Business and Information Technologies

Technology Induced Change in Film/Television Distribution

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1 Introduction

This research paper is an overview of technology-induced change in film/television distribution. Specifically, this analysis has to do with “end-chain” distribution technologies that are most tangible to consumers. There are two key perspectives that have been taken. They are as follows:

1. The primary technologies examined are those that involve the delivery of motion pictures and related content to consumers across the film/television distribution chain; and
2. The research focus is on determining whether the adoption of emerging technologies will be significantly disruptive to induce change, and if so, what changes can be predicted to occur.

The entertainment industry is a diverse and large landscape that encompasses many products and services. Although entertainment includes areas such as music, video games, and radio, this research is focused on the distribution of motion pictures and related content *as a starting point* because Hollywood “Studio” releases touch across a broad chain of incumbent and emerging industry participants. It provides us with a framework in which the emerging digital distribution methods can be analyzed by their value to consumers at different stages of consumption. The film/television industry is anchored by a small group of companies that are the gatekeepers to consumer demand. This research hopes to clarify how technology will change that relationship between content providers, industry carriers and consumers.

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3 Scope of Analysis

The scope of this research project is to identify whether key emerging distribution technologies are disruptive enough to induce change. The core technologies that are the catalysts to change-compression, processing power, bandwidth, mobility and storage, have been packaged to deliver new products and services. Their influence is seen in the following emerging technologies:

1. Digital Cinema;
2. Video on Demand (VOD);
3. Personal Video Recorders (PVR);

4. High Definition Television (HDTV); and
5. Video over wireless devices (VOWD).

Quite simply, the research can be seen as a view of how entertainment distribution has evolved from the largest form factor (theatres) to the smallest (wireless devices).

This paper is organized as follows:

1. Background of the film/television industry including key industry dynamics and current value chain structure;
2. Explanation of the core technologies that are the catalysts for change;
3. Analysis of Digital Cinema and high definition (HD) infrastructure in the Exhibitor/Studio value chain;
4. Role of VOD in the industry rivalry between cable and satellite providers;
5. The impending rise of HDTV;
6. Feasibility of VOWD to bring content to the newest and smallest form factor; and
7. Summary and conclusion of key research findings on the impact of technology induced change on the industry value chain.

4 Research Methodology

The methodology followed in this study was:

- Identify major issues - Collaboratively developed by advisor and team. Secondary research and initial interviews with industry participants will be used to determine what technology drivers are most significant to disruptive change in film/television distribution. From these technology drivers, the specific products and services that will serve as the basis for research were derived.
- Form hypotheses around major issues - Collaboratively developed by advisor and team. Once the specific products and services were identified as the scope of this study, major hypotheses were formulated. The goal of the project was to support or refute these hypotheses through primary research.
- Test hypotheses – Performed through primary and secondary research. Primary research was performed through in-depth interviews with industry participants using customized questionnaires developed by the Team.

5 Motion Picture Industry

5.1 Industry Structure

In 2002, the U.S. motion picture industry box office grossed more than \$9.5 billion. The Top 20 films comprised 40% of U.S. box office gross with 78% of total revenues generated by the six dominant “Studios”: Warner, Disney, Sony, 20th Century Fox, Universal, and Paramount. Although annual market shares tend to fluctuate, the aggregate picture remains roughly the same with these six firms as the industry leaders. The motion picture industry is an oligopoly where the six major Studios and two smaller (but still significant) players account for almost 90% of the total market share in 2002.

Studios produce, finance or acquire the rights to motion pictures. It is important to understand that “Studios” are the licensors of original content and act as the gatekeepers of content throughout the industry chain. More importantly, the entertainment industry has strong vertical integration across media outlets to ensure that content can be distributed across the chain. For example, Viacom, the parent company of Paramount, owns the CBS network and pay/non-pay cable channels; Disney owns the ABC network and cable channels; Time Warner owns the WB network and a pay cable channel, News Corporation, the parent company of 20th Century Fox Film, owns the FOX network, and Vivendi, the parent company of Universal Pictures, owns a pay cable channel.

The dominance of a small set of firms reflects the strong barriers to entry for new entertainment distribution companies to emerge. On average, 60-70% of major theatrical film releases are unprofitable in theatres. The high economic uncertainties in this business and the enormous costs to market and distribute content make it difficult for any new entrants.

The basic Studio business model can be divided into two stages; production, and window release. These are discussed further in the next sub-section.

5.2 Production

Production costs are incurred in three stages; pre-production, principal photography, and post-production. Economies of scale are hard to obtain because production procedures vary significantly for each film. Production costs have increased continuously over the past 20 years even though technology advances have created many production efficiencies.

Sharp increases in production and marketing costs have all but eliminated profit margins to studios from theatrical releases. However, this profit erosion is balanced by the Studios’ ability to re-release content on multiple distribution formats embodied in the ‘window’ release distribution structure.

5.3 Window Release Distribution

Once a film completes production, Studios develop a market strategy that covers the window release schedule. Every aspect of release is developed and formalized prior to the theatrical first-run and includes the following:

- Determination of the total number of film prints to be produced and which Exhibitors will receive them;
- Schedule for DVD/VHS replication and release; and
- Licensing for pay and non-pay television broadcasts.

The sequential release schedule is chosen based on marginal-revenue contributions that maximize total revenues. The order is as follows:

1. Theatre release;
2. Home video and video rentals;
3. Current VOD;
4. Network television (includes cable, satellite and terrestrial delivery); and
5. Local channel syndication.

