

The Staff Report uses the term "immature" to describe the market for mobile television.[157] However, the Staff Report does review the rollout of commercial mobile television services in Italy, Finland, Germany, and the United Kingdom (UK),[158] all of which involved partnerships between the cellular network operators and content providers/broadcasters. In addition to the four countries with commercial service, another 13 European countries have conducted or are conducting mobile television service trials.

Exhibit 12
Broadcast Mobile TV Subscriber Uptake:
Perplexity Among Analysts



Source: Commission Staff Working Document (July 18, 2007).

Using a logic that could be adjusted to apply easily in the U.S., the EU Staff summarized the arguments in favor of choosing a single standard as follows:[159]

a. **Compatibility** with the digital terrestrial broadcast standard in Europe (DVB-T);

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154 Commission Staff Working Document to the EU Report, "Impact Assessment" (July 18, 2007).
155 Staff Report, p. 5.
156 Staff Report, p. 12.
157 Staff Report, p. 25.
158 In July 2007, the British Telecom-Virgin Mobile Movie Mobile Television venture was shut down. Sales of service were slower than expected (10,000 subscribers) and the transmission technology was DAB, not DVB-H, the announced choice of the EU.
159 Staff Report, pp. 26-27.

b. **Economies of scale** that would allow European markets to "…reach critical mass in a rather short time thus providing the conditions for Europe to remain competitive on global markets;"

c. **Lower sunk costs** than otherwise by avoiding further investment in competing technologies;

d. **Avoidance of uncertainty** which would stimulate near-term European investment in production facilities and development of services; and

e. **Increased consumer demand** both due to end-user confidence as to the standard and to lower cost user handheld devices resulting from economies of scale in production and distribution.

2. Asia-Japan

For digital broadcasting, Japan has adopted the Integrated Services Digital Broadcasting (ISDB) standard that has associated substandards for terrestrial, satellite, and cable. In Japan, mobile television is provided from two sources: (a) a specified sub-channel of terrestrial digital television; and (b) a dedicated mobile video services satellite.[160]

a. Terrestrial Mobile Digital Television

Japan began terrestrial digital television broadcasting in its unique ISDB-T standard in 2003, with terrestrial analog television currently scheduled to terminate in 2011. The ISDB-T standard is designed to carry an HD signal or 2-3 SD signals in a 6 MHz broadcast channel. The ISDB-T standard provides that these regular broadcast programs be carried in 12 of the 13 "segments" of the transmitted signal. The 13th segment is reserved for broadcasting to mobile receivers. Due to this fact, mobile DTV service is referred to as "one-segment" or "1-seg" service (1SEG).[161]

One-segment broadcasting by Japan's terrestrial broadcasters began on April 1, 2006. The primary form of service at present is the free rebroadcast of ordinary terrestrial programming. However, the standard permits the transmission of data signals combined with video programming. Because 1-seg receivers are generally cell phones or laptops with communications capabilities, this service may take advantage of the data return channel of those devices. For example, NHK states that, "Data broadcasting provides news, weather information, and even program-related information integrated with the mobile terminal's telecommunications functions."[162]

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[160] This service uses a satellite partially owned by a South Korea cellular provider and which also provides mobile video services to that country.

[161] See NHK's digital broadcasting web site, www.nhk.or.jp/digital/en/digitalbroad/index.html.

[162] www.nhk.or.jp/digital/en/digitalbroad/04_3_mobile.html

The number of 1-seg-compatible receivers has been increasing rapidly. For example, one Japanese newspaper reported that the cumulative volume of 1-seg-compatible cell phones exceeded 10 million as of the beginning of October 2007, with strong competition for such receivers among handset manufacturers.[163] On September 20, 2007, Sony introduced a PlayStation Portable with a 1-seg receiver.[164] Sony also sells 1-seg-equipped VAIO laptops, and Nintendo has also introduced a 1-seg receiver card for its game players.[165] In an interview conducted for this report, a representative of Sharp Electronics reported that the company recently sold their five millionth cellular phone in the Japanese market, which is capable of COFDM reception.[166]

In January 2007, NTT DoCoMo purchased an interest in Nippon Television Network Corporation to facilitate joint development of services provided by DoCoMo cellular handsets in conjunction with Nippon Television one-seg capabilities.[167] Another Japanese mobile network operator, KDDI, also states that it also is working with broadcasters to provide content to its mobile phone subscribers in conjunction with one-seg services.[168]

Notwithstanding these efforts, according to a recent study by the Mobile Consumer Lab at the International University of Japan, there is as yet no profitable business model to support one-seg services using the free-to-air/no user fee business model. Furthermore, based on an analysis of 800 Japanese 1-seg users, the report concluded that watching free mobile TV decreased cell phone subscribers' usage of other (revenue-generating) carrier services.

There has been speculation that an appropriate business model for mobile television in Japan could be developed around the concept of "entertainment" with the "development of location and time-specific programming, with content, advertising and services bundled with Mobile TV programming to enhance the user's viewing experience from specific usage environments."[169] Under this model, the user would pay some type of per-use fee and/or a subscription fee.

b. Satellite Mobile Television

Satellite mobile television is provided on a subscription basis by Mobile

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163 www.asahi.com/english/Herald-asahi/TKY200710020076.html.
164 Sony Computer Entertainment, Inc., Press Release (July 17, 2007).
165 Research On Asia Group, *Mobile TV in Japan* (June 2006), p. 3.
166 Sharp has 40% of the Japanese cellular handset market.
167 NTT DoCoMO, "NTT DoCoMo Acquires Stake in Nippon Television Network" (Press Release, January 4, 2007).
168 KDDI, "KDDI's 'One Seg" Mobile Phones Exceed Two Million' (Press Release, February 28, 2007).
169 Mobile Consumer Lab, "Mobile TV Insight Report Summary" (July 20, 2007), p. 3.

Broadcasting Company, whose major shareholders include Toshiba, Toyota, Sharp, Matsushita, and NTT Data, as well as SK Telecom of Korea.[170] Service began in October 2004 over a special purpose satellite, and is transmitted using a code-division multiplexing scheme.[171] There are "gap-filler" terrestrial repeaters in certain expressway tunnels and on some railroad lines.[172]

Using the brand name MobaHO!, the service provides various service packages, including a premium one consisting of 7 video channels, 40 audio channels, and multiple data channels, for about 2,500 yen per month,[173] including 180 Major League Baseball games. [174] MobaHO! service can be received over a wide variety of devices, including receivers provided by Mobile Broadcasting (which can also receive 1-seg broadcasts),[175] PC cards, and automobile navigation devices. In particular, Mobile Broadcasting's part-owner Toyota provides a receiver compatible with all its navigation systems.[176]

3. Asia-Korea

As in Japan, Korea has developed a unique terrestrial broadcast standard. Also, Korea uses a mix of terrestrial and satellite broadcast services.

a. Terrestrial Mobile Digital Television

Terrestrial Digital Mobile Television Broadcasting was launched in the Seoul metropolitan area in December 2005 and extended to the rest of Korea by the middle of 2007, based on regional broadcast areas.[177] Denominated T-DMB, the service uses a transmission system that is based on the European-developed digital audio broadcasting standard (DAB), but using a higher bandwidth and MPEG-4 encoding.[178] Apparently, during the debate in Korea regarding the adoption of the ATSC vs. DVB-T standard for DTV, the evaluators concluded that neither had good mobile reception, so T-DMB was adopted due to better mobile television receive capabilities.[179]

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170 See www.mbco.co.jp/english/01_corp/corp.html.

171 See www.mbco.co.jp/english/01_corp/history.html; Mobile Broadcasting Corp., *Corporate Profile*, at 4 (2003).

172 See www.mbco.co.jp/english/01_corp/history.html; www.mobaho.com/english/support/receive.html.

173 See www.mobaho.com/english/plan/index.html.

174 Mobile Broadcasting Corp., "Major League Baseball Comes to MobaHO!" (Press Release, May 7, 2007).

175 Mobile Broadcasting Corp., "New Debut: The Most Advanced Mobile Tuner for MobaHO! and 'One-Seg' Broadcasting Services" (Press Release, May 11, 2007).

176 Mobile Broadcasting Corp., "Toyota Drivers Can Watch Unlimited Animation – As Well As 180 MLB Games Per Year – In Their Cars!" (Press Release, May 16, 2007).

177 Presentation of Young-Moo Lee, Deputy Director, Korean Ministry of Information and Communications, " T-DMB in Korea" (May 15, 2007), pp. 5, 7 ("Lee Presentation").

178 Kumar, *Mobile TV*, p. 130.

179 Yong Han Kim, Seoul University, "Digital Multimedia Broadcasting" (June 14, 2007), p. 11.

In the Seoul area, T-DMB services are provided over broadcast channels 8 and 12, which are subdivided into three "ensembles" per channel, each of which is licensed to a different broadcaster. Each provider offers a combination of video, audio, and data services, totaling 7 video, 13 audio (many with a visual component including ad content), and 9 data channels.[180] A $30 million "gap-filler" system provides service to the Seoul Metro system (2.6 billion passenger rides annually).[181] There are a broad range of receivers, including cell phones and PDAs, vehicle and vehicle-navigation systems, and laptop computers.[182]

As of March 30, 2007, four million T-DMB receivers[183] had been sold as follows:[184]

Device	Percentage	Number
Cell phone:	40.0%	1.6 million
Vehicle Navigation:	39.9%	1.6 million
PDA:	9.5%	.3 million
Laptops	2.0%	.1 million
Other:	10.6%.	.4 million

Penetration estimates for 2010 range from 11.1 to 18.5 million,[185] equivalent to a forecasted range of increased receivers in service of 7.1 million to 14.5 million. The wide variance in expectations apparently reflects some level of uncertainty as to consumer take rates. However, even the low end of the range (i.e., 11.1 million) represents almost triple the number of receivers currently in service.

The current Korean mobile television business model is that broadcast video and radio services should be provided for free to attract users (i.e., without subscription fees but broadcasters could increase ad revenue due to viewership by the mobile audience), and then subscription revenue could be generated from subscription data services, such as those addressing travel and traffic.[186] Reports indicate that broadcasters are not

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180 Lee Presentation, p. 6.

181 Lee Presentation, p. 11.

182 See T-DMB portal of the Korea Radio Promotion Association, http://eng.t-dmb.org ("product"); Lee Presentation, p. 15. Long-term improvements would increase band width from 1.062 Mbps to 2.0 Mbps, permitting an increase in the number of program streams and/or permitting transmission of standard definition programming to larger screen (e.g. 15 inch) devices with 5.1 channels of audio.

183 Receivers may be grouped by price into three categories: (1) high price: $400-$800; (2) mid-price: $200-$500; and (3) low price: $50-$120. See Lee Presentation, p. 15.

184 Lee Presentation, p. 14.

185 Lee Presentation, p. 13.

186 The regulatory intent of the requirement for free services is apparently "market creation"/demand stimulation. See Lee Presentation, pp. 32-34. Note that the Korean government is very active on matters of broadcast standards and on what can/cannot be done by broadcasters. In that sense, the current model is the "official" model. One factor driving government policy is the need to develop technology at home to be exported later to the rest of the world.

making a sufficient return on investment from this two-tiered approach (i.e., free-to-air video with subscription data services):[187]

> The authorities … required six terrestrial DMB operators to beam everything from soccer games and sitcoms to the evening news free of charge. "There's no question this free service was vital for mobile TV to take off," says Lee Jung Gu, a director at the ministry. … No one questions that free service helped accelerate the spread. "But I don't think low-priced monthly fees or a one-off initial charge would have made that much difference," says Eom Min Hyung, DMB project leader at KBS, or Korea Broadcasting System, one of the six terrestrial operators, each of which has piled up an accumulated loss of between $22 million and $33 million. …[C]ommuters in Seoul can watch TV news in the subway on their way to work, thanks to so-called gap fillers that relay signals underground. But that's because of a deal struck among broadcasters, mobile-phone operators, and cell-phone manufacturers. Agents for the mobile carriers agreed to collect an additional $3.30 from each buyer of a phone-TV combo to finance the building of a subway network for TV signals. Broadcasters, in return, agreed to carry ads for phone manufacturers—and they want a similar arrangement for further infrastructure projects… Perhaps most important is the need for cooperation between mobile-phone companies and broadcasters. As the bulk of mobile TV viewers are expected to be handset users, broadcasters need marketing help from carriers who fear TV programming could cannibalize on their video business that they hoped would increase traffic over telecom networks.

b. Satellite Mobile Television

Satellite mobile television is provided by TU Media, a partially owned subsidiary of SK Telecom, one of the three Korean cellular carriers. The system began commercial service on May 1, 2005, and is called S-DMB. The Korean S-DMB service is based on a *Japanese* mobile television standard (since it shares the same satellite).[188] Gap-filler repeaters support the service in locations where continual satellite line-of-sight is difficult, including subways and on the Korea Train Express.[189]

The satellite service offers 16 video and 20 audio channels for $12 monthly.[190] However, "they're not from the major broadcasters. It's a mixture of entertainment, sports, news, education, with an interactive shopping channel and movies on demand channel where you pay 1,000 won to watch a film."[191] The service is primarily received on cell phones

187 "South Koreans Want Their M-TV," *Business Week* (August 3, 2007).
188 Yong Han Kim, Seoul University, "Digital Multimedia Broadcasting" (June 14, 2007), pp. 8, 13.
189 "Mobile TV coming to Korea Train Express," Digital Media Asia (May 5, 2006).
190 "South Koreans Want Their M-TV," *Business Week* (August 3, 2007).
191 Tech Digest, Korea/Japan Week, "The Problem With DMB Mobile Digital TV" (October 9, 2007).

or PDAs.[192]

TU Media has not yet reached break-even subscription levels, apparently due, in part, to competition from free T-DMB services:[193]

"We are bleeding red ink because we have difficulty in increasing the subscriber base as we are racing against free services," says senior manager Heo Jae Young at TU Media. The company has 1.2 million paid subscribers, while TU says it needs at least 2.5 million users to break even in operation, even before recouping its $435 million investment in satellites and networks.

[192] "Satellite DMB," www.sktelecom.com/eng/html/service/Ubiquitous/Satellite.html.
[193] "South Koreans Want Their M-TV," *Business Week* (August 3, 2007).

V. MOBILE TELEVISION: BROADCASTER ECONOMIC POTENTIAL

The overall objective of this chapter is to assess the economic potential of a M/H DTV service. An economic assessment of an emerging business has three components, each of which is discussed in this chapter. The three are:

1. A review of the competition;
2. An analysis of competitive advantages and go-to-market business models; and
3. An estimate of the addressable market size over a reasonable forecast period.