Roughly speaking, home video, video rental and current VOD begins 3 months after theatre exhibition. Network television generally premieres 9-12 months after theatre exhibition, and local channel syndication receives content two or more years after theatre exhibition. A brief summary of each release method follows. Detailed descriptions of these distribution channels are discussed further in the following sub-sections.

5.3.1 Theatrical Exhibition

As new technology in production and distribution evolves, new windows for film release have been created and films are moving faster from one window to the next, thus threatening traditional theatrical exhibitors (Exhibitors). The proportion of total revenues from theatrical release has been getting smaller. The top five exhibitor firms account for 45% of the screens in the United States. These operators are Regal Cinemas, AMC theaters, Loews Cineplex, Cinemark theaters, and Carmike Cinemas.

5.3.2 Home Video Distribution

The U.S. box office, especially the first weekend, is a critical indicator of the overall demand that Studios can expect from each major release. First weekend revenues not only represent the first line of revenues, but they also dictate revenue expectations for second and ancillary markets. Since the widespread adoption of VCRs, Studios have generated most of their revenues from the home video market. However beginning in the

late 1990's, DVD sales and rentals have taken off. In 2002, DVD unit rentals and sell-through revenues exceeded that of VHS for the first time (\$11.6 billion versus \$8.7 billion, respectively). The home video industry has become a critical cash sources for Studios to recover their production costs. Consequently, this "cash cow" discourages Studios from creating (or experimenting) with products and services that may disrupt this business model.

5.3.3 Cable/ Satellite Distribution

The "third leg" of content distribution comes from the monthly pay-TV content providers-cable and satellite. The majority of U.S. households subscribe to either of these services. The cable industry earns roughly 80% of revenue from subscription and 20% from advertising. To meet the quality needs of paying subscribers, it is critical that these subscription providers offer quality content whether that may be motion pictures, sports or specialty content. Given the prolific demand for pay TV programming and broadband Internet, satellite and cable providers have made huge investment in network infrastructure and product offerings to attract and keep customers. Satellite services have been an important entrant into this market space and have been the catalyst for significant competition between cable and satellite products and services. The top seven operators are shown in the table below with their respective market share in revenues and subscribers.

Table 1: 2002 Cable/Satellite Shares

	Revenue (\$ in million)	Market share (% of revenue)	Market share (% of subscribers)
DirecTV	9,176	14.41%	12.5%
Echostar	4,821	7.57%	9.1%
Sum of Satellite	13,997	21.98%	21.60%
Comcast	21,112	33.16%	24.3%
Warner Cable	9,244	14.52%	10.3%
Cox	5,039	7.91%	7.0%
Charter	4,566	7.17%	7.5%
Cablevision	4,003	6.29%	3.3%
Sum of Cable	43,964	69.05%	52.40%
Sum of top 7 operators	57,961	91.03%	74.00%
Others	19,707	30.95%	47.6%
Total market	63,671	100.00%	100.0%

Source: Morgan Stanley, Cable and Satellite

5.3.4 Terrestrial Broadcast Distribution

Five national broadcast networks (CBS, UPN, ABC, FOX, and WB) out of six are owned by the parent companies of Studios. Furthermore, there has been tremendous

consolidation among major networks, studios, and cable companies. These transactions have cemented the Studios' strategy to ensure that they possess total control of the different distribution channels to customers. Given the rising costs to develop content, Studios have generally taken the position that maintaining strong channel ownership is the best method to reach consumers.

6 The Value Chain

Figure 1 (below) illustrates how content goes from production to the end consumer.

The financial success of the U.S. film/television industry is rooted in Hollywood's ability to adapt products and services to technological change, such as the emergence of television or the VCR. What is ironic about this adaptability has been the fact that the industry has traditionally fought technological innovation. The legality of recordable VCR's was originally challenged in court. The transition to color television was only possible due to a common ownership of NBC and RCA electronics (the primary inventor of color TV). In the past few years, another disruptive time period has come about with the advent of 5 key technologies. These technologies form the backbone of potential industry change that should ultimately benefit the end consumer.

7 Technology Drivers in Changing the Consumer Entertainment Experience

Technology advances change both business practices and consumer lives dramatically. In video-based entertainment distribution, technology not only provides more alternatives as to how content is processed, received and consumed, but it also drastically reduces the delivery costs to consumers. As a result, consumers enjoy more freedom as to when, where and how premium video content is enjoyed. However, technology creates new threats and opportunities for incumbent firms in the industry. Incumbents must compete more vigorously to: (i) deliver higher quality products and services; and (ii) continuously build core competitive advantages with technological innovation.

In this section, a brief look at those fundamental technological drivers is provided to build a link to the core technology topics examined in this research. They are bandwidth, mobility, compression, processing power and storage.

7.1 Bandwidth – Faster Delivery and More Choices

The Internet boom has made the availability of mass broadband a reality whether as DSL, cable modems or Wi-Fi networks. With higher bandwidth, video on-demand can be delivered through current Telco¹ networks. Cable operators have also upgraded their cable systems to provide unprecedented high speed, two-way, data streams. Consumers have benefited from this oversupply of bandwidth that has not only caused price drops but has also given them more freedom in choosing how content may be consumed.