The M/H competition for local broadcasters consists of systems capable of distributing video content to one or more M/H device types (e.g., cellular phones, vehicles) and to do so in a reliable way that meets consumer expectations and is transparent to the end-user. Note that the focus is on infrastructure competition, namely, competition among operators of wireless networks to use their facilities to transmit video signals to M/H devices. In this context, control over content may be important in that it may provide a competitive advantage to broadcasters but the focus of this analysis is not upon content competition *per se*.

A business model is the method of doing business by which a company generates revenue.[194] A key component of any business model is the value proposition, that is, how a product/service meets the requirements of a buyer and the willingness and ability to pay of that buyer.

Mobile television is an evolving business in which local broadcasters are only one part of a complex supply chain (Exhibit 7) consisting of content creators, distributors (local and national), advertisers (local and national), receiver device manufacturers, and consumers. Who will make money and how much remains uncertain. The opportunity for local broadcasters is to get in on the ground floor of a business that is expected to grow significantly from 2009-2010 forward.

For purposes of this analysis, we have reviewed and relied upon third party forecasts of the size and evolution of the U.S. mobile television market. In general, the forecasts for mobile television have certain elements in common, such as a revenue ramp up that accelerates from a 2009-2010 base and an expectation that content will drive consumer demand which, in turn, will determine how fast the M/H business will develop and how large it will become. Forecasters of new markets, such as mobile television, develop specific estimates of total market size but only provide general guidance as to the market share to be attained by specific competitors.

[194] The discussion of business models is based on the concepts of Professor Michael Rappa, who teaches Technology Management at North Carolina State, and has published extensively on the subject of go-to-market models for new technology-based business ventures.

A. The Competitive Framework

In this report, the focus is on infrastructure competition, that is, competition among network operators that have, or will have by 2009-2010, the capacity to transmit video for reliable reception by M/H devices. As described below, in the U.S. there are four potential sources for local video distribution to M/H devices, as well as a fifth (satellite) that is theoretically possible but practically not considered a player on the local side of the mobile television distribution market in the U.S.

1. 700 MHz Service

The primary service now being offered at 700 MHz is the MediaFLO service of Qualcomm. MediaFLO USA is deploying and intends to operate a national network that will broadcast video and audio programming to wireless subscribers in the U.S. The spectrum for the service is at 700 MHz and was acquired primarily at auction by Qualcomm.

This wholesale service is now deployed in the U.S. with Verizon Wireless as a customer and MediaFLO may also be utilized by AT&T Wireless. The spectrum used corresponds to UHF channel 55 that is in the process of being cleared as part of the analog-to-digital conversion.[195] At the RF level, MediaFLO uses the COFDM modulation system that is completely incompatible with the ATSC DTV modulation standard and could not be transmitted by U.S. broadcasters.

MediaFLO's business model involves aggregation and distribution of content in "service packages" that the company "will make available on a wholesale basis to our wireless operator customers…." The "distribution, marketing, billing and customer [subscriber] relationships" are provided by the wireless carriers who buy the MediaFLO service at wholesale from Qualcomm.[196] The model is similar to a provider of cable television channels who sells at wholesale multiple channels (usually for so many cents per subscriber per month) to a direct broadcast satellite (DBS) system operator. Currently, the MediaFLO service operates as a national service and does not have local content. It appears that Qualcomm is still experimenting with revenue models including charging wireless operators for some combination of use fees, per subscriber fees, and/or revenue sharing.

Qualcomm operates MediaFLO in the United States as a "strategic investment." The 2006 annual report [10-K] of Qualcomm listed $329M in assets (at cost) for MediaFLO USA with no revenue and a $55 million increase in operating expenses in 2006. Clearly, Qualcomm is investing in the rollout of MediaFLO. The MediaFLO service should be considered competitive with proposed local broadcaster M/H DTV services.

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[195] MediaFLO has apparently paid some incumbents to accelerate the movement out of the channel 55 slot.

[196] Primary Source: Qualcomm Inc. Form 10-K filed with the SEC for FY 2006 ending September 2006. See pages 2, 6, 47, 53, 58, F-28, F-30.

As discussed previously, under their current business model,[197] the cellular operators exercise "control" over the functionality of the handsets that are allowed to operate on their wireless networks. Because cellular operators buy handsets from the OEM and then sell the handsets below cost to subscribers (i.e., subsidize subscribers), the operators exercise substantial control over the capabilities of handsets that will operate on their networks. The reason that cellular operators have permitted MediaFLO receive capabilities in the handsets is because Qualcomm and the carriers have negotiated deals in advance of handset deployment. Based on information from interviews, it is apparent that Qualcomm goes to the cellular operators with a total MediaFLO package – infrastructure, content, handsets, and business models.

With respect to the existing MediaFLO service, the service carries some of the national broadcast television networks, such as Fox and NBC. The programming is time shifted and not simulcast with local broadcaster transmission of broadcast network feeds. Commercials remain in the MediaFLO service to the extent that such commercials were present in the source programming. Currently, there is no provision for the insertion of local content or local advertising. However, reports are that MediaFLO is in its "infancy" and that local insertions are one of the possible future scenarios.

In 2006, AT&T Wireless announced its intention to also launch a retail video service that would use the MediaFLO service as its network carrier. Originally, this service was to have launched in 2007, but, in October, AT&T announced a launch delay until Q1 2008.[198]

AT&T recently purchased two UHF channels (54 and 59) from Aloha Partners, a company that at one point, planned to launch a mobile television service to compete with MediaFLO. The Aloha system was to be based on DVB-H technology. AT&T will pay approximately $2.5 billion for the Aloha Partners' licenses. The purchased spectrum (12 MHz per market in most markets) covers 196 million people in 281 markets, including 72 of the top 100 markets and all ten of the top ten markets.[199] There appears to be no public disclosure of what AT&T intends to do with the Aloha spectrum (i.e., communications and/or mobile television). If AT&T were to utilize the Aloha spectrum for a video service of its own, then most likely that would obviate the need to utilize the MediaFLO service.

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197 See the discussion in the prior chapter with respect to the differences between the existing "closed" model and an evolving "open" model that is being driven by multiple forces, including the FCC, Google ("Android"), and Verizon.

198 "AT&T Delays Mobile TV Launch," *Daily Wireless* (posted October 29, 2007).

199 AT&T press release, "AT&T Acquires Wireless Spectrum from Aloha Partners" (October 9, 2007).

In Q1 2008, the FCC will auction additional 700 MHz spectrum. This spectrum is considered highly desirable for use across the full range of mobile services, including video.[200] Kagan estimates that a 700 MHz national, 20 video channel network covering 200 million in population could be built out for $450 million (excluding the cost of spectrum acquisition).[201] Kagan concluded that "such a network… could get [cellular] carriers into a robust mobile video business fast." Therefore, the outcome of the auction could result in one or more additional video-capable networks that would increase the competition to distribute mobile television locally. For example, Google may bid on one or more spectrum blocs, thereby making a formal entry as a wireless network operator.

2. L-Band Service

In early 2006, Modeo, a subsidiary of Crown Castle International, announced that it would deliver mobile TV to the top 30 markets in the U.S. This announcement followed a pilot test in Pittsburgh using DVB-H technology.[202] At one point (mid-2006), Modeo was negotiating a joint mobile TV venture with AT&T, but the deal never closed. Modeo attempted to go it alone and launched a New York City trial in January 2007. The Modeo business model was similar to that of MediaFLO and HiWire, namely, build out a national mobile TV network and then sell capacity at wholesale to one or more of the cellular operators that would then sell mobile TV service to subscribers at a retail price.

In July 2007, Crown Castle announced that it would close Modeo and take a write off. The L-band spectrum was then leased to an investment group for $13 million annually from 2007 to 2013 with a back-end buyout provision by the lessee organization.[203] Trade press speculation was that the demise of Modeo resulted from: (a) a lack of capital to complete a nationwide network build-out; (b) too little spectrum in comparison to MediaFLO and HiWire; and (c) no cellular partner/anchor tenant for the proposed service.

Based on propagation characteristics and transmitter power, Kagan estimated that, to cover 200 million of the U.S. population, it would take 15 times the number of transmit sites using L-band as it would at 700 MHz.[204] In this scenario, Kagan further estimated that the capital spend required at L-Band would be five times that at 700 MHz for the same coverage, which led Kagan to conclude that use of 700 MHz for mobile video was "compelling" (and by comparison, the use of L-Band was not economically viable). The comparative cost estimates generated by Kagan go a long way toward explaining the demise of the Modeo venture.

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200 Morgan Stanley, "700 MHz Primer: Beachfront Property for Sale" (February 14, 2007); Lehman Brothers, "700 MHz May Move Stocks in '07" (December 20, 2006).

201 Kagan Research, "700 MHz Players Ready to Play Ball" (2006), p. 7.

202 Crown Castle press release, "Crown Castle Mobile Media Becomes Modeo" (January 4, 2006).

203 Crown Castle press release, "Crown Castle Announces Long-Term Modeo Spectrum Lease" (July 23, 2007).

204 Kagan Research, "700 MHz Players Ready to Play Ball" (2006), p. 7.

3. Sprint's WiMAX Service

Sprint announced plans to provide high-speed data service over spectrum the company has in the 2.5 GHz band using the WiMAX standard.[205] Service is supposed to begin in 2008 in a limited number of major markets and then expand in 2009. The upfront capital cost is expected to be equal to, or greater than, $5 billion, which amounts to approximately $50 per person for each of the almost 100 million people to be covered by the planned system.

There has been speculation that Sprint would use this 2.5 GHz spectrum for a mobile TV service.[206] The business logic to use the spectrum for video was that: (a) a one-way broadcast service would require less capital to build out than a two-way data service; (b) use of its own spectrum would provide more control to Sprint than signing a deal with MediaFLO or HiWire (now AT&T); and (c) Sprint had close relationships with cable television companies that could be a source of video content.[207]

However, financial difficulties at Sprint caused the termination of the CEO and called into question the company's ability to build out the planned WiMAX network.[208] However, Sprint has announced that it remains committed to building out its 2.5 GHz spectrum.[209] In the meantime, Sprint continues to sell its "Sprint Power Vision TV Pack" for $20 per month that delivers 20 TV channels including seven popular prime time programs (e.g., CSI: NY, Desperate Housewives, Grey's Anatomy) over its cellular/ PCS network.[210]

4. Cellular Networks

As discussed previously, the major U.S. cellular network operators operate 3G networks that are based on GSM (AT&T and T-Mobile) or CDMA (Verizon and Sprint) technology. All four offer high-speed data and video services to their mobile subscribers. At this point in time, the only one of the four to put their video service on a separate network from their cellular network is Verizon (via the MediaFLO 700 MHz network). The others offer video service through their cellular networks.

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205 Sprint-Nextel Corp., Annual Report (Form 10-K) for the fiscal year ended December 31, 2006, p. 5.

206 For example, see ABI Research, "U.S. Mobile Broadcast Video Market: Five Predictions" (July 2006). On the other hand, there has also been public speculation that Sprint lacks the financial capacity to build out the WiMAX service.

207 Currently, Sprint's relationship with the cable industry appears to have cooled. See "Sprint Freezes Pivot," *Multichannel News* (July 20, 2007). "Pivot" is a Sprint mobile phone service marketed by Comcast, Cox, Time Warner, and Bright House.

208 Sprint Nextel Corp. has announced the replacement for this CEO position, Dan Hesse, "Sprint names wireless exertas its next CEO," *Wall St. Journal*, (December 19,2007).

209 "Sprint Carries on with WiMAX; Analysts Leery," chicagotribune.com (November 13, 2007).

210 Sprint's mobile TV service has three modes: (1) "on demand" (for broadcast TV shows after OTA broadcast); (2) "linear" which features continuously streaming, scheduled video content; and (3) "simulcast" showing broadcast programs as they are being broadcast (such as the CBS Evening News).

Both CDMA (via Evolution-Data Only [EV-DO] technology) and GSM (via High-Speed Downlink Packet Access [HSDPA] technology) networks can be modified to mix high-speed data/video with voice services.[211] However, real-time, broadcast (one-to-many) television programming sent to cellular customers over the cellular network tends to increase network congestion and cause problems for voice and text users.[212] The bottom line is that broadcast (one-to-many) video traffic through a cellular network may be technically feasible but economically suboptimal.

One solution for cellular network operators is to offload video traffic (especially real-time broadcast video traffic such as could occur during a televised sports event) onto a second, video-capable network. Assuming a dual-mode receive device (i.e., receipt of both the cellular and the video networks by a single M/H device transparent to the user) was in-use, an ancillary benefit to the use of dual networks would be the potential for interactivity with the cellular network providing the return channel.[213] The dual network solution assumes that mobile video delivers real-time video programs that are popular and available on a broadcast basis to a mass audience using M/H devices. Note that a dual network solution is consistent with the attempts by cellular operators (e.g., Verizon Wireless with MediaFLO, AT&T with Aloha spectrum, Sprint with WiMAX) to secure a parallel network to deliver mobile video service without tying up cellular network bandwidth.

5. Satellite Service

In 2006, HiWire and satellite operator SES Americom announced that the two companies would act as partners for the HiWire mobile video service trials.[214] The satellite operator was to aggregate and process content in its New Jersey operations center. Then SES Americom would uplink the content from there to HiWire receive locations where that content would be tailored to the local market and sent out over HiWire 700 MHz spectrum to M/H devices of participating cellular operators.[215] There is no public indication that the SES Americom partnership survived the business termination of HiWire by its parent company, Aloha Partners.

A more recent instance of the potential use of a satellite platform as part of a M/H DTV service was the joint announcement of ICO Global (a provider of satellite services) and Clearwire Corporation to collaborate on a mobile video trial.[216] Clearwire is controlled by Craig McCaw and holds terrestrial licenses for 2.5 GHz spectrum. ICO is also controlled by McCaw and has one geo-stationary

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211 Kumar, *Mobile TV*, Chapter 4.

212 Solomon, "The Economics of Mobile Broadcast TV."

213 "TV on a Mobile: Extending the Entertainment Concept by Bringing Together the Best of Both Worlds," IBM Institute for Business Value (2006), p. 9.

214 SatNews Daily, "HiWire Teams with SES Americom for Broadcast Mobile TV Trial" (April 26, 2006).

215 The primary cellular partner was to be T-Mobile.

216 Clearwire-ICO Global Joint Press Release (October 9, 2007).

satellite in orbit. ICO has 2.0 GHz spectrum and one announced purpose of the joint test is to determine whether there are spectrum efficiencies in the two companies working together. Raleigh, North Carolina is to be the site of the first trial.

In neither the SES Americom-HiWire venture nor the Clearwire-ICO Global announced test, is there any indication of a direct satellite-to-M/H device transmission. It appears that the satellite component is used for national distribution to local redistribution sites, a use very similar to that made of satellites by traditional OTA broadcast networks.[217]

The situation may change if XM Satellite Radio and Sirius Satellite Radio merge successfully. In combination, the two had approximately 14 million subscribers as of year-end 2006.[218] If merged, the two would most likely eliminate redundant audio channels, thereby freeing up bandwidth that could be used to transmit video to M/H devices.

B. Broadcaster Competitive Advantages

There are four core competitive advantages that local broadcasters have relative to the set of competitors described above. Competitive advantages do not guarantee a successful outcome. Rather, such advantages represent points of relative strength that should be emphasized in business planning and execution.

1. Substantially Lower Capital Requirements

The incremental capital cost (i.e., variable cost after the sunk cost of the analog-to-digital conversion) at the transmitter to send a M/H signal could be as low as $100,000.[219] That is a very low cost of entry given the market opportunities.

Therefore, to incorporate M/H DTV capability into 1,700 broadcast transmitters[220] would cost approximately $170 million, a capital cost that would be spread among all owners of broadcast properties based on the number of transmitters in service. Furthermore, broadcasters already have the spectrum necessary for digital broadcasting and do not have to participate in any spectrum auctions and/or buy/aggregate spectrum from any other source(s).

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[217] Note that this approach is different than that used in Korea and Japan (discussed previously), where there are direct broadcast transmissions from the satellite to mobile devices.

[218] *Digital America 2007*, p. 17.

[219] The cost will be for a non-redundant exciter and multiplexer. Some observers have noted that broadcasters may also need to purchase and deploy "gap filler" low power transmitters to deliver reliable M/H broadcast services in certain markets. Estimates in our interviews ranged from $100,000 to a high of $350,000.

[220] Includes commercial and public broadcasting transmitters; excludes low power stations and translators.

The capital spend requirements of broadcasters contrast very favorably with those of potential infrastructure competitors. For example, in order to launch MediaFLO as a national service, Qualcomm purchased spectrum at auction, purchased additional spectrum from third parties that controlled 700 MHz spectrum in other markets, and now is in the process of building out a nationwide 700 MHz broadcast service. In its annual report, Qualcomm states that it had an asset base (at cost) of $329 million as of the 2006 fiscal year end, up from $98 million as of the end of the prior year.[221] Qualcomm's reported capital spend is consistent with Kagan's estimate that the cost of a nationwide 20 channel 700 MHz broadcast television network (covering two-thirds of the U.S. population) would be $450 million.[222] (The $450 million estimate was for the build-out and did not include capital spending to acquire spectrum).

However, it is very important to note that the full capital cost advantage of broadcasters only exists so long as the competitor has not yet built out its network. Once a competitor builds out its network, then the capital spend of the competitor becomes a sunk cost, and the competitive advantage of broadcasters is reduced significantly. However, even after the build out, the advantage is not eliminated since the competitor has a much larger investment upon which a satisfactory return must be returned (i.e., broadcasters could price below the competition and still earn their required return on a much smaller capital investment).

2. Low Cost and Routine Access to Content

Local broadcasters have established access to content. Some of this content is created and owned by local broadcasters (e.g., news) or is otherwise licensed for broadcast in that market (e.g., network and syndicated programming).

Infrastructure-type competitors, such as MediaFLO and cellular operators, lack established access to content. They can and do purchase the rights to content. However, purchasing such content adds to the cost of their service and provides broadcasters with a clear competitive advantage.[223]

In addition to the overall programming cost advantage, broadcasters create and own local content (e.g., news) that, as shown by the ratings, is often extremely popular from early morning to late evening all days of the week. The non-broadcaster mobile television services tend to be national services without local content (e.g., MediaFLO). Once again, the advantage is with broadcasters.

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221 Qualcomm Annual Report (2006), p. 53.

222 Kagan Research (2006), p. 7.

223 Before launch of a M/H DTV service, there is a need for legal research and analysis with respect to distribution rights for programming to M/H devices. Clarification is required of the precise rights that the networks have to broadcast purchased programs (e.g., by NBC from Warner Brothers) over a M/H DTV service. Clarification is also required with respect to the program rights of local broadcasters with respect to broadcasting network programs to M/H devices.

3. Lower Coverage Cost Per POP[224]

Broadcasters transmit high power signals using spectrum that is ideal for wide area coverage for one-to-many (i.e., broadcast) applications, such as a mobile video service. Except at 700 MHz,[225] potential competitors control spectrum that may be appropriate for wireless voice or data in a cellular configuration using relatively low power transmitters.[226] Therefore, broadcasters can cover more geographic area (and therefore more population) for less cost than any competitive systems (i.e., cost per POP). For example, the average cost per POP for Sprint's $5 billion WiMAX build out is estimated to be approximately $53 (excluding spectrum acquisition costs).[227] This cost advantage includes competitors at 700 MHz (e.g., MediaFLO) since the competitors have to both pay for the spectrum and the build out of their network.

This competitive advantage of broadcasters operates in two ways: (1) the cost per person served in dense areas is less than competitors; and (2) larger geographic areas can be covered by broadcasters for a cost that only allows competitors to cover a much smaller geographic area. This is important because there is an expectation that "users have come to expect ubiquitous coverage and the availability of video services -- anywhere, any time…"[228]

4. Access to Advertising Revenue

Local broadcasters routinely market and sell access to audiences to national, regional, and local ad buyers. Monetizing audiences is a core competency of successful commercial broadcasters. None of the other competitors has much (if any) experience with an advertising revenue model, nor do the competitors have in place the large local sales staffs necessary to sell to advertisers and their agents.

a. Mobile Advertising Revenue to Support a M/H DTV Service

Mobile advertising delivers its messages over mobile devices, such as cellular phones or PDAs. Mobile advertising is projected to grow at the highest growth rate (41%) in the 2006-2010 period of any media category[229] (although off a very small base). Other forecasts for the growth of mobile advertising are even more optimistic. IDG has published a forecast assigning an annual compounded growth rate of over 100%

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[224] In the wireless industry, "POPs" refers to the number of people (the population) in a specific geographic area. The "cost per POP" is calculated by dividing the projected/actual cost to provide a wireless service (such as M/H DTV) to an area, divided by the total population of that area.

[225] Originally used for UHF analog television broadcasts.

[226] For a discussion of the economic impact of spectrum propagation characteristics, see Morgan Stanley's "700 MHz Primer: Beachfront Property for Sale" (February 14, 2007), pp. 8-10.

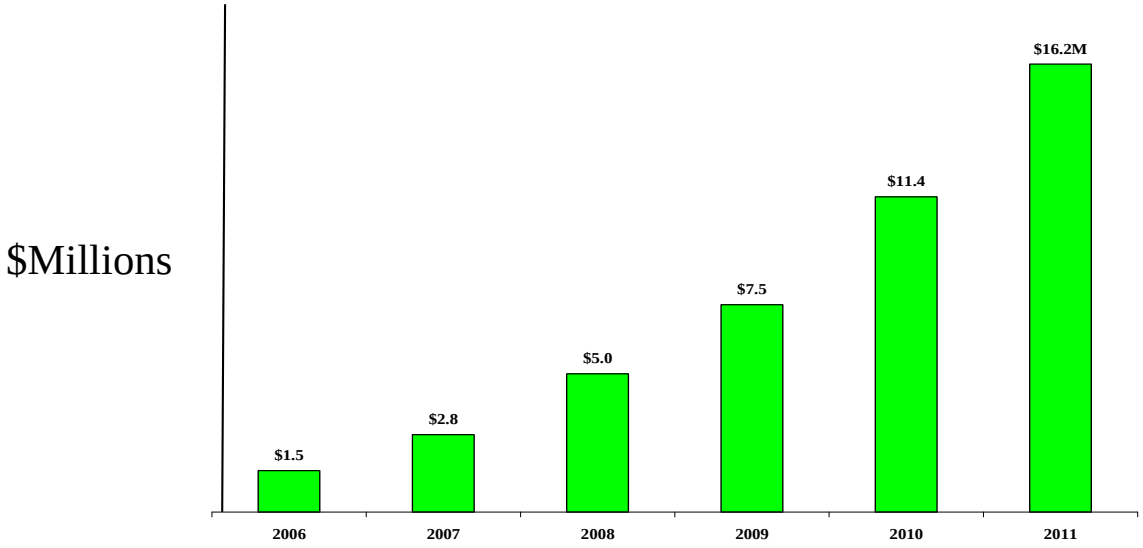
[227] Assumes 95 million people covered for a $5 billion upfront capital spend. See Parks Associates Report (August 16, 2007).

[228] HP, "Accelerating 3G," p. 10.

[229] IBM Global Business Services, "The End of Advertising As We Know It" (2007), Figure 1, p. 5.

through 2012.[230] Exhibit 13 shows projected mobile advertising spend based on eMarketer's review of trends and third party forecasts. These trends show: (1) a rapid increase in mobile ad spend off a small current base; and (2) mobile is a key focus area for advertisers and their agents.

Exhibit 13
Mobile Advertising Spending



Source: eMarketer "Mobile Advertising" Includes Text, Audio, Product Placement, and Video Advertising formats

What is important for broadcasters is that "mobile" is of increasing importance to advertisers and a M/H DTV service will enable broadcasters to leverage their existing advertising experience and sales experience. After launching a M/H DTV service, broadcasters could sell and deliver multi-platform advertising programs (on air, web sites, and mobile) that would enhance the value broadcasters deliver to advertisers, as well as communicate that broadcast television can combine elements of both new and old media.

b. Location-Based Advertising Revenue

It is expected that M/H DTV services may involve broadcasters entering into partnerships (e.g., with cellular operators, with vehicle manufacturers such as GM). Cellular phones and vehicles with GPS allow location-based advertising. The government requires cellular operators to be able to locate subscribers making emergency calls. Given that location can be determined, there is the potential to tailor advertising to that location (e.g., daily specials offered to carriers of mobile phones within one mile of a store or shopping center). Market research suggests that several location-based formats can drive store traffic including: (1) sale alerts; (2) store

[230] "Mobile Advertising Prepares for Take-Off," *InfoWorld* (September 11, 2007).

finder services; (3) gift finder services; and (4) downloaded coupons/vouchers.[231]

Cellular operators and automobile manufacturers do not have the in-place sales force or the market knowledge to sell location-based advertising, but broadcasters could leverage their organizations and market knowledge to do so. This competence can be brought to the table when negotiating a deal with potential partners around M/H DTV service offerings.

C. Broadcaster Business Models

Revenue/business opportunities for M/H DTV can be divided into two categories:

1. **Opportunities that relate to the traditional role of broadcasters delivering a mass market to advertisers (usually involves no charge to the consumer, but is distributed on a free-to-air basis); and/or**

2. **Opportunities that diversify the traditional broadcaster revenue base to include subscriptions, transactions, and paid carriage for third parties over the broadcaster's high-speed digital infrastructure.**

New providers of information and entertainment are becoming competitive with broadcasters for advertising dollars. Since the ad spend in the U.S. remains relatively constant at 2.2% of gross domestic product (GDP), more competition for ad spend dollars puts pressure on broadcasters to: (1) increase audience size; and/or (2) segment the audience so that advertisers will pay a premium; and/or (3) deploy enhanced capabilities that will make programming and associated advertising more attractive to consumers and, therefore, more valuable to advertisers (including downloading of supplemental advertiser-supplied information). Advertising over a M/H DTV service has the potential to achieve all three.

With respect to traditional advertising revenues, interviews with representatives of the advertising community stress that any claim on incremental advertising revenues by broadcasters must be supported by proof that larger -- and/or more qualified/premium audiences -- are actually delivered. Therefore, there are three prerequisites for broadcasters to generate incremental revenues from M/H DTV services: (1) the impact must be measured;[232] (2) the effect must be differentiating and not result from cannibalization of broadcaster audiences;[233] and (3) the impact must be material (e.g., achieving a measured increase of at least one percent [1%] in share).[234]

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231 Enpocket, "Mobile Marketing: A Vertical Perspective" (2006), p. 17. One of the best known mobile marketing firms, Enpocket was purchased by Nokia in September 2007.

232 Enhanced broadcasting technologies will allow programs to reach consumers outside-the-home and/or through use of non-traditional receiver devices (e.g., laptops). Therefore, deployment of next generation audience measurement technologies (e.g., Arbitron's PPM) are a prerequisite to realize incremental advertising revenues for broadcasters.

233 An example of cannibalization would be to take a station's audience and spread the same absolute number of viewers/listeners across two or three channels multicast by the station.

234 "One percent" seems to be a materiality threshold for the advertising community. Less than a one percent share

Non-traditional opportunities are somewhat varied and limited only by the capabilities of the digital infrastructure and the willingness-to-pay of the buyers. Examples include: (a) all forms of subscription revenue in which the business relationship is between the subscriber and a business entity that might be a broadcaster, but is more likely to be a partner to a broadcaster, such as a cellular operator; and (b) distribution of content in electronic format for which other parties are the rights holders (e.g., downloads of real time traffic maps to subscribing vehicles paid for by a third party such as GM).

Exhibit 14 summarizes the near-term M/H DTV opportunities for the broadcast industry. There are three key assumptions behind this exhibit:

1. **The critical period is 2009-2010, because the take off for mobile video service is forecasted for this period[235] and therefore this is a window of opportunity for broadcasters to launch M/H DTV services, line up partners/suppliers, and test their business models.** This timing coincides with the overall campaign designed to explain and promote the transition to broadcast DTV that will be effective in February 2009.

2. **At launch, the primary content to be provided over M/H DTV transmissions will be essentially identical to the programming offered on the main DTV signal** (e.g., primarily network and syndicated programming with local news, weather, and traffic). There may be some time shifting and/or additional local content (e.g., tailored news) added especially in later years. However, the launch of an M/H DTV service by broadcasters does **not** require programming an entirely different channel.

3. **The analysis is at the broadcast industry level, not at a broadcast group level.** It was beyond the scope of this analysis to analyze optimal M/H DTV strategies at the broadcast group level.

gain appears to be regarded as just noise in the measurement system.

[235] See the assumptions built into the forecasts (ABI Research, IDC, Veronis Suhler Stevenson, and OVUM) cited below in the "Cellular Handsets" section.

Exhibit 14
Summary Of Broadcaster Business Opportunities (2009-2011)

Receive Devices	Potential Broadcaster Business Model at Launch		Key Stakeholder(s)	Dependent on M/H DTV Standard	Near-Term Opportunity (2009-2011)	Comments
	Advertising Based Revenue	Subscription Based Revenue				
1.Cellular Telephone **High Priority**	Yes	Yes	1. Cellular Operators 2. Handset Manufacturers 3. Google	Yes	Yes	Business models (advertising vs. subscription) are mutually exclusive; either/or but not both
2.Stand alone video receiver-player **High Priority**	Yes	No – Potential over long term	Device Manufacturers (e.g., Apple, Microsoft)	Yes	Yes	Potential fee only for advanced services; would require inter-activity and conditional access
3. Vehicles **Lower Priority**	Yes	Yes	Automobile Manufacturers	Yes	No –Factory-installed Maybe – third party-installed	Long lead time for factory-installed options Potentially more of a near-term data-casting opportunity
4. Laptop Computers **Least Priority (for M/H Service)**	Yes	No – Potential over long term	Laptop Manufacturers	Maybe (See comments)	Yes	May not require M/H DTV receive cap-abilities in short-run so long as can receive main OTA DTV signal

D. M/H DTV Business Opportunities for Broadcasters

The opportunities are organized by receive device because the device dictates the participating stakeholders and the size and nature of the opportunity. While stakeholders overlap across some devices (e.g., Nokia in cellular handsets and stand-alone video receivers), most of the key players in key markets do not (e.g., Verizon Wireless, AT&T, GM, Dell).