7.2 Mobility – Wireless broadband

Wireless broadband is an emerging reality. Although 3G services have not met with success in either Asia or Europe, the U.S. market we will soon have 100 Kbps to 300 Kbps data access rates on portable devices. Besides 3G, there are other wireless connection alternatives that also deliver new capacity to wireless devices. These alternatives include IrDA, Wi-Fi, and UWB.

The emergence of wireless broadband creates the opportunity for new channels of entertainment distribution and further frees consumers from location constraints. It will lead to new content providers that will better utilize the mobility created by wireless channels.

7.3 Video Compression

The advancement of compression technology has greatly facilitated the dissemination of video content on multiple devices. Compression technology uses various bit rates to deliver content of all kinds on different screens and frame rates. It allows image quality to be delivered at levels not possible with analog technology and gives content providers

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¹ Defined as a telecommunication service provider, such as the “Baby Bells”.

a method to “centrally source” content that can be transformed to different entertainment platforms.

Coupled with broadband technology, compression permits a new level of on-demand video-watching experience.

7.4 Processing Power

In 1965, Gordon Moore observed that the logic density of silicon integrated circuits closely followed the curve (bits per square inch) = $2^{(t - 1962)}$. From late 1970s, the doubling period slowed to 18 months. This phenomenon is commonly known as "Moore's Law". The exponential growth of IC density described by Moore's Law has given more and more processing power to all kinds of devices both large and small. Processing power forms the basis of digital creation, processing, transportation and display of video content.

7.5 Storage

Since the hard disk drive was invented in 1952, technological advancement has led to astonishing improvements in storage capacity, speed, reliability and price/performance ratios. In the 1990s, the storage density of magnetic disks increased 75% per year, outpacing even Moore's Law. The result has been significant price reductions so that from 1992 to 2002, the cost of storage per Gigabyte fell by a factor of 400².

Similar to the trends in processing power, increasing density in storage media at lower costs has enabled affordable local storage on all kinds of devices. This facilitates the storage and dissemination of video on distribution devices far beyond what anyone might have imagined many decades ago.

7.6 Applying Technology Drivers to Consumer Benefits

The advances in key technologies have lead to a birth of innovative products and services that may fundamentally change how consumers source and view film/television content. From the industry value chain, one can map the “consumer experience” by mobility and quality. This framework can serve as the research roadmap to identify the end products and services that may induce industry change. This framework is shown below in

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² Based on data by Berghell Associates, Newport Beach, CA

Figure 2: Evolution Plot of Commercial Video with the commensurate “technology disruptors” that have been identified in this research study.

Figure 2: Evolution Plot of Commercial Video

For the purpose of our study, we divide the consumer experience of watching commercial video programs into three “experience” categories: theatrical, home entertainment, and mobile. The above figure shows the trends in the industry and the disruptive technologies that we have identified. We believe these specific technology advancements push the frontier of consumer experience forward in terms of both quality and freedom (time and place film/TV are watched).

Without a doubt, the technology disruptors are all derived from the root technology innovations described earlier. The chart below maps this relationship.

Table 2: Breakdown of Technology Disruptors

	<u>Theatrical Experience</u>	<u>Home Entertainment Experience</u>		<u>Mobile Experience</u>
	Digital Cinema	VOD	PVR	Video on wireless
<i>Bandwidth</i>	◐	●	○	●
<i>Mobility</i>	○	○	○	●
<i>Video compression</i>	●	●	●	●
<i>Processing power</i>	●	◐	◐	◐
<i>Storage</i>	●	◐	●	◐

Note: ● very relevant | ◐ relevant | ○ irrelevant

What follows are detailed analyses of the disruptive technologies and their impact on the value chain.

8 The Emergence of Digital Cinema in Theatre Exhibition

As discussed earlier, Exhibition is the first stage of release for a major motion picture. Therefore, it is a natural starting point to examine how digital technologies have been (or will be) a driving force in changing this distribution channel. At the heart of Exhibition is the 35mm film format to master, distribute and view movies. 35mm

film is an incumbent technology that is not only a global standard, but it is also the preferred recording format for other entertainment content (e.g., television shows, documentaries, etc.). Although the entertainment industry has found ways to capture, edit and enhance 35mm film with digital tools, there are inherent limitations to this medium. Digital technology has finally reached the stage where the entertainment industry now has a preview of the future platform for Exhibition. That platform is loosely known as “Digital Cinema”.

Described in more detail throughout this section, Digital Cinema encompasses the move to delivering Exhibition content in full digital format without the use of film reels. Digital Cinema can be summarized as a technological solution that allows Exhibitors to receive content as a compressed and encrypted digital file, decode it via a hardware system and project it on to a screen. Although many motion pictures will continue to be shot in film for the foreseeable future, Digital Cinema will allow studios to distribute movies under a whole new film-free architecture. More importantly, Digital Cinema has the potential to change the Exhibition business model by providing readily available access to “alternative content”. This latter possibility is closely tied to the industry shift to new high-definition (HD) video formats that provide the level of quality necessary for the “big screen”. In short, Digital Cinema is a distribution technology that is highly aligned with changes taking place at the production level. Rationalizing the move to Digital Cinemas, and its potential, is the topic of this section.

Our framework to analyze Digital Cinema is as follows:

1. A brief description of the current economic climate in Exhibition;
2. Background of 35mm film technology;
3. Technology and the value proposition of Digital Cinema;
4. Value creation and value destruction in the Exhibitor value chain; and
5. Necessary conditions and recommendations for a successful change platform.

8.1 Film Exhibition

The scope of film exhibition can be measured by screen count. In the United States, there are roughly 35,000 screens owned by 6,000 theatres. Worldwide, there are approximately 114,000 screens. Exhibitors primarily earn revenues from two key sources - movie ticket sales and concessions. The dominant licensing model between Exhibitors and Studios is a rather complicated revenue sharing model based on a percentage of box office receipts.

Historically, Exhibitors have earned 50% of total box office receipts over the course of an engagement. However, they are required to pay licensing fees on a sliding scale basis such that most box office receipts in the first two weeks are paid to the licensor. In recent years, Studios have been more aggressive in taking a larger percentage of box office receipts. It is not uncommon for Exhibitors to receive only 10% of box office receipts for the first week of a major release. Exhibitors are at a high risk for engagement losses if a motion picture loses popularity quickly. Under the licensing arrangement, Exhibitors commit to an engagement far before the actual release date so that Studios can allocate physical prints. This constraint imposed by a finite set of prints is a limitation that Digital Cinema is poised to eliminate.

Since 1995, growth in Exhibition, as measured in box office receipts and by the number of admissions, has been fairly respectable. The industry as a whole, however, has been struggling. Numerous Exhibitors have recently entered, or plan to enter Chapter 11 bankruptcy to reorganize their property obligations. This financial distress is attributable to an overcapacity of new screen construction that took place between 1995 and 2000. The “megaplex” cinema model of 16+ screens per theatre, with stadium seating and larger overhead expenses, drove a surge of expansion. From 1995 to 2000, screen count increased by 34%, but admission revenues could not sustain these capital expenditures. Industry experts believe that overcapacity has not been sufficiently addressed and Exhibitors still need to shrink another 10-15% in screen count to reach market equilibrium. The Table below highlights key trends in Exhibition from 1995-2000.

Table 3: Exhibition Screen Trends

Year	U.S. Trend Data			
	Box Office Gross (\$US MM)	Admissions (Billions)	Screen Count	Films Released
1995	5,494	1,263	27,805	511
1996	5,912	1,339	29,731	471
1997	6,366	1,388	31,865	510
1998	6,949	1,481	34,186	509
1999	7,448	1,465	37,185	461
2000	7,661	1,421	37,396	478
2001	8,413	1,487	36,764	482
2002	9,520	1,639	35,280	467
1995-200 Absolute Growth		12.53%	34.49%	

Source: www.MPAA.org

It is interesting to note that the number of films released has fallen since 1995. This trend is partially due to the growing costs needed to market and produce a major release. In 2002, the MPAA estimated that it costs roughly \$90 million to produce and market a

leading release. With higher screen capacity, motion pictures are going into wider release on more screens and consequently “burn” faster. Both digital piracy and the home video market have also facilitated the burn rate by giving consumer more options to watch releases outside of theatres. Furthermore, box office gross is disproportionately reliant on a fraction of releases. Roughly 80% of the box office gross comes from half of the titles released. In short, the economics of the Exhibition business have gotten much riskier over the past five years. Exhibitors are unwilling to pursue risky projects that drain cash unless there is a financial benefit that can be legitimately realized in a reasonable time frame.

This review of the current economic climate of the Exhibition industry highlights key issues related to the potential adoption of Digital Cinema:

1. Exhibitors are not focused on new massive capital investments having just updated their facilities;
2. Exhibitors are open to alternative revenue models that improve bottom line results so long as those revenues are not highly risky. This can be seen in the growing number of advertisements for the use of theatres for large-scale corporate presentations and/or training.
3. Exhibitors want to maintain their core business of showing feature releases and selling concessions (which can account for over 50 percent of an Exhibitor’s profits) at peak hours. The average utilization of a theatre screen is 10-15%, highlighting the fact that core Exhibition profits come from a narrow window of peak business hours.

At its most basic as a value proposition to Exhibitors, an investment in Digital Cinema must be a mechanism that can: (i) increase (or help maintain) revenue dollars per admissions; (ii) increase total admissions; (iii) increase screen utilization; or (iv) decrease operating costs. One of these core value propositions must be realized if the industry is to assume the burden of adopting a new technology platform. Whether the Exhibition industry might be partially (or fully) subsidized in adopting Digital Cinema is a key issue addressed later in this analysis.

The sheer volume of screens also highlights a key infrastructure issue: network externalities related to the 35mm film format. Across theatre screens worldwide, theatre projection systems are standardized to show 35mm film stock. This allows content providers to manufacture a finite set of film prints can be re-circulated to different regions. Although some leading motion pictures have same-day global release on a limited basis, the majority of U.S. theatrical content is still released regionally to accommodate the logistics of managing physical film prints.

To fully appreciate the 35mm incumbent technology that Digital Cinema seeks to replace, a discussion of this platform is discussed below.

8.2 The 35mm Film Format

8.2.1 Physical Format

Celluloid film has been in existence for over 100 years. The longevity of this platform can be exemplified by the fact that a film print produced 50 years ago can still be played on today's projection systems. Stored and used properly, film has an exceptionally long shelf life. Traditionally, motion pictures and leading television content are originally shot on film. It remains the standard in recording visual content because its resolution and color/contrast retention are superior to those of any existing digital video formats. Film's inherent resolution (equivalent to roughly 4,000 horizontal lines) is particularly important to Exhibitors because a high resolution is necessary for large screen display.