1. Laptop Computers

Laptops are ideal receivers for digital television broadcasts -- relatively large screens, high resolution capability, significant power sources, and a potential return channel via Ethernet, Wi-Fi or cellular modem connection. While laptops are portable, the usual in-use situation is at rest (e.g., table top).

Our understanding is that: (a) the laptop platform is an excellent candidate to be equipped with a digital tuner to receive the main OTA DTV broadcast signal; and that (b) there is no provision in the proposed ATSC standard for auto-selection logic to have the DTV tuner default to the M/H DTV signal only when the main DTV signal is not available.[236] Therefore, at least for the period of consideration used in this report (2008-2012), laptops are not considered a M/H DTV business opportunity for broadcasters (but do constitute an audience-expanding opportunity for the main DTV signal which, in turn, could augment broadcaster advertising revenues).

2. M/H DTV for Vehicles

a. Datacasting

There are approximately 16 million new vehicles sold each year in the U.S. Everyone of them is a candidate for a factory-installed "vehicle information center" to which text and graphics could be downloaded to include advertising and promotional material. This vehicle information center would not be video-capable since it would not be safe to have the screen where a driver could be distracted and cause an accident. The business opportunity for participating broadcasters[237] with respect to this information center is two-fold: (a) provision of local content (e.g., weather, traffic) that could be formatted for vehicles; and (b) use of transmission facilities to datacast to vehicles. Because the car manufacturer would control access to the vehicle, broadcasters would be partners with one or more manufacturers who would expect to be paid for provision of basic access to the mobile audience and/or on a subscription basis by vehicle owners for advanced services provided.

We have found no public revenue forecasts for this type of datacasting service. However, using reasonable assumptions,[238] by 2012, the revenue for broadcasters may be in the $15-$20 million range. While the size of this revenue stream is not particularly large, it is important to note that there would be almost no incremental cost so that nearly the whole amount would be operating income.

b. Video Reception

In addition to the datacasting service, there is an opportunity for increased advertising revenue if the in-vehicle entertainment centers that are

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[236] This situation assumes simulcast of identical programming on both the main DTV signal and the M/H DTV signal. It is not certain that this situation would prevail.

[237] The participating broadcasters would most likely be limited to those groups that have broad geographic coverage.

[238] The assumptions are as follows: (1) service launch in the 2011 model year; (2) GM leads with Ford and Toyota following quickly; (3) 2M vehicles participate in 2011 and 5M in 2012; and (4) broadcaster revenue for content and transmission equates to $2-$3 per participating vehicle per year.

provided as an option in vans and some SUVs could be equipped for M/H DTV reception. For example, Chrysler's Town & Country van offers a "MyGIG infotainment center" as a $1,700 option. This package features two LCD flip-down screens for DVD play, satellite radio, MP3 play capability, and a hard drive that can hold/play music, as well as navigation information. It would be in this type of package that an OTA M/H DTV service could be inserted. However, van sales in the U.S. are less than one million annually.[239] Those equipped with optional entertainment centers are a subset of the van category. The bottom line, is that this opportunity is relatively small -- maybe 200,000 to 300,000 vehicles per year across the entire U.S. within the 2007-2012 timeframe.

There is also the potential for M/H DTV reception in public transit and taxis. In order for this opportunity to be realized, transit and taxi fleet operators would have to include M/H DTV receive systems in the vehicle specifications that they provide to vehicle manufacturers (or arrange for third party or self-installation). Therefore, the operators would have to be convinced that M/H DTV reception would support increased fares and/or provide a competitive advantage. As with individual cars with entertainment centers, it is difficult to see any material increase in advertising revenue from M/H DTV in mass transit/taxis in the timeframe covered by this study.[240]

3. Portable M/H Video Devices

Almost all digital audio consumer electronics companies manufacture and sell M/H video-capable devices, as do some companies not always thought of as consumer electronics companies, such as Microsoft under its Zune brand of products and associated download services.

The opportunity for broadcasters is to have M/H DTV receive capability incorporated into multiple brands and models. Essentially, consumer electronics manufacturers would build-in a tuner that allows users to tune in the OTA M/H DTV service of their choice.[241] Given that such receive capability were built into the players as an additional functionality, there should be incremental advertising revenue to broadcasters based on: (a) increased viewership from the mobile audience of M/H device users; and (b) improved demographic targeting on M/H device users who tend to be younger, techno-savvy and affluent.[242]

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239 *Dallas News*, "Chrysler Van is Functional – But Not Fun" (November 12, 2007).

240 There would most likely be trials in this period. Also, there might be the basis for a datacasting service for fleet vehicles, but that remains to be seen.

241 Another option, especially in the 2009-2010 period, is for some type of "plug-in" M/H DTV receiver that could allow consumers to retrofit their previously-purchased MP3s. In addition, a plug-in would allow the M/H DTV capability to be purchased separately by new buyers of MP3s, in case the factory-installed version was delayed or in short supply.

242 The viewing on MP3 players would have to be measured and reported by market so that advertisers could know what they are purchasing, but this is standard procedure in the broadcast industry.

Unit sales of MP3 players increased 56% (2005-to-2006) while, during the same time, average sales prices decreased approximately 8% (from $152 to $140).[243] The average price drop is somewhat deceptive in that the storage capability, functionality, and scope (music, video, and photos) have increased consistently in this category since Apple launched the original iPod for the 2001 Christmas buying season.

For example, a low end estimate would be, if 20% of the MP3 players (as classified by CEA) sold in the U.S. had M/H DTV receive capability for the 2009 Christmas season, then by 2012 there would be an embedded base of approximately 20 million M/H DTV-capable MP3s. This mobile audience with known demographics could then be sold to advertisers, thereby increasing advertiser revenue for broadcasters.[244] Importantly from a financial perspective, the incremental advertising revenue for broadcasters would have almost zero marginal cost so it would drop directly to the bottom line.

The size of the available audience would vary by the percentage of devices sold that had M/H DTV receive capabilities. For example, at the high end, if the percentage were 50% in the 2009 (as opposed to the 20% used in the above example), then the number of M/H DTV-capable DTV players in circulation in the U.S. by 2012 would approximate 50 million potential viewers across all TV markets with concentration in an audience with favorable demographics. On the issue of the potential volume of M/H video devices, three factors favor high volumes: (1) for manufacturers, the economies of scale dictate that there needs to be very high volume runs; (2) the embedded base of such devices – as is the case with almost all consumer equipment under $300 – swaps out at about two-three years, so there is real potential for a rapid take up; and (3) broadcast programs are the most popular type of programs. These three points in combination make a high volume assumption both logical and supportable.

For device manufacturers to incorporate M/H DTV receive functionality rapidly, there would be several prerequisites: (a) there would be M/H DTV programs transmitted across the full range of U.S. TV markets; (b) consumers would want to watch this programming; (c) the addition of M/H DTV capability would not adversely impact the purchase decisions of consumers (e.g., due to a required increase in the size of the MP3 player); and (d) the cost of the chips, components, and intellectual property licenses was acceptable to both manufacturers and consumers, in terms of the impact on both the wholesale and retail prices of the device. In addition, rapid deployment would require consumer and manufacturer confidence that there was a dominant, if not single, M/H DTV system in the market.

[243] NPD Group press release (January 2, 2007).

[244] To generate additional advertiser spend, the incremental viewers would have to be: (1) measurable reliably; (2) truly be incremental for a given program at a specific timeslot; and (3) be material (i.e., probably in the order of a one percent or more gain).

4. Cellular Handsets

In general, there are two major scenarios by which broadcasters would work with cellular network operators. The first scenario involves free-to-air transmission of M/H DTV services by local broadcasters to cellular handsets containing tuners that allow the user freedom to tune to the M/H DTV service of their choice.[245] Under this scenario, compensation to the broadcasters would consist of payments by advertisers for access to a formerly unreachable mobile audience.[246]

The second scenario involves sale of content to be re-transmitted over non-broadcaster facilities (e.g., MediaFLO) chosen by the operators to be received on the handsets of their subscribers. In this scenario, compensation to broadcasters would most likely be in the form of a monthly payment per subscriber by the cellular operator to the participating broadcasters.[247]

When looking at the potential revenue from delivery to cellular handsets, it is important to understand the size of the potential market for cellular-based mobile television. Forecasts vary, but the overall consensus is that mobile television will be a material business for cellular operators. Our review shows that forecasters generally expect the following: (1) mobile television in the U.S. to be a viable business; (2) take off in the 2009-2010 period; (3) tens of millions of subscribers; and (4) an annual spend by subscribers that generates a revenue stream for cellular operators in excess of $1 billion by 2011. A sample of forecasts is provided below.

ABI Research[248]

2011: 27 million wireless customers spend $2.3 billion to subscribe to "broadcast mobile video services" from cellular operators (approximate spend per month = $7 per customer)

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[245] The impact of including an ATSC tuner to receive M/H DTV signals in cellular handsets remains to be determined. The main addition to the handset would be the ATSC tuner and possibly new video and audio decoders. Other changes could involve the power supply, the keyboard, and the antenna. Taking up space within a handset is an issue that will involve multiple stakeholders, including cellular network operators, device manufacturers (and their supply chains), handset software providers (such as Google), and broadcasters. The value proposition presented by broadcasters would have to be substantial.

[246] Most likely, this free-to-air scenario could be implemented faster with an "open" model in which cellular network operators do not control the functionality of the handsets that operate on their networks. See the discussion of the "open" versus the "closed" model in the prior chapter.

[247] In this second scenario, an M/H DTV system is not required because the chosen infrastructure may be MediaFLO or other facilities not controlled by local broadcasters.

[248] **ABI** Research, "U.S. Mobile Broadcast Video Market: Five Predictions" (July 26, 2006).

IDC[249]

2011: 24 million audience to watch video on mobile phones

Veronis Suhler Stevenson[250]

2011: over 50 million "mobile TV subscriptions"

OVUM[251]

2011: 49 million cellular subscribers spending $1.7 billion on mobile video (approximate spend per month = $3 per customer)

From the perspective of OTA broadcasters, what is important about these forecasts is the following:

(1) The near-term (2009-2011) ramp up of subscribers constitutes the "window of opportunity" for broadcasters;

(2) Substantial revenue is forecasted for cellular operators providing mobile video services;

(3) The "worst case" forecast is for 20+ million subscribers and an annual subscription spend over $1 billion; and

(4) The forecasts indicate a low monthly subscription fee paid to the cellular operators, probably in the range of $5 per subscriber.[252]

a. Free-to-Air Handset Reception Scenario

Under this scenario, broadcasters either: (1) negotiate successively to have cellular operators allow handsets to have OTA M/H DTV service reception capability ("closed" model); or (2) work with handset manufacturers to have M/H DTV receive capability built into the handsets, so that users could receive free-to-air broadcast programs ("open" model).[253] As described earlier, most likely, the process would develop along the following lines. The cellular handset market has three tiers: (a) the high end top tier in which there is little or no operator subsidy for handsets (approximate price point = $500 and above for a handset); (b) a middle tier with subsidy and price points at or above $150; and (c) a

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249 IDC, "U.S. Mobile Commercial Video and Television 2007-2011 Forecast" (March 2007), quoted by Sprint on their web page (posted September 26, 2007) as part of the Sprint announcement that seven primetime broadcast hits will be available on-demand over the Sprint network.

250 Veronis Suhler Stevenson, *Communications Industry Forecast 2007-2011*, 21st edition (2007), p. 325.

251 OVUM, *Wireless Content Forecast* (U.S. only), custom data run prepared for this report.

252 The low spend per month is the prerequisite for creating a mass mobile television market. The current $20/month subscription fee is not considered viable in the long term.

253 For more details on the "closed" and "open" models, see the discussion of cellular telephones as receive devices in Chapter IV.

"low end, basic" tier. Most likely, the progression for M/H DTV capability would be introduction into the top tier and then, if the functionality proves popular with cellular subscribers, the M/H DTV functionality would be moved down rapidly into the middle tier.[254]

The revenue source would be payments by advertisers to broadcasters for delivering access to, and viewing by, the mobile audience. The size of the potential audience would be a function of: (1) the number of handsets in circulation with M/H DTV receive capability; and (2) the number of viewers and duration of viewing. For example, if 25% of the phones sold each year had M/H DTV receive capability, then,[255] after three years, the embedded base of such phones would be in the range of 60-70 million. Likewise, if the penetration rate of M/H DTV receive capability were 50% of phones sold annually, then the embedded base after three years would be twice as many -- or approximately 120 to 140 million by year end 2012. The obvious goal would be to make M/H DTV receive capability as ubiquitous as digital-cameras-in-handsets are today.

The free-to-air scenario involves no guaranteed payments from cellular operators to participating broadcasters.[256] Rather, this scenario involves business as usual for broadcasters who would have the potential to reach a broader audience and then sell that reach to advertisers. All broadcasters would compete for those advertising dollars, just as they do today. Most likely, broadcasters would be selling a multi-platform ad campaign involving OTA, their web site, and mobile audience access.

b. Content Retransmission Scenario

The general analogy here would be retransmission by the cable industry of local broadcast stations. However, when dealing with cellular operators, there would be two very important differences from the cable industry: (1) the channel capacity of the cellular video services is limited (i.e., 16-20 compressed channels); and (2) there is no legal compulsion to retransmit all -- or any -- of the broadcast stations in a given market. Therefore, most

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254 In the event that subscribers did not buy handsets when available in the top tier, then movement into the more mass market middle tier would be problematical.