It is important to separate the use of film to shoot content versus the use of film as a distribution platform. Live action content is first shot or acquired on film. It is then digitized using a tele-cine film scanner in the post-production phase where content can be edited, visual effects can be added and other color correcting process can be performed. Once a feature is completely edited, the digitized feature is transferred to a color negative original. This color negative original serves as the basis for the film duplication process. Roughly 2,000 to 3,000 physical prints are produced for each major release at a cost of approximately \$1,500 - \$2,000 per print. This cost is fully borne by studios. Total Exhibition print costs are roughly \$4 million per feature, or \$2 billion annually excluding shipping and handling costs. A diagram of the complete process is shown below:

Figure 3: Production Process for Exhibition Prints

When proponents discuss the marginal cost savings of Digital Cinema, they are focusing on annual print costs. The ideal Digital Cinema solution would receive content electronically so that physical media would no longer be necessary. All the steps shown after the Color Negative Original would be eliminated. Although *capturing* original content in digital form has made incredible strides in quality the past few years, it is a separate topic from Digital Cinema and the move to a new *distribution* model for Exhibition. For major motion pictures, it is simply not a significant issue as to whether content is originally captured on film; those costs are secondary compared to the costs to acquire talent, create effects and market a release. Many leading directors and cinematographers have a professional and emotional attachment to shooting film such that it will remain a viable platform for many years. However, today's younger cinematographers who use digital film technologies will be influential in the adoption of more digital film technologies, going forward.

8.2.2 Exhibition Distribution

As previously stated, film prints are leased to Exhibitors who then mount the prints on projectors for screening. These projectors cost roughly \$30,000 - \$40,000 and have a lifecycle that can last 20 years. Under ideal situations with well-mastered, scratch-free print stock and fully optimized projectors, content can be shown at a high quality resolution that exceeds that of current Digital Cinema technologies. However, this ideal situation is generally not met over the course of a released engagement. Film prints routinely get scratched, dirtied and mishandled. Older projection systems may have minor playback inconsistencies. Consequently, many Exhibition releases are shown at a lower quality than theoretically possible. For releases that stay in circulation for a long time (for example, over 6 weeks), degradation can be significant. However, it is important to note that lower quality does *not* correlate to fewer admissions. Box office trends have been historically positive in the last 20 years. Given that the underlying film technology has remained fairly stable, consumers value the theatre experience tremendously. It remains a service that at current levels, does not appear to be immediately challenged by another entertainment substitute in the way that television originally challenged theatres in the 1950's. The consumers' willingness to pay for current theatrical content suggests that the market is satisfied with current playback systems and that other factors (e.g., admission prices, Exhibition location, facility amenities) are more important to gain consumer wallet-share.

8.2.3 Incumbent Technology Summary

From a technological perspective, it is very clear why 35mm film is the dominant platform for theatrical content. Despite its limitations, its advantages are that:

- It is compatible for global Exhibition since projectors are standardized worldwide;
- Film distribution offers sufficient quality to the marketplace even with inherent degradation;

- The infrastructure and labor associated with handling film is cost-effective and stable; and
- There are no substitute products that offer superior value to Exhibitors.

It is this last point that makes the value proposition of Digital Cinema a challenging issue. Once of the core issues related to any new technology adoption has to do with expected benefits commensurate with investments. It is necessary for Digital Cinema technology to define real value to Exhibitors. Understanding the technology and its value proposition is critical to determining what factors need to take place for this new platform to be embraced.

8.3 Digital Cinema Technology

8.3.1 Introduction

The simplest way to understand the concept of Digital Cinema is to examine the nature of the alternative digital distribution system. This is a theoretical model of a Digital Cinema distribution system with alternative methods for content transmission³. In this model, content must first be sourced from the content provider. There are two hypothetical sources: (i) a post production facility (e.g., a facility where motion picture content is digitally mastered); or (ii) a live event that is being captured in HD video. Content would first be transmitted to a “Network Operational Center” or some other telecommunications intermediary that would compress and encrypt the content. This data would then be relayed to Exhibitors in one of three ways: (i) physical media (e.g., DVD’s, portable hard drives, etc.); (ii) satellite transmission; or (iii) Internet Protocol (“IP”) transmission.

Once an Exhibitor has received the content file, the Exhibitor would then transmit the encrypted data to specific screen projectors through its own Local Area Network. The screen projectors would decrypt the content for projection on to a screen. So conceptually, the architecture of a Digital Cinema system is rather simple. There are numerous benefits that come from this arrangement. The most discussed are:

1. Consistent high quality content projection with none of the degradation of film;
2. Cost savings to Studios from eliminating multiple prints for distribution;
3. Cost savings to Studios from eliminating ground shipping and transportation logistics for print distribution;
4. Central server capability to change, manage and organize content by Exhibitors;
5. The ability to show real-time, live-action content at a high quality; and
6. The ability to perform same-day global releases for motion pictures on a much wider scale.

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³ A diagram can be found at <http://www.evs-cinema.com>

These benefits are described in more detail below.

8.3.2 Costs and Quality

Digital files do not degrade. Therefore, Exhibitors and consumers are assured that content quality will be the same from the first to the last showcase. Studios greatly benefit in cost savings since the duplication costs for Digital Cinema content are (for all practical purposes) negligible; the industry could save roughly \$1 billion per year in print costs. Furthermore, shipping and transmission costs *could* be negligible compared to the logistics necessary to ship cumbersome film reels, each of which weighs roughly 40 lbs. However, those cost savings may not be realized under many conditions and warrant further examination (to be discussed later).