255 Assumes the following: (a) 100 million or more cellular phones sold annually; (b) introduction of M/H DTV-capable handsets by Christmas 2009; (c) the embedded base of handsets turns over in its entirety every 2 to 2.5 years; and (d) in 2010, the penetration percentage is 15% increasing to 25% in 2011 and 2012. These handsets are also assumed to be able to operate on open cellular networks. That open network outcome may be achieved de jure (formal agreement of the cell operators following the announcement by Verizon) or de facto (the cell operators acquiesce to handset manufacturers including tuners in handsets yet receive no subsidies from the operators). Why might a de facto situation evolve? One reason could be the cost of including broadcast channels in a subscription service is less profitable than the stimulus to handset sales (and therefore subscriber increases) due to including free broadcast reception in the handset. At the same time, the small operators like Alltel and T-Mobile might have nothing to lose by allowing free to air reception so the majors have to go along to compete

256 In fact, it may involve the cellular operators requesting payments from broadcasters (under a "closed" model).

likely, the cellular operators would only want to work with two to four local broadcasters in top tier markets and one or two (if any) outside the top tier. As shown on Exhibit 15, the potential payments to participating broadcasters could be substantial, in that they would flow directly to the bottom line.[257]

Exhibit 15
Content Retransmission Potential Payments By Cellular Carriers to Participating Broadcasters

High-End Payment Calculation

a. (50M subscribers)x($5)x(12 months) = $3B annual cellular mobile video revenue
b. 50% of revenue allocated to pay for content = $1.5B
c. 25% of content payments allocated to pay for broadcast content = $375M

Low-End Payment Calculation

a. (20M subscribers)x($5)x(12 months) = $1.2B annual cellular mobile video revenue
b. 50% of revenue allocated to pay for content = $600M
c. 25% of content payments allocated to pay for broadcast content = $150M

Assumptions:

- Cellular subscription fee = $5/month.
- "Broadcasters" include both networks and local stations.

It is important to remember that, in this scenario, the local transmission facilities being used by the cellular operators are chosen by the operators (e.g., MediaFLO) and are not necessarily those of the broadcaster. Those operators are simply paying for the right to retransmit broadcaster-controlled content over facilities chosen by the cellular operators. Under this scenario, cellular handsets are not enabled generally to receive OTA M/H DTV services.[258]

The ATSC M/H DTV standards selection process is relevant to this scenario. In the event timely choice of a single standard cannot be made and/or a "format war" erupts, then it would be difficult to negotiate with cellular operators to allow handsets to receive M/H DTV services on an OTA basis.[259] In effect, this content retransmission scenario is the default scenario for broadcasters in the absence of timely selection of a single M/H DTV standard.[260]

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257 In the content retransmission scenario, an M/H DTV system is not required because the infrastructure chosen by the network operators may be MediaFLO or other facilities not controlled by local broadcasters.

258 To do so would cannibalize subscription revenue (i.e., if broadcast programs are available on M/H devices free-to-air, then why would a cellular customer pay a subscription fee to receive local broadcast content?).

259 The consent of the operators is critical under the "closed" network model. Under the "open" model, the handset manufacturers become the decisive stakeholder group.

260 This does not mean that timely selection of a M/H DTV standard means that there will automatically be a different outcome out of negotiations with the cellular operators. Rather, timely selection of a standard opens up a broader range of potential outcomes and provides broadcasters with more negotiating leverage.

Annual payments to participating broadcasters under the content retransmission scenario could reach $375 million (Exhibit 15). These payments would be almost entirely operating income as there would be little or no incremental cost to deliver content to cellular operators for retransmission.

In addition, there would be incremental advertising from reaching an audience of mobile television subscribers that may number up to 50 million. Also, the demographics (e.g., younger, tech-savvy) of this audience of subscribers would be of particular interest to specific advertisers. Finally, the actual viewing patterns of the audience may be trackable and reportable by the cellular operator who may know the viewing patterns of subscribers.[261]

Exhibit 16 summarizes the differences between the "content retransmission" scenario and the "free-to-air" scenario.[262]

Exhibit 16
Summary of Scenario Differences

	Free-to-Air Scenario	**Content Retransmission Scenario**
1. Revenue Source(s)	• Advertising revenue	• Retransmission fees • Advertising revenue
2. Participating Broadcasters	• All broadcasters that choose to transmit a M/H DTV service	• Networks + limited number of large station groups
3. Importance of timely selection of M/H DTV standard	• Prerequisite for market participation	• Provides negotiating leverage with cellular operators
4. Cellular network operator model	• Better fit for early launch with "open" model	• Possible under either an "open" or "closed" model, but probably a better fit with the "closed" model

[261] Viewer measurement is critical to achieving credibility with advertisers. Cellular network operators should know which, and how many, subscribers access video-on-demand programs and also know the number of purchasers of their subscription channels, but may not know who is watching what, for how long, on their subscription channels.

[262] As noted previously, under the content retransmission scenario, the cellular operators use non-broadcaster controlled infrastructure so the choice of an M/H DTV system is not relevant.

VI. IMPACT OF ATSC M/H STANDARD

In this chapter we focus on the economic implications of various potential outcomes to the scenario setting process.

For broadcasters, the consensus view based on our interviews, trade press accounts and industry presentations clearly is that February 2009 marks the critical date by which ATSC must release its M/H standard specification. Otherwise, broadcasters risk not having a strong showing in the fast evolving mobile video market. Indeed, the belief further is that this work must be completed in substance by the Summer of 2008 so that the various industry players may begin making informed plans while the political processes of the ATSC standard setting process wind their way through the final voting procedures.[263]

We consider two questions of primary concern to broadcasters.

1. What happens to M/H DTV market if the Advanced Television Systems Committee (ATSC) is or is not able to develop a single standard that is accepted by the broadcast industry as of February 2009? To address this question, we consider four scenarios that we define below.

2. What are the specific financial and business implications to broadcasters and others in the emerging "mobile television ecosystem" of four scenarios including whether a single M/H DTV system launches in the digital broadcast space or whether two or three rival systems launch?

We emphasize that a M/H DTV standard is a necessary but not sufficient ingredient for broadcasters' success in achieving the baseline scenario.

A. Four Scenarios – ATSC-M/H Standard versus Rival Systems

As we considered in Chapter III, industry standards are important determinants of the pace and breadth of technology innovation and its marketplace impacts for a variety of reasons already discussed. In Exhibit 17, we show four of six possible scenarios as the more likely outcomes worth analyzing. In Chapter V we presented a baseline forecast by receive device category for the M/H DTV market in the U.S. The question we examine now is how broadcasters' fortunes may vary based on the changes from this baseline as assumed in each of our scenarios.

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263 ATSC Chairman Glenn Reitmeier, (who participated in our interview, along with other NBC-U executives, see Appendix) is VP of technology standards and policy for NBC Universal, expects that field work will be wrapped up by April and that the ATSC may be deciding on the physical layer soon thereafter. Says Reitmeier, "I think you'll be seeing some fundamental decisions made in May or June [2008]." *Broadcasting and Cable*, November 12, 2007.

The scenarios consider whether or not there is a standard and whether a single system, two rival systems or three rival systems enter the M/H DTV market with solutions. Each scenario may imply different outcomes for the various receive device categories.

Our specification of no more than three rival systems competing in the M/H DTV market is premised both on the responses to the ATSC's Request for Proposals for the M/H standard setting process and our expectations for market entry behavior by firms.[264]

Based on our analyses and discussions with industry experts at the NAB and elsewhere, we conclude that any system not seen as among the top three by broadcasters will adopt a strategy to either exit the market or pursue an alternate strategy be it technology sharing in some sort of approach similar to the Grand Alliance[265] or simply by licensing the necessary intellectual property to remain in business but using substantially one of the three major systems proponents.

Two of the proponent systems (A-VSB and MPH)[266] responding to ATSC have already demonstrated their solutions at NAB 2007 by hosting industry observers driven around Las Vegas in buses equipped for mobile DTV reception. In particular, we view these proponents as the likely participants in the event of a multi-system rivalry as anticipated in Scenarios 2, 3 and 4. Without picking a specific third system, we explore the case of three rivals in Scenario 4.

In order for Scenarios 2, 3 and 4 to occur, the rivals must first conclude that there is something superior about their solution. They would see their systems as better in term of technological, marketing, production efficiencies, business relationships (e.g., ecosystem family) or some other criteria. This then would encourage them to conclude they have a reasonable chance of succeeding in the marketplace. This could occur if the IDOV testing does not bring to light a clear winner. Relative success in the OMVC IDOV demonstrations in the first quarter of 2008 will certainly inform the likelihood of the various scenarios.

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264 See: "Minutes, Specialist Group on ATSC M/H (draft), November 15, 2007. Mr. Sterling Davis (one of our interviewees) reported that input to the IDOV activity had been received from four proponents: (1) Samsung/Rohde & Schwartz/Nokia; (2) LG/Harris; (3) Thomson/Micronas and (4) Coherent Logix. However, only three *complete* systems (i.e., encompassing the (1) physical; (2) transport and application and (3) management layers) had been submitted to ATSC TSG/S4. The incomplete system is the Coherent Logix system which submitted only a cross-layer control system (Document S4-077 to ATSC TSG/S4 on October 19, 2007.

265 In the FCC's DTV system setting process nearly two dozen firms competed to be selected as the standard. Seven of the leaders (AT&T, General Instrument, Thomson, Philips, MIT, Zenith, Sarnoff) engaged in a "grand alliance" strategy by sharing technologies among their various subsystems to achieve a single technology solution drawing from each proponent's technology set. This reduced the competitive field and led to a clear standards choice.

266 Advanced VSB (A-VSB) was demonstrated at NAB 2007 by Samsung in partnership with Rohde & Schwarz and Nokia. The Mobile Pedestrian Handheld (MPH) system was demonstrated by LG Electronics/Harris/Zenith.

Exhibit 17
Four Scenarios

# M/H DTV Systems in the Market	ATSC Standard Feb 2009	No ATSC Standard Feb 2009
1	Scenario 1	■
2	Scenario 2	Scenario 3
3	■	Scenario 4

What we assume to be a critical tipping point in any market forecast is whether the ATSC can agree on the choice of system/technology *by the summer of 2008* and publish an M/H DTV Candidate Standard *specification by February 2009*. The release of the candidate standard is a critical path that is a timely driver to set in place further dependencies impacting the consumer electronics and handset companies who need this kind of lead time to increase their likelihood of having devices available to the market by the end of 2009. This scenario likely would occur only with substantial broadcaster support not only for the standard but also for a particular proponent system[267]. The assumption of a February 2009 deadline for release of the ATSC M/H standard as being critical to the scenarios is predicated on the stated urgency expressed by broadcasters and system proponents. Some support this deadline as a marketing goal to tie the M/H service announcement into other digital transition related publicity.[268]

We also factor into our analyses the conclusion that broadcasters will be disinclined to make the capital investment to install and operate two or three rival M/H systems. We see this as driven by two major considerations – *Bandwidth Budget* and *Complexity*.

1. *Bandwidth Budget*: Digital television broadcasters have a finite bandwidth resource which is their 19.4 Mbps fixed rate data stream[269]. To offer

[267] Of course, among the rival proponents it may come to pass that as a result of the OMVC IDOV demonstrations that by Summer 2008 there may be concessions and accommodations such that some form of a "Grand Alliance" is achieved among two or more systems reducing the competitive field. If such a consortium is selected as the candidate system by ATSC, this would prove to be an important expedient for going to market with ATSC M/H broadcasting services and receive devices by Holiday Season 2009.

[268] A possibility is that if there is no ATSC M/H standard by February 2009 that broadcasters fearing they will miss out on their opportunities to participate on favorable terms in the fast evolving mobile video marketplace may instead commit to platforms other than their own infrastructure such as MediaFLO, 3G or 4G unicast systems or other players.

[269] While any one station is constrained to a maximum constant bit data rate of 19.4 Mbps, it certainly is possible for multiple stations in a market to band together and aggregate collective bandwidth capacity to support compelling business models. For example, USDTV was a start-up company supported by major broadcasters including Fox Television Stations, Hearst-Argyle and LIN Television to offer a "wireless cable" service of cable network (e.g, Fox News, ESPN) and local station programming for $19.99/month. USDTV aggregated bandwidth from several stations in markets including Las Vegas, Albuquerque, Dallas and Salt Lake City to attract up to 16,000 subscribers on equity investments of $26 million. However, the company filed for Chapter 7 bankruptcy protection by mid-2006 after a two year run. See: John M. Higgins, "USDTV Files for Chapter 7," *Broadcasting and Cable*, July 11, 2006.

broadcast services, broadcasters must trade-off their "bandwidth budget" in a zero sum game[270] to address four goals each of which supports different business models and paths to revenues. These zero sum goals involve using their bandwidth budget to maximize (1) *Quality* (e.g., HDTV programs); (2) *Quantity* (e.g., SDTV multicast channels), (3) *Robustness* (e.g., mobile/handheld services) and (4) *Variety* (e.g., different services such as datacasting services for public alerting, program guide information). In making their bandwidth budget or allocation decisions, broadcasters must determine how they can select business models that best monetize their bit streams. It is not possible to simultaneously maximize across Quality, Quantity, Robustness and Variety, so broadcasters must pick and choose to make relative decisions.

We see it as *extremely unlikely* that broadcasters would allocate scarce bit stream capacity to *more than one M/H proponent system* because we do not find evidence from our interviews that broadcasters see a path to revenues from running two M/H system sufficient to support the opportunity costs associated with diverting bits from the other bandwidth budget maximizing goals.

2. *Complexity*: Broadcasters have transitioned from a business model of providing a linear service to emerging business models offering more complexity. Traditionally, broadcasters have delivered one real-time program service with embedded advertising as its business model. Content acquisition, scheduling, marketing, sales and operations were all relatively straightforward. The digital age challenges broadcasters to offer a mix of digital services including HDTV, SDTV multicasting, datacast services[271], and 3rd party platform deals[272] in order to remain competitive and achieve corporate growth objectives.

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[270] Adding more bit stream capacity to further one goal necessarily means less bit stream capacity is available to serve other goals.

[271] Datacasting examples include Gemstar's use of analog capacity on CBS affiliated stations to provide programming data (See: "TV Guide On Screen to Be Available to 95% of U.S. Households," *Multichannel News*, November 19, 2007. Public stations are part of the national and in many cases state and local public alert and warning systems including the Federal Emergency Management Agency's *Integrated Public Alert and Warning System (IPAWS).*At the local level, coincidentally BIAfn's wholly owned SpectraRep business unit is rolling out datacasting based emergency notification and response systems with broadcasters in Las Vegas and New Jersey – see: Sanjay Talwani, "Vegas PBS Prepares for Emergencies," *TV Technology*, November 26, 2007. In the case of Las Vegas, SpectraRep and Vegas PBS are using the current ATSC signal to distribute data to police cars using an "on the pause" paradigm, i.e., datacast streams are delivered to police vehicles when they are stationary. However, some trials show successful data delivery even at 75 MPH using 5th generation ATSC datacast tuners mounted in the police vehicles.

[272] ATSC's request for proposals specified not only the need to deliver live, advertiser-supported TV to cell phones, but also support subscription services, non-real-time download services for on-demand playback, datacasting applications, interactive TV and real-time navigation data for automobiles. These services could involve broadcasters in the platform (i.e., data distribution) part of the business case only or other aspects as well.

The broadcast business model has been linear and relatively simple to execute, at least in concept – program a single channel and sell advertising. With a range of new HDTV, SDTV, datacasting and M/H DTV service offerings, broadcasters are entering into a much more complex business model. The prospect of broadcasters embracing not one but two or indeed three different technologies and all the downside risk and incremental costs (more operational and opportunity costs than capital of supporting different technology platforms and related deals) associated such a decision lead us to conclude that it is unlikely that any one broadcaster would adopt more than one M/H system. Nonetheless, different broadcasters may certainly choose different systems and so we investigate the multisystem scenarios.

In Exhibit 18 we summarize industry sensitivities to the stated deadline of ATSC releasing its M/H DTV standard by February 2009.

Exhibit 18
Industry Segment Sensitivity to ATSC M/H Standard Release by Feb 2009

Industry Segment	Sensitivity	Rationale
Broadcasters	High	ATSC M/H standard is a key marketing deadline. If the ATSC M/H standard is not selected by the deadline, broadcasters may emphasize 3rd party platform deals with other mobile service providers rather than committing their own infrastructure as a means of participating in the mobile market.
M/H System Proponents	High	High risk game, ATSC winner can set terms for IP licensing, will win support of broadcasters, CE companies. Loser(s) face high hurdles and must offer significant advantages compared to winner to be at all viable.
Consumers	High	Consumers will not respond well in a "format war" and will slow their purchases.
Consumer Electronics	Medium	If there is a market, CE companies will build multiprotocol devices, accepting low margins in first generation and efficiencies in subsequent device generations.
Advertisers	Medium	Advertisers can remain indifferent to the technology platform. However, experience suggests that more complicated buying processes are associated with lower advertising expenditures. For example, local cable advertising was too complicated to buy until the rise of cable interconnects.
Content Owners and Distributors	Medium	Content owners/distributors have the option to remain indifferent to the technology platform. However, to the extent a standard stimulates market demand from the M/H category, content owners are impacted more or less positively. Broadcasters control local content such as news, weather, traffic and perhaps market rights for simulcast network programming. As such, local contents fortunes may be tied more strongly to M/H DTV standard

Broadcasters: The issue is critical to broadcasters. Without a timely ATSC standard (i.e., candidate standard by early 2009), broadcasters have great concerns that they will miss the window of opportunity. Indeed, they may see themselves as better off partnering with cellular service providers, new 700 MHz entrants or other spectrum platform partners. Broadcasters must also make bandwidth budget decisions about allocating relatively scarce bandwidth (19.4 Mbps) among a number of services. The opportunity cost of allocating perhaps 20% of their bit stream capacity to the M/H service that does not achieve market success over a several year period versus earning additional advertising or subscription revenue from another service might be too high.

Television broadcasters are sensitive to time frames for digital television standards. Even with the FCC mandating a digital television standard and deadline certain (although it changed more than once) for ending analog broadcasting, it still took more than a decade to complete this transition. In the radio industry, there is no FCC mandate to transition to digital audio broadcasting and so this is progressing even more slowly. We have already explored the case of AM stereo format war in Chapter III.

From our interviews with broadcasters, we see at least three essential concerns. We conclude that broadcasters:

1. Anticipate incremental revenues from an ATSC mobile broadcasting platform they own and control and would like access to these revenues sooner rather than later.

2. Are anxious to participate earlier in this evolving market when market share may be easier to capture.

3. Prefer developing the M/H market on their own if possible rather than ceding away more of the value chain to competing cellular service providers and others as they did to cable operators during the growth of that industry.

Broadcasters and others in our interviews support the conclusion that the ATSC process likely will favor their interests so they assume that indeed a standard will be selected and that one of the proponent systems responding to the ATSC request for proposals will be the system of choice. Broadcasters as a group also feel that while the February 2009 is critical and aggressive given the history of ATSC standard setting, it is achievable.

The reason broadcasters are so firm on the need for a standard by the deadline is two-fold. First, it is a firm deadline (artificial or no) to drive industry behavior. One of our interviewees told us, “I’ve never seen the commercial broadcast industry so unified . . . not in the history of broadcasting.” Second, broadcasters expect a large marketing dividend if as the industry transitions to an all digital platform and analog operations are terminated, the additional value of an ASTC M/H service to consumers (and content owners and advertisers) can be promoted as an integral benefit of DTV.

M/H System Proponents: For the ten M/H system proponents responding to the ATSC process, of course, they are dramatically impacted by whether the ATSC selects their system or that of a competitor.

Consumers: In the Consumer segment, as we discussed in Chapter III, they are not inclined to be participate in a market place with a format war raging on. The risk of selecting a CE device that ends up being orphaned is not one large numbers of consumers wish to assume. Innovators and Early Adopters are less price-sensitive and less risk averse so there may be a small market for multiple M/H DTV standards. But critical mass for production efficiencies and advertising are unlikely to be realized if there is a format war.

Consumer Electronics: CE companies face a medium sensitivity to the ATSC standards decision and this primarily is because of an increased cost basis in their Bill of Materials (BOM) if they must support multiple systems in one device. According to our interviews, the question of whether there is an ATSC standard is interesting to CE companies but not dispositive. If they see a market for M/H devices, they will build and sell them. If the market opportunity is attractive enough to support the higher cost basis of a multi-protocol approach, they will also pursue that strategy. If however an ATSC standard winner or M/H technology leader offers onerous licensing terms or is overly litigious in protecting its intellectual property rights, this would raise the risks for CE companies seeking to enter the ATSC M/H market. We heard this concern in our interviews.

Advertisers: While indifferent to the technology platform, in Scenarios 2, 3 and 4 we assume that there are different devices and different broadcast stations and groups making different elections about which system to use, the situation will get complicated for advertisers. Advertisers require accountability (i.e., audience measurement) and transactional efficiencies. To the extent M/H audiences are fragmented across different devices which must be measured separately, this could increase the cost and reduce the reliability and validity of audience surveys impairing the value of these research data to advertisers. Also, in order to aggregate critical M/H audiences, if advertisers must evaluate audiences and distribute ad content to multiple platforms this additional work flow effort may be seen as too much effort for the reward.

Content Owners and Distributors: We do not see any great sensitivity to content owners on the issue of whether or not there is an ATSC standard since their product largely is independent of any particular technology implementation. However, to the extent a standard facilitates the development of the M/H market category and stimulates additional demand for product, content owners certainly can be positively impacted. As we have seen in the Betamax versus VHS and also in the current HD-DVD versus Blu-ray format wars, there can be linkage between content owners (i.e., movie and game titles) and the player devices. However, in the case of ATSC M/H, we see the content layer as relatively independent of the M/H receiver device. In the case of local content owners, (including

broadcasters), the stakes are a bit higher since the ATSC M/H DTV platform may be a more cost effective way to provide local services.

In Exhibit 19 we summarize the likely impacts of the four scenarios on the devices market segments in terms of a qualitative sensitivity analysis of the ATSC M/H standard decision.

Exhibit 19
Sensitivity Analysis of ATSC Standard Decision by M/H Platform and Device Market Segments

M/H Market Segment	Who's Impacted	Sensitivity	Impact on Market Forecast
Cellular - Handsets	Handset manufacturers	Medium	• Costs basis will increase with need to license 3rd party technology, build dual/tri mode handsets and incur non-recurring engineering expenses to build their own solutions. • Difficulty of maintaining additional retail inventory. Box stores such as Best Buy or Circuit City may not be sufficiently incentivized to carry multiple types of handsets unless they are multi-standard. • The higher the risk, the more likely ATSC video will be offered only in high end handsets with lower carrier subsidies.
Vehicles – Manufacturers	Vehicle manufacturers	Medium	• Each feature option increases the number of build combinations. ATSC standard and one system doubles build combinations; two rival systems triples and three rival systems quadruple build options. • Key models for auto manufacturers' business case are likely to be vans/SUVs (e.g., video for kids). • Factory-installed M/H video devices require 24-36 month lead time; will not be available in critical mass by 2012 for significantly positive impact on advertising revenues.
Vehicles - Video	After-market electronics	Medium	• Cost basis will increase with need to license 3rd party technology, build dual/tri mode handsets and incur non-recurring engineering expenses to build or OEM their own solutions. • After market M/H video devices require 18-24 month lead time; will not be available in sufficient quantity by 2012 to have a material impact on advertising.

Exhibit 19
Sensitivity Analysis of ATSC Standard Decision by M/H Platform and Device Market Segments

M/H Market Segment	Who's Impacted	Sensitivity	Impact on Market Forecast
Video Players	OEM/Retail	Medium	• Each feature option increases the number of build combinations. ATSC standard and one system doubles build combinations; two rival systems triples and three rival systems quadruple build options. Increases Bill of Materials (BOM) for CE manufacturers creating disincentives to support more than one system.
Cellular – Networks	Service providers	Low	• We include cellular networks in the devices discussion due to the existing bond between carriers and handset manufacturers (i.e., "closed networks"). • The higher the risk, the more likely ATSC M/H will be offered only in high end handsets with lower carrier subsidies. These high end devices will have limited appeal to enterprise users and mass market consumers. • Some impact may be felt via potential competitive entry by broadcasters in the transport and content layers of the market. To the extent broadcasters enter the market successfully; this could impact the carriers' revenue models. • Some feel that carriers could claim the VOD unicasting niche (more likely subscription supported); whereas broadcasters may dominate the multicasting/broadcasting niches (more likely ad supported). • Since carriers are not aggressively pursuing video advertising, probably not much of an impact. Carriers are beginning to pursue ad revenue models by requiring that beneficiaries of advertising accessed via cell networks provide a revenue share to the network operators.
Laptops	OEM/Retail	Low	• Laptops will more likely rely on the conventional ATSC service rather than the M/H service since they have more capacity, larger screens and more functionality.

B. Scenario Specifications

For all four Scenarios we make the assumptions summarized in Exhibit 20 below.

Multiple Systems

As we have noted earlier both in Chapter III discussion on the importance of standards and again in Chapter IV particularly in discussion of the EU Staff Report, there are multiple benefits to having one technology standard. Nonetheless, we include among our scenarios the case of multiple systems in the market. In the cases of multiple competing systems, these may or may not coexist in the same market but almost certainly would coexist in adjacent markets and therefore negatively impacts mobile video users who may have functionality on some stations and markets but not others.

Also, as we heard in our interviews with CE manufacturers and system proponent companies, having a multi-standard device does not entirely solve the format war problem because of the underlying economics. Even if the leading system proponent licenses its proprietary intellectual property, high license fees and/or facing threat of litigation for possible violations can cool any interest other companies may have. Multiprotocol devices do not solve any format war for four reasons:

1. Economies of scale will be difficult to achieve.
2. Multiprotocol devices necessarily are more expensive to produce.
3. A format war will generate confusion among consumers and this will lead to reluctance to purchase devices.
4. Inevitably, the consumer take-up rate and extent of penetration will be lower in the near terms and potentially in the long term as well.

Revenue Models

In Chapter V, we addressed the two basic business model categories for broadcasters – (1) free-to-viewer advertising model and (2) various paid models. The largest near term (2009-2012) revenues available to broadcasters on the M/H DTV platform will be advertising based (any subscription or other revenues are de minimis on the DTV M//H platform by 2012). The rationales here are that (1) it is most likely that primarily advertising supported programming will be offered as a simulcast stream to M/H DTV devices by 2012; and (2) broadcasters are more likely to partner with 3rd parties who have core competencies in billing, digital content asset management, subscriber management systems and other layers of the mobile ecosystem to pursue VOD, subscription or PPV revenue models.

As we noted in Chapter V, with respect to traditional advertising revenues, interviews with representatives of the advertising community stress that any claim on incremental advertising revenues by broadcasters must be supported by proof that larger -- and/or more qualified/premium audiences -- are actually delivered. Therefore, there are three prerequisites for broadcasters to generate incremental advertising revenues from M/H DTV services: (1) the impact must be measured;[273] (2) the effect must be differentiating and not result from cannibalization of broadcaster audiences;[274] and (3) the impact must be material (e.g., achieving a measured increase of at least one percent [1%] in share).[275]

Also, the demographics delivered by the M/H DTV platform may well be more desirable to advertisers and could support a premium for broadcasters who are successful in aggregating this additional audience segment.

[273] Enhanced broadcasting technologies will allow programs to reach consumers outside-the-home and/or through use of non-traditional receiver devices (e.g., laptops). Therefore, deployment of next generation audience measurement technologies (e.g., Arbitron's PPM) are a prerequisite to realize incremental advertising revenues for broadcasters.

[274] An example of cannibalization would be to take a station's audience and spread the same absolute number of viewers/listeners across two or three channels multicast by the station.

[275] "One percent" seems to be a materiality threshold for the advertising community. Less than a one percent share gain appears to be regarded as just noise in the measurement system.

Exhibit 20
Assumptions for the Four Scenarios

Assumptions	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1. ATSC standard by February 2009	Yes	Yes	No	No
2. # Competing systems	0	2	2	3
3. # Systems per station	1	1	1	1
4. # Systems per market	1	2	2	2-3
5. Clear technology winner/leader in IDOV	Yes	Yes	No	No
6. Receiver and transmitter manufacturers commit to system(s)	Yes	Yes	Yes	Yes
7. National footprint (at least one system) as a result of the adoption of several large groups	Yes	Yes	Yes	No
8. M/H capital investment required	~$100K	~$100K	~$100K	~$100K
9. RAND licensing available	Yes	Yes	Yes	Yes
10. Initial technical information required by CE manufacturers available by Summer 2008, with M/H standard released in early 2009	Yes	Yes	No	No
11. Critical audience mass achieved for advertising success due to many local broadcasters transmitting an M/H DTV service	Likely	Somewhat Unlikely	Unlikely	Very Unlikely
12. Advertising is the only material source of revenues for ATSC M/H. M/H viewing hours are additive to other hours and have same value to advertisers.	Yes	Yes	Yes	Yes
13. Cell handset and video player ("MP3" players) M/H device types	Yes	Yes	Yes	Yes
14. PC (M/H reception), Car/Vehicle video	No	No	No	No
15. Open cellular networks[276]	Yes	Yes	Yes	Yes

[276] See Chapter III, pp. 12-13, Chapter IV, pp.44-45, and Chapter V, pp. 81-83 for a discussion of the importance of open networks and recent developments advancing this concept.

C. Scenario 1: ATSC M/H DTV Standard – One System

Scenario Description:

One of the system proponents (or a subsequent consortia) responding to the ATSC RFP has been selected as the standard and that this system only launches in the M/H DTV market.

Scenario End State:

- Optimal outcome from broadcasters' perspective.
- Broad support and early entry among major broadcast groups.
- Broadcaster adoption is sufficient to provide a national footprint.
- Consumer uptake of handheld (cellular, portable players) and utilization of M/H content services is sufficient to attract initially national advertising dollars and eventually local advertising dollars.

D. Scenario 2: ATSC M/H DTV Standard – Two Competing Systems

Scenario Description:

We assume that two system proponents launch in the M/H DTV market and that one system was selected by the ATSC for the M/H standard.