8.3.3 Content Optimization and Release

Theoretically, a fully networked Digital Cinema megaplex would have the ability to change screen content easily because the Exhibitor would not be limited to the physical number of prints leased under contract. An Exhibitor could add screens for a particular release by simply serving another digital file for public showing. Furthermore, major releases could be released globally rather than regionally. This latter option is increasingly seen as a method to counter piracy since consumers in other regions would not have to wait for high-demand releases.

In addition, proponents of Digital Cinema cite the ability to generate additional Exhibitor revenues from “alternative content” such as concerts, live-action sports and other entertainment events. However, current projectors are not designed to capture direct-feed content such as terrestrial broadcasts or other satellite-transmitted feeds. More importantly, there is an issue related to capturing content at a significant resolution appropriate for a theatre screen. For example, it would be impossible to show traditional U.S. television content on a theatre screen because current broadcast quality is insufficient. Any live broadcasts would need to be captured and transmitted at the appropriate quality commensurate with Digital Cinema.

Conceptually, Digital Cinema offers a range of benefits to both Exhibitors and studios. However, as of early 2003, there were only 154 Digital cinemas worldwide. Furthermore, there were only 60 feature films released in Digital Cinema format since the technology was introduced in 1999 with the premiere of *Star Wars Episode 1* on 4 digital cinemas. Exhibitors have stopped any significant investments in further adoption until fundamental issues of standards, quality and cost are resolved.

The stagnation in Digital Cinema adoption warrants a deeper analysis of the technology’s value proposition. There is a significant question about the return on investment that Exhibitors expect, and whether the current business dynamics are short-term transients, or permanent structural impediments to Digital Cinema’s adoption. These questions are analyzed in detail below.

8.4 Digital Cinema Value Analysis

8.4.1 Increasing Consumer Willingness to Pay

The primary consumer value proposition of Digital Cinema is consistent high quality content exhibition that is comparable to first-run release. Unfortunately, there is no tangible evidence to suggest that Exhibitors can generate significant incremental revenues for this consistent quality by charging an admissions premium. Few movies make it past 6 weeks of release where degradation can become significant. Since movies go through lifecycles faster in today's economy, film degradation is not perceived to be a serious threat to consumer satisfaction. This suggests that consumer willingness to pay cannot be the driver to having Digital Cinema replace traditional film projectors.

8.4.2 Technology Adoption Costs

Costs are the first barrier to any potential technology adoption. Current Digital Cinema projection systems cost \$100,000 - \$150,000. In addition, there may be other ancillary technology costs associated with network and infrastructure costs that can raise the total costs to over \$200,000 per screen. This is roughly 500% more costly than film projectors. It is not difficult to do a simplified break-even analysis to identify how many digital movie releases would be necessary to recover the costs of the initial system, if we assume transmission and other support costs to be negligible *and assuming that the studios were willing to subsidize the full conversion cost.*

Estimation 1: Digital Cinema Adoption Breakeven Analysis

Initial investment cost per screen	\$ 200,000
Film duplication dollars saved per screen	\$ 2,000
Total print copies saved to break even	100
Average number of weeks for a release	6
Total releases per screen (52 weeks)	8.7
Years to break-even	11.5

This rough analysis provides important insights about the cost barriers related to technology adoption. First, currently, *no studios subsidize Exhibition equipment costs.* Because the revenue benefits of Digital Cinemas to Exhibitors are so unclear; there is no way to calculate a reasonable break-even analysis using Exhibitors as the technology investor. As an alternative, using content providers as the technology investor helps clarify how current technology costs are prohibitively expensive even if we assume that the primary beneficiaries of the transition were willing to provide financial assistance.

Although the break-even analysis shows that a return does not happen for many years, it would suggest that a slow but steady adoption of Digital Cinemas could be a plausible strategy since there is a clear payoff. However, the real issue is not the initial investment costs; it is the fact that nobody can reliably estimate the lifecycle and operation costs of these systems. There is a fundamental lack of Digital Cinema standards with the result that no system in place can be assured a long lifecycle. Already, many Digital Cinema

systems in operation are out of date; new projection systems with roughly double the resolution are almost ready for sale. It is this additional uncertainty in infrastructure costs that makes it unattractive for studios and Exhibitors to pursue business models that can finance Digital Cinema procurement.

8.4.3 Technology Transmission and Content Organization

As previously discussed, there are three alternative methods to distribute a digital film: (i) physical media; (ii) satellite; or (iii) IP. Physical media is the use of special DVD's or portable hard drives to physically store and transport digital movies. Fixed media has a significant cost advantage over the other two methods. Digital Cinema content requires more data storage than normal DVD's so that 15-20 disks are needed for each release. However, today's systems are not fully designed for rapid content exchange. In the case of current DVD-based systems, it can take hours to install content and troubleshoot a system. This is a significant cost to Exhibitors considering that Exhibitors can quickly change content with current film projection systems. One of Digital Cinemas' potential and eventual benefits is the ability change content quickly. But this is simply not the case in the near term where digital content loading and manipulation is slow compared to having laborers physically move film reels.