Scenario End State:

- This scenario is a suboptimal outcome from broadcasters' perspective.
- Broadcasters will invest in one or the other *but not both systems* more out of a concern for bandwidth budget than the small amount of capital investment required. Each of the rival systems will achieve support from several key players but with delayed entry by broadcasters as they make their decision to commit to one system or the other. For broadcasters to back the non-ATSC system, they would have to see some technological or business merit they did not see in the ATSC backed system. These factors could range from required bandwidth commitment, device manufacturer commitments, content provider commitments, all the way to the quality of the consumer experience.
- Major broadcast groups providing a national footprint for at least one of the rival systems is achieved.
- Consumer uptake of handheld (cellular, portable players) and utilization of M/H content services may be sufficient to attract initially national advertising dollars and eventually local advertising dollars.
- Ad spend will be limited due to a failure to build critical audience mass on either system.

E. Scenario 3: No ATSC M/H DTV Standard – Two Competing Systems

Scenario Description:

We assume that two system proponents launch in the M/H DTV market and that neither system was selected by the ATSC for the M/H standard because the standard setting process was either prolonged or abandoned. This scenario is a highly suboptimal outcome from broadcasters' perspective.

Scenario End State:

- Very limited support from key players and delayed entry by broadcasters who will adopt a "wait and see" approach if either of the system proponents signals a willingness to either exit or combine their offer with the other proponent.
- The two competing systems may coexist in the same market or not but almost certainly will exist in adjacent markets and therefore negatively impacts mobile video users who may have functionality on some stations and in some markets but not others.
- Major market deployments will occur but probably not sufficient to reach a goal of serving a national footprint.
- Consumer uptake of handheld (cellular, portable video players) and utilization of M/H content services is not sufficient to attract initially national advertising dollars and eventually local advertising dollars.
- Ad spend will be limited due to a failure to build critical audience mass on either system.

F. Scenario 4: No ATSC M/H DTV Standard – Three Competing Systems

Scenario Description:

This scenario is the worst outcome from broadcasters' perspective and will stimulate very limited support from key players and delay entry as broadcasters "wait and see" if either of the other system proponents signals a willingness to either exit or combine their offer with the other proponent.

Scenario End State:

- Several broadcasters may eventually commit to one or another of the rival systems in several major markets. Broadcasters will invest in only one system more out a concern for bandwidth budget than the small amount of capital investment required.
- The three competing systems may coexist in the same market or not but almost certainly will exist in adjacent markets and therefore negatively impacting mobile video users who may have functionality on some stations and markets but not others.
- Consumer uptake of handheld (cellular, portable players) and utilization of

M/H content services is not sufficient to attract initially national advertising dollars and eventually local advertising dollars.

- Ad spend will be limited due to a failure to build critical audience mass on either system.

G. Financial and Business Implications of Potential Outcomes

For the period 2009-2012 we anticipate the three major revenue categories in the mobile/handheld space to be (1) traditional OTA advertising, (2) new forms of advertising (e.g., search, banner, location-based and video ads), and (3) subscription, and VOD sales or rentals. While broadcasters have each of these revenue models available to them, our interviewees certainly support the conclusion that the most desirable revenue model is advertising. This is especially true for broadcasters who do not have the infrastructure or core competence to support subscription or VOD business models. Broadcasters pursuing these types of revenues are more likely to partner with 3rd parties such as News Over Wireless[277] rather than stand up their own businesses.

In the largest sense, the M/H market includes all platforms such as 3G cellular, WiMAX, MediaFLO, satellite and M/H DTV. This also includes mobile access to Web sites, particularly those supporting the Wireless Access Protocol (WAP).[278] Broadcasters will participate in one or more of these market categories. For example, a television station might have a deal to sell M/H DTV advertising with Third Screen, plus a deal with News Over Wireless to sell subscriptions to access its video on demand news services or live streaming news as well as a deal with iTunes to sell downloads of network programming (and earns a revenue split with the network).

In our Chapter V Exhibit 14 ("Summary of Broadcaster Opportunities 2009-2011"), we suggested that (a) the most likely and highest revenue for M/H DTV business models will be advertising supported programming and (b) cellular phones and stand-alone video players will be the two kinds of M/H DTV capable deices that will drive the early market. Therefore, in our scenarios, we consider advertising revenue generated by M/H DTV viewing on two device categories – cellular phones and video players to drive our forecasts. For our scenarios, we make the assumption that cell networks will be "open" or have processes in place for 3rd party deices to be certified on these networks.

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277 News Over Wireless is a mobile solutions company that has partnered with over 80 TV stations to deliver text, graphic and video news formatted for mobile phones. See www.newsoverwireless.com.

278 The Wireless Access Protocol (WAP) is an unlicensed protocol for wireless communications available at no charge which supports access Web pages from a mobile telephone. WAP is a de-facto industry standard with broad support. WAP supports WCDMA, CDMA and GSM,. WAP devices can use the WML language (an XML application) which is designed for smaller screens with touch screen, pointer devices or other devices without a keyboard.

Scenario 1: ATSC Standard Selected by February 2009, No Competing Systems

In order to estimate these additional advertising revenues for our baseline case, Scenario 1 (ATSC standard adopted in February 2009 and no competing system) we rely on the estimates presented in Chapter V and discussed below on the number of different mobile receive devices in the hands of consumers by 2012. As stated, under that set of assumptions there will be approximately 130 million cellular handsets able to receive M/H DTV signals, and an additional 50 million MP3 players able to receive those signals as well. Of those 50 million MP3 players, we assume that only 50% will not also own one of the M/H DTV cellular handsets, thereby increasing the number of M/H DTV viewers by 25 million.

Given this base of mobile receivers, we also assume that the average user of these devices will, on average, view an additional one hour per week of over-the-air broadcasting using these devices. This additional viewing, assuming that it is measurable, will result in broadcasters able to generate supplementary advertising revenues. Using estimates of existing television advertising revenues along with estimates of average viewing, we arrive at an estimate of $2.0 billion in additional advertising revenues under Scenario 1 in 2012. This additional advertising will be distributed across the over-the-air networks, local television stations, and program syndicators.

It cannot be emphasized enough that in order to reach these revenues that Scenario 1 must be fully realized and other conditions must be met including:

1. System/technology choice agreed by mid-year 2008;
2. ATSC candidate standard by February 2009;
3. IP licensing worked out between system proponents and other interested parties;
4. M/H DTV audiences are reliably measured; and
5. A significant number of broadcasters are providing M/H DTV services by Christmas 2009.
6. CE and cellular service providers offer M/H DTV devices by holiday season 2009.
7. Existing broadcaster audiences and advertising revenues are not cannibalized.

To perform our financial impact analysis, our method is to use the following data and assumptions:

1. Determine the number of M/H DTV receiver devices in the two relevant categories of (a) cellular handsets and (b) portable M/H receivers (e.g., MP3/video players) that will be in the market by 2012. We make these assumptions:

a. 100 million or more cellular phones sold annually

b. Introduction of M/H DTV-capable handsets by Christmas 2009;

c. The embedded base of handsets turns over in its entirety every 2 to 2.5 years;

d. In 2010, the penetration percentage is 15% increasing to 25% in 2011 and 50% in 2012

e. This results in approximately by 2012 there will 130 million cellular handsets deployed in the U.S. market with the ability to receive M/H DTV signals.

f. As previously estimated (Chapter V), we expect 50 million MP3 players to be M/H DTV receivable. While there is overlap between owners of cellular handsets and portable M/H receivers, we estimate there will be at least 25 million unique MP3 type players in the market by 2012 adding M/H DTV receive capability to viewers who would not otherwise have it in (i.e., they do not have M/H capable cellular phones).

2. The average use of the M/H receivers, whether cellular handset of MP3 style, will amount to an incremental one hour of additional viewing per week per user.[279]

3. This additional viewing hour per device per user is measurable by Nielsen and accepted by advertisers to have the same value as traditional OTA viewing hours.

4. In order to estimate the value of these additional OTA viewing hours, we calculated the average value of the present total viewing audience. The average viewer, aged 2 and older, watches, 4.23 hours per day – 1,545 hours per year.[280] Given the 2+ population of nearly 290 million people,[281] this result in total people hours of viewing of over 446 billion. Assuming 50% of that viewing is to OTA broadcasting, over 223 billion people hours are to local television stations.

5. We estimate that total OTA television advertising revenues (networks, local stations, syndication) will increase by 15.3% over

[279] The assumption is that viewing would not "cannibalize" OTA viewing. George Kliakoff, Chief Digital Officer at NBC-U observed that, "digital is addictive and drives viewership" and that while NBC was concerned that putting primetime shows online would cannibalize viewing, in fact, overall viewing actually increased. Comments made at "Economics of the New Television Marketplace," Jack Meyers Breakfast, November 27, 2007.

[280] Nielsen Media Research.

[281] *American Demographic:2007*, Trade Dimensions International, p. 6-113

the time period 2008-2012, resulting in total advertising revenues of over $54 billion.[282]

6. Dividing the total advertising revenues by the total viewing hours for OTA broadcasting, we arrive at an average value of revenue per hour viewed of $0.24.

7. We then multiply that average value of revenue per hour viewed by the total number of hours viewed to estimate the total potential M/H DTV advertising revenue opportunity.

   a. 130 million cellular handset users + 25 million MP3 users = *155 million M/H DTV users*.

   b. 175 million users * 1 viewing hour/week * 52weeks/year = 9.12 *billion additional viewing hours*.

   c. 9.1 billion additional viewing hours * $0.24 (average value of revenue per hour viewed) = $1.956 billion of additional advertising dollars due to total M/H DTV.[283]

Scenario 2: ATSC Standard Selected, One Competing System

The impacts on these advertising revenues under the other scenarios are varied in magnitude. Scenario 2, an ATSC standard is realized but two systems compete in the marketplace, will result in lower advertising revenues. The presence of the two competing systems will result in increased uncertainty, both on the part of broadcasters, and more importantly, on the part of consumer electronics manufacturers. We believe this uncertainty will push back the successful introduction of M/H DTV receivers (cellular phones and MP3 players for the most part) by about eighteen months. This seems to be what we are experiencing with the HD DVD and Blu-ray format war, though the end of the story is still being written

In the Beta-VHs format war we saw the market suppressed for as long as 60 months. Based on our interviews, we heard that the format wars between Blu-ray and HD DTV is also slowing down consumer acceptance and commitment by content owners. As noted above, for our purposes, we make an assumption of at least an 18 month delay. The IP licensing negotiations will be much more involved and take longer. Additionally, the development of multi-system receivers will also take longer and be somewhat more expensive, leading to a slower adoption. Finally, the introduction of M/H DTV services by television broadcasters will also be impeded, as these broadcasters must make an additional decision. As a result, the success of these services by 2012 will be impeded and

[282] These estimates used 2007 national revenue estimates from Bob Coen, McAnn Erickson, and applied annual growth estimates from BIA Financial Network.

[283] This amount is substantially higher than the estimated total mobile advertising revenues as shown in Exhibit 13, which did *not* include OTA M/H DTV services and the estimated 175 million M/H DTV receivers in use in 2012.

the estimated number of these receivers will be one-half the amount under Scenario 1, leading to only $1.0 billion in additional advertising revenues in 2012.

Scenario 3: No ATSC Standard, Two Competing Systems

In Scenario 3, there is no ATSC standard and two competing systems. We see the resulting benefits to the television industry as somewhere in between Scenarios 2 and 4. Additional uncertainty (as compared to Scenario 1) will be present slowing down the adoption by broadcasters and other interested parties. Yet, we believe that early on, one of the systems will have a slight edge in the number of broadcasters adopting its system. Consumer electronics companies will wait to see that system emerge. The delay in adopting M/H DTV devices should be somewhere between 24 and 30 months from Scenario 1. This delay will lead to advertising revenues in 2012 from M/H DTV services ranging from $400 to $900 million.

Scenario 4: No ATSC Standard, Three Competing Systems

In Scenario 4, where there is no ATSC standard and there are three competing systems, this is not a very desirable outcome. Also, it is not likely to be a very stable outcome. As we have seen in the cases of AM stereo, home video and next generation video players, large numbers of competing systems in the market do not last long. Soon we get down to two and finally the market winner. In the interim, the market is chaotic. We heard this again in our interviews. Recall that in our Chapter IV discussion that an EU staff paper found that a fragmented European market for mobile television would be, "…likely to result in loss of economies of scale, slower service take-up, and more expensive equipment," all of which in combination would have adverse economic effects.[284]

Uncertainty in selecting the appropriate system by both broadcasters and receiver manufacturers will be rampant. While one of the systems may end up becoming a market leader, possibly in terms of the percentage of broadcasters adopting its system, that will take some time. Consumer electronics manufacturers will wait to see if there is any trend in that adoption while also developing receivers that are capable of receiving each of the three systems. Of course, that development, along with the IP negotiations with each of the system proponents, will take a considerable amount of time. Additionally, these multi-system receivers will be more costly. As a result, the adoption of M/H DTV receivers will be noticeably slower, with our estimate being 10% of the total under Scenario 1. Consequently, additional advertising revenues from M/H DTV service by 2012 will only be slightly more than $200 million in that year.

[284] EU Report, p. 4.

Financial Impact Analyses

Advertising Revenue Impact

For purposes of our financial impact analyses, we considered the impact of our four scenarios on local broadcast stations' ability to generate additional advertising revenues from their M/H DTV broadcasts. Assuming that local OTA stations receive nearly 60% of the total television industry advertising revenues in 2012, we can estimate the amount of M/H DTV advertising revenues they will receive in that year.[285] We summarize these financial impact analyses in Exhibit 21.

Exhibit 21
Financial Impact on Broadcasters of Scenarios 1-4

Scenario	Local Station Share of M/H DTV Advertising Revenue ($ Billions)
1	$1.1
2	$0.6
3	$0.2 to $0.4
4	$0.1

Station Valuation Impact

Since the only additional costs associated with these M/H DTV revenues are rep and agency commissions and sales staff commission costs, most of these revenues will fall to the bottom line. Assuming an average total commission rate of 25%, this will result in total station cash flows increases of between $83 to $825 million. While it is difficult to project cash flow multiples four years into the future, assuming a range from 9 to 11 times,[286] these additional M/H DTV revenues could result in the total valuation of OTA stations increasing by $750 million (Scenario 4) to $9.1 billion (Scenario 1).

The estimates listed above are based upon the model described above. That model includes significant assumptions (as detailed in previous chapters and in each of the scenarios) on the timing and extent of adoption of M/H DTV receivers and provision of such services by OTA broadcasters. Any deviation from these assumptions will have profound impacts on the final results. Therefore, care should be taken when using these estimates.

[285] Based upon BIAfn's estimates of advertising growth from 2007 through 2012 for the three components of television advertising – network, syndication, and local television station advertising.