IP transmission is the use of the TCP/IP protocol to deliver content. Because of the open network landscape, one must assume that this transmission method will only be adopted once an acceptable level of encryption is developed. The costs of high speed access have fallen dramatically in the past few years such that high-capacity broadband is relatively affordable. However, a high-speed broadband line is not available to all locations. In addition, the average 2 hour Digital Cinema movie file is 100GB in size. This would require hours of continuous streaming to send one movie.

The most ambitious model to transmit Digital Cinema content is the use of satellites. Satellite transmission rates are 45 Mbps. It is also the best method for content to be delivered globally. However, costs are the problem with satellite transmissions. First, transmission infrastructure must be rented or constructed to transmit content to the satellite. Second, satellite transponder (e.g., access) time must be purchased. Current market costs for one full-time satellite transmission channel at 45 Mbps is \$2 million per year. Finally, Exhibitors would also need to invest in base stations that can receive the satellite relay. In other words, satellite transmission would only be cost effective if a substantial number of screens converted to Digital Cinemas at once so that fixed transmission costs could be spread across many Exhibitors⁴. This "big bang" technology adoption requirement across independent businesses is simply not congruent with the traditional technology adoption curve.

The characteristics of each transmission method highlight the fact that today no single platform has a clear advantage. Although fixed media is the most primitive method, it

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⁴ Conceptually, the costs would be spread if we assume that many Exhibitors are quipped to receive satellite transmissions. That way, when one movie title is transmitted, many base stations can receive the content at one time.

requires no significant capital investment by the Exhibitor for receiving content. In 2002, there were 474 megaplexes (16+ screens) in the United States and 1,437 multiplexes (8-15 screens). These large venues would be most suitable for full Digital Cinema networks that use satellite delivery. However, large-scale venues are still a minority of theatre facilities; most theatres have less than 8 screens. Smaller theatres may not substantially benefit from a satellite delivery system. Research suggests that more than anything else, Exhibitors priorities are that content be delivered reliably and affordably and the delivery method is not a significant priority.

8.4.4 Alternative Content

Because the transition to Digital Cinema has significant cost savings for content providers but zero (and in fact negative) cost savings to Exhibitors, the industry must be provided the incentives to adopt this new technology. The most common revenue model championed to Exhibitors is alternative content such as sports, concerts and other live-events.

Historically, Exhibitor content and television broadcast content have been largely mutually exclusive. The U.S. television standard resolution, NTSC, is inferior and fundamentally different. It is simply not technologically possible for broadcast events to be fed to theatre screens with NTSC signals. However, that barrier is disappearing with the emergence of better HD video equipment and High Definition Television (HDTV).

Since HDTV will be covered later in this paper, its attributes will not be discussed here. But what is important about HDTV is the following: although, HDTV transmissions are not fully appropriate for Digital Cinemas, greater proliferation of HD production hardware encourages more HD content to be shot and potentially delivered to Digital Cinemas. The fundamental difference that separates an HDTV signal from a Digital Cinema signal is data compression rate, a measure of image quality. An HDTV data compression rate of 19.2 Mbps is over 50% less than the generally accepted data rates for quality Digital Cinema content. Fortunately, HD content can be mastered at the high data rates acceptable to Digital Cinema and down-converted to HDTV or DVD quality resolutions. By having a standardized HD infrastructure, alternative content becomes a greater reality whether it is live-events delivered via satellite or HD recorded content that is physically delivered to an Exhibitor. Boeing Digital Cinemas, a technology solutions provider, has already demonstrated satellite's ability to: (i) perform HD live-stream content; and (ii) transmit content to global sites. Quite simply, the bottleneck of having to master filmed content for current projectors is gone with a Digital Cinema system. The critical question lies in identifying what type of HD content is an acceptable value proposition to Exhibitors.

When technology revolutionizes products and services, it is often difficult to identify unarticulated consumer demand. Exhibitors are challenged to do so if they hope to earn incremental revenues from alternative content. Certain content, such as high-profile sports events, would be ideal for Digital Cinemas. However, it is hard to imagine that current licensees of sports content (e.g., major U.S. networks) would ever allow licensors

to contract with Exhibitors given the networks' enormous bargaining power in signing exclusive contracts. Content acquisition could thus be a serious barrier.

More important, there is an enormous inertia among incumbents that discourages leading Exhibitors from exploring alternative content business models. It is hypothesized that certain venue changes (e.g., alcohol sales, different seating arrangements, etc.) may be needed to attract consumers to watch alternative content. Risking change is inconsistent with theatre Exhibition. Most leading Exhibitors can be considered "pragmatists" in the adoption technology curve. They have expertise and are comfortable with the proven incumbent business model. As previously stated, Exhibition peak hours are a narrow time interval. It cannot be expected that Exhibitors are willing to risk these business hours to explore unproven content models. The Exhibition industry is still trying to contract and conserve cash due to prior over-expansion. They are not in a position to explore strategies that involve risky cash flows. Although it is not difficult for large Exhibitors to invest modestly in Digital Cinema systems, it is costly to invest marketing, research and management resources to this initiative. For example, although Regal Cinemas has a proprietary network digital projection system, this system is used to display advertisements and not releases. This exemplifies pragmatism in technology adoption. We believe that this incumbent inertia is vastly underestimated in the debate about alternative content on Digital Cinemas

8.4.5 Value Summary

It is quite clear that a deeper analysis of the industry and technology forces shows how difficult the landscape will be for Digital Cinemas to be pervasive. People continue to predict the adoption rates of Digital Cinema systems, but these predictions are fundamentally flawed because there are structural business incentive issues that have not been resolved. Without a doubt, costs are a critical factor. However, arguing that costs alone are the driving factor vastly oversimplifies the issues. A framework for technological change is necessary to add clarity to how this new distribution chain can come about.