[286] Based upon prevailing multiples across the entire local television station marketplace, and expectations of how these multiples may change into the future.

VII. APPENDICES:

A. List of Parties Interviewed

B. Bibliography

C. Authors' Biographies

D. Glossary

APPENDIX I: List of Parties Interviewed

PARTIES INTERVIEWED

Representatives from the companies listed below were interviewed as part of the research process for this report. The interviews were confidential.

A. Advanced Television Systems Committee (ATSC)
Mark Richer

B. Alltel Wireless
Philip Junker

C. Association of Public Television Stations (APTS)
John Lawson*

D. Consumer Electronics Association
Brian Markwalter

E. Cox Broadcasting
Sterling Davis

F. Ford Motor Company
Francis O'Hearn

G. General Motors
Timothy Talty

H. Harris Broadcasting
Jay Adrick

I. Ion Media Networks
Brandon Burgess*

J. LG Electronics
John Taylor

K. McKinsey & Company
John Wilkins

L. Media General
Jim Conschafter*

M. Micronas
Scott LoPresto

* OMVC Executive Committee member.

N. Nielsen Media Research
Scott Brown

O. NBC
John Eck*
Glenn Reitmeier

P. Nokia
Thomas Derryberry
Tony Pila

Q. Panasonic
Peter Fannon

R. Pioneer North America
Adam Goldberg

S. Post-Newsweek
Alan Frank*

T. Qualcomm
Brent Nelson

U. Samsung
John Godfrey

V. Sharp Labs of America
Craig Tanner

W. Sinclair Broadcasting
Nat Ostroff

X. Zenith
Wayne Luplow

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APPENDIX III: Authors’ Biographies

AUTHORS' BIOGRAPHIES

Richard V. Ducey, Ph.D., Chief Strategy Officer, BIA Financial Network

Rick Ducey is Chief Strategic Officer of BIA Financial Network (BIAfn) where he leads BIAfn's Strategic Advisory Group. BIAfn's Strategic Advisory Group specializes in assisting media, telecom, technology and publishing clients design and evolve their digital strategies, develop business and operational plans and perform market assessments. In addition to working with clients, Rick advises BIAfn's business units. Rick co-founded SpectraRep, Inc., now held by BIAfn. He is a co-inventor of a patent pending network-based public alerting system which is sold by SpectraRep.

Prior to joining BIAfn, Ducey was a top executive at the National Association of Broadcasters. As Senior Vice President of NAB's Research & Information Group, he was in charge of new technology assessment, strategic planning, and information systems. He served on the graduate and undergraduate faculties of George Mason University, George Washington University, University of Maryland and Michigan State University teaching and conducting research in new media technologies, strategic marketing, research methodology and statistics. He published a number of research articles and papers in these areas and serves on editorial boards of leading scholarly journals in the communications field. He worked at radio stations WSOQ-AM/WEZG-FM and Upstate Cablevision in North Syracuse, NY. Ducey received his Ph.D. from Michigan State University, M.S. from Syracuse University and B.A. from the University of Massachusetts at Amherst.

Mark R. Fratrik, Ph.D., Vice President, BIA Financial Network

Mark R. Fratrik, Ph.D. is a Vice President of BIA Financial Network. In that role, he supervises the maintaining of the many BIAfn databases and conducts primary research on various trends as they affect the broadcasting and related communications industries. He is also involved in conducting research and analysis for clients on matters related to the broadcasting and related communications industries.

Prior to joining BIAfn, Mark was with the National Association of Broadcasters (NAB) for nearly 16 years as Vice President/Economist. While there, he conducted primary research and wrote several books about the broadcasting and related industries. Before joining NAB in 1985, Mark worked for the Federal Trade Commission in the Bureau of Economics where he spent five years conducting analyses of industry practices to evaluate overall economic impact.

Throughout his career, Mark has researched and spoken at numerous conferences on the impact of the economy on the broadcasting industries, proposed and enacted regulatory changes, and new media technologies, including DTV datacasting. Mark is often quoted in the media and is a leading spokesperson concerning trends and forecasts for the media industry including analyzing competitiveness of media and related industries. He is the author of BIAfn's acclaimed **State of the Radio and TV.**

Mark received his B.A. in mathematics and economics from State University of New York at Binghamton and his master's and doctoral degrees in economics from Texas A&M in College Station, Texas. He currently serves as an adjunct professor of economics at John Hopkins University.

Joseph S. Kraemer, Ph. D., Director, Law and Economics Consulting Group (LECG)

Dr. Kraemer is a Director at the Law and Economics Consulting Group (LECG), a consulting firm with expertise in the business and financial issues that affect industries undergoing structural change. For over 25 years, he has worked with, and served as counselor to, senior management at communications, media, and high-tech companies in Asia, Europe, and the Americas. He teaches business strategy and marketing courses at both the Georgetown University McDonough School of Business and the Kogod Business School at American University. The Progress & Freedom Foundation (Washington, D.C.) has designated him an Adjunct Fellow, and Dr. Kraemer was designated a "Digital Television Pioneer" by the Consumer Electronics Association (CEA).

Dr. Kraemer has been consulting on digital television issues since 1996. He co-authored *Digital Television in a Digital Economy: Opportunities for Broadcasters*. He also testified before the Senate Commerce, Science, and Transportation Committee on ways of expediting the broadcast digital transition and analyzed the economic implications for the broadcast industry of the choice between the COFDM and the 8VSB modulation standards. Recent publications and presentations include: *An Assessment of the Present and Future State of the Broadcast Television Industry*; *Trends in Competitiveness of Telecommunications Markets* (with Richard O. Levine and Randolph J. May); *Summary of Strategic Trends in the U.S. Telecommunications Industry*; *Telephony, Television, and the Internet*; and *Digital Television in the United States: Long Fuse and Big Bang*.

APPENDIX IV: Glossary

GLOSSARY

3G: The third generation wireless service promises to provide high data speeds, always-on data access and greater voice capacity. The high data speeds enable full motion video, high-speed Internet access and video-conferencing, and are measured in Mbps. 3G technology standards include UMTS, based on WCDMA technology (quite often the two terms are used interchangeably), and CDMA2000, which is the evolution of the earlier CDMA 2G technology. UMTS standard is generally preferred by countries that use GSM network.

EV-DO: Evolution data optimized is an evolution of the CDMA2000 (3G) standards and provides for high-speed data applications.

ARPU: Average revenue per user.

ATSC: The Advanced Television Systems Committee is a digital television standard used in North America, Korea, and some other countries. It uses 6-MHz channels previously used for NTSC analog TV to carry a number of digital TV channels. It is based on the use of MPEG-2 compression and transport stream, Dolby digital audio, and 8-VSB modulation.

CDMA (Code Division Multiple Access): A technology used to transmit wireless calls by assigning them codes. Calls are spread out over the widest range of available channels. Then codes allow many calls to travel on the same frequency and also guide those calls to the correct receiving phone.

CDMA2000: Code division multiple access is a 3G evolution of the 2G cdmaOne networks under the IMT2000 framework. It consists of different air interfaces such CDMA20001X (representing use of one 1.25-MHz carrier) and CDMA 2000 3X, etc.

Cell: The basic geographic unit of wireless coverage. Also, shorthand for generic industry term "cellular." A region is divided into smaller "cells," each equipped with a low-powered radio transmitter/receiver. The radio frequencies assigned to one cell can be limited to the boundaries of that cell. As a wireless call moves from one cell to another, a computer at the Mobile Telephone Switching Office (MTSO) monitors the call and at the proper time, transfers the phone call to the new cell and new radio frequency. The handoff is performed so quickly that it's not noticeable to the callers.

COFDM: Coded OFDM employs channel coding and interleaving in addition to the OFDM modulation to obtain higher resistance against multipath fading or interference (see OFDM). Channel coding involves forward error correction and interleaving involves the modulation of adjacent carriers by noncontiguous parts of the signal to overcome bursty errors.

DAB: Digital audio broadcasting is an international standard for audio broadcasting in digital format. It has been standardized under ETSI EN 300 401 (also known as Eureka 147 based on the name of the project). DAB uses a multiplex structure for transmitting a

range of data and audio services at fixed or variable rates.

DMB: Digital multimedia broadcasting is an ETSI standard for broadcasting of multimedia using either satellites or terrestrial transmission. DMB is a modification of the digital audio broadcasting standards. The DMB services were first launched in Korea.

Dual Band: A wireless handset that works on more than one spectrum frequency (e.g., in the 800 MHz frequency and 1900 MHz frequency bands.

DVB-H: Digital video broadcasting-handhelds is a DVB standard for mobile TV and multimedia broadcasting. DVB-H is a modification of digital terrestrial standards by adding features for power saving and additional error resilience for mobiles. The DVB-H systems can use the same infrastructure as digital terrestrial TV under DVB-T. DVB-H services have been launched in Italy, Germany, and other countries.

ETSI: European Telecommunications Standards Institute.

GPS (Global Positioning System): A worldwide satellite navigational system, made up of 24 satellites orbiting the earth and their receivers on the earth's surface. The GPS satellites continuously transmit digital radio signals, with information used in location tracking, navigation and other location or mapping technologies.

GSM: Group Special Mobile, which established recommendations for a global system of mobile communications, adapted initially in Europe and worldwide shortly thereafter.

HSDPA: High-speed downlink packet access is an evolution of 3G-UMTS technologies for higher data speeds. HSDPA can provide speeds of up to 7.2 Mbps at the current stage of evolution.

IMT2000: The ITU's framework for 3G services. It covers both CDMA-evolved services (CDMA2000) and 3G-GSM-evolved services (3G-UMTS). Different air interfaces such as WCDMA, TD-CDMA, IMT-MC (CDMA2000), DECT, and EDGE form a part of the IMT2000 framework.

Interactive TV: Interactive TV (iTV) refers to TV programming and technology that allows the viewer to engage in two-way interaction with the television/programming. It represents a continuum from low interactivity (TV on/off, volume, changing channels) to moderate interactivity (simple movies on-demand requests) and high interactivity in which, for example, an audience member affects an outcome of the watched program (e.g., by voting), or enters into a purchase transaction (T-commerce).

Interoperability: The ability of a network to coordinate and communicate with other networks, such as two systems based on different protocols or technologies.

ISDB: Integrated services digital broadcasting is the digital TV standard adopted by Japan. It features the broadcasting of audio as well as digital TV and data. The standard features multiple channels of transmitted data occupying 1 or more of the 13 segments available

in the OFDM spectrum.

Location Based Service (LBS): A range of services that are provided to mobile subscribers based on the geographical location of their handsets within their cellular network. Handsets have to be equipped with a position-location technology (such as GPS) to enable the geographical-trigger of service(s) being provided. LBS include driving directions, information about certain resources or destinations within current vicinity, such as restaurants, ATMs, shopping, movie theaters. LBS may also be used to track the movements and locations of people, as is being done via parent/child monitoring services and mobile devices that target the family market.

MediaFLO: A multimedia broadcasting technology from Qualcomm. It is based on a CDMA modulated carrier for broadcast or multicast of multimedia including mobile TV. It is designed to use spectrum outside the cellular allocations for easy implementation in different countries. In the United States 700 MHz is planned as the frequency of introduction. MediaFLO is a competitor to other broadcast technologies such as DVB-H or DMB.

MMDS: Multichannel multipoint distribution service is a technology for delivery of TV signals using microwave frequencies (2- to 3-GHz band). MMDSs are point-to-multipoint systems and are an alternative to cable TV to deliver channels to homes. Digital TV systems such as ATSC or DVB-T are now considered better alternatives for such delivery.

Mobile Advertising: A form of advertising that is communicated to the consumer/target via a handset. This type of advertising is most commonly seen as a Mobile Web Banner (top of page), Mobile Web Poster (bottom of page banner), and full screen interstitial, which appears while a requested mobile web page is "loading." Other forms of this type of advertising are SMS and MMS ads.

Mobile Marketing: The use of wireless media as an integrated content delivery and direct response vehicle within a cross-media or stand-alone marketing communications program.

Mobile TV: Television/video programming formatted for the mobile screen. Program is streamed or broadcast via various platforms – MediaFLO, DVB-H, etc.

Mobile WiMAX: A mobile version of WiMAX has been defined under the IEEE 802.16e recommendations (see WiMAX). Mobile WiMAX uses scalable OFDM modulation for providing better protection against multipath effects. Mobile WiMAX can be used for mobile broadband Internet in a mobile environment.

Network Operator: A company that provides wireless telecommunications services (e.g., a cellular telephone company such as Verizon Wireless).

NTSC: The National Television Standards Committee stands for the analog TV transmission standard used in North America, Japan, Korea, Taiwan, etc.

OFDM: Orthogonal frequency division multiplexing is a multipath resistant modulation technique used in digital television transmissions (using ATSC standard) and other applications. It is based on a large number of carriers (up to 2K) being modulated independently by a stream of data. The signal is thus split into a number of streams, each with a low bit rate. The frequencies selected are such that each modulated stream is "orthogonal" to the others and can be received without interference.

POPs: For wireless, POPs generally refers to the number of people in a specific area where wireless services are available (the population).

Repeater: Devices that receive a radio signal, amplify it and re-transmit it in a new direction. Used in wireless networks to extend the range of base station signals and to expand coverage. Repeaters are typically used in buildings, tunnels or difficult terrain.

S-DMB: Satellite-based digital multimedia broadcasting, a mobile TV broadcasting system standardized by ETSI under ETSI TS 102-428. It is used in Korea and planned for use in Europe. DMB is a modification of the digital audio broadcasting standards to carry multimedia signals.

Short Message Service (SMS): A standard for telephony messaging systems that allow sending messages between mobile devices that consist of short messages, normally with text only content.

Spectrum Allocation: Process whereby the federal government designates frequencies for specific uses, such as personal communications services and public safety. Allocation is typically accomplished through lengthy FCC proceedings, which attempt to adapt allocations to accommodate changes in spectrum demand and usage.

T-DMB: Terrestrial digital multimedia broadcasting, a mobile TV broadcasting system standardized by ETSI under ETSI TS 102-427. It is used in Korea and Europe. DMB is a modification of the digital audio broadcasting standards to carry multimedia signals.

UMTS: Universal Mobile Telecommunications System (WCDMA).

V CAST: A video clip streaming service from Verizon Wireless, USA.

VoIP: Voice over Internet protocol, used for making voice calls using the Internet as the underlying media rather than conventional circuit-switched networks.

WiMAX: Worldwide interoperability for microwave access is an IEEE 802.16 family of standards for providing broadband wireless access over large areas with standard cards for reception. The bit rates achievable depend on the spectrum allocated and can be typically over 40 Mbps in a given area. Fixed WiMAX is provided as per IEEE 802.16d standards. Spectrum for WiMAX is usually provided in the 2-11 GHz range.