8.5 Necessary Conditions to Induce Change

8.5.1 Standards Setting

In content-delivered technologies, network externalities are critical to mass adoption. Some technologies become de facto standards while others become established through industry/government approval. Through 2002, no official standards exist for Digital Cinema systems. This has been an important barrier that is discouraging investments. For example, the first Digital Cinema systems were 1280 pixels ("1K") in horizontal resolution. This was deemed deficient by many cinematographers and film producers. New 1,920/2,048 pixel systems ("2K") are much more acceptable in quality and better match the resolution of most digital movie effects. The old and new systems are not easily upgraded so early adoption was clearly risky. For content providers, the lack of standards has also made content delivery overly complex and costly. Studios had to master different Digital Cinema files for different Digital Cinema systems. More

importantly, a universal encryption standard is lacking. Security is a crucial element in digital technology, and a consensus encryption standard need to be developed for any significant content to be progressively released.

Fortunately, the standards issue is expected to be resolved fairly soon. Studios, seeking to define acceptable guidelines, have established the Digital Cinema Initiative (DCI). DCI, a consortium effort formed in early 2002. DCI is expected to deliver technology guidelines (e.g., minimum resolution, compression methods, encryption needs, etc.) that can be translated into real industry policies. The goal is to develop a standard that is significantly open in architecture such that multiple vendors can compete with global interoperability. An ideal goal would be the completion of an industry standard by 2003-2004 such that technology providers can have some confidence about how to proceed with product development. Therefore the first barrier to potential adoption, that of standards, appears to be addressed. However, the rate at which a Digital Cinema standard can be completed and embraced is still highly unclear.

8.5.2 Cost Considerations

Earlier, a hypothetical break-even analysis was performed as a measure of cost magnitude. As previously stated, there are no outstanding initiatives by the Studios to subsidize equipment costs to Exhibitors, even though there are clear cost benefits. There are three reasons why a subsidy is highly unlikely:

1. The “Paramount” antitrust decree makes it illegal for studios to require Exhibitors to meet content quotas/must-carry requirements. Studios cannot subsidize Digital Cinema systems in exchange for some degree of content control;
2. Studios are not technology companies and they do not want to be engaged in funding Digital Cinema developments; and
3. Subsidizing Digital Cinema effectively means that Exhibitors can use these systems for alternative content. This latter scenario currently provides no value to Studios.

The only viable business model is for Digital Cinema systems to be independently funded and operated by Exhibitors such that Exhibitors maintain full control of content management.

Under the latter proposition, there is only one procurement model that is reasonable for Exhibitors. That model is a leasing arrangement whereby Exhibitors minimize the risks of technology obsolescence and service costs. The leaseholder would have to be the technology provider or a business intermediary that has competencies in leasing contracts and would be willing to assume the risks of product service and upgrades. A leasing model effectively translates one-time projection system costs into a stream of operating costs to Exhibitors. Using this idea, one can perform a rough calculation of how far costs must fall before Digital Cinema systems are financially attractive to leading Exhibitors.

The analysis is performed as follows. Three leading publicly-held Exhibitors who reported positive operating income were chosen. Operating income is defined as revenues less operating expenses excluding interest and non-operating income/expenses. Each company's operating margin (operating income / revenues) is calculated. It was then assumed that the maximum annual expense burden from a Digital Cinema operating lease would be 1% of sales⁵. This expense was then divided by the number of screens per Exhibitor to determine the maximum acceptable incremental costs per screen. This cost can be considered a perpetuity to a leaseholder. The principal system value is then the incremental cost divided by a cost of capital (three different rates are used so as to develop a range of system costs). This is the requisite price range that makes Digital Cinema adoption financially realistic.

Estimation 2: Viable Digital Cinema System Costs

	AMC Entertainment		Cinemark Theatres		Regal Cinemas		
FYE	3/28/2002		12/31/2002		12/26/2002		
Screen count	2,899		3,031		4,164		
Revenues	\$	1,341,506,000	\$	939,265,000	\$	1,544,400,000	
Operating costs	\$	<u>1,289,947,000</u>	\$	<u>810,371,000</u>	\$	<u>1,311,600,000</u>	
Operating profit	\$	51,559,000	3.8%	\$ 128,894,000	13.7%	\$ 232,800,000	15.1%
Ceiling cost from adopting Digital Cinema systems	\$	13,415,060	1%	\$ 9,392,650	1%	\$ 15,444,000	1%
Ceiling cost per screen		4,627		3,099		3,709	
System costs at 5% cost of capital	\$	92,550	\$	61,977	\$	74,179	
System costs at 10% cost of capital	\$	46,275	\$	30,989	\$	37,089	
System costs at 15% cost of capital	\$	30,850	\$	20,659	\$	24,726	

The analysis above suggests that total Digital Cinema system prices must be similar to current film projection system prices if the Exhibition business model stays substantially static. That requires the system prices to fall some 75% for major Exhibitors to consider widespread adoption. The above analysis excludes any additional transmission and/or distribution costs such as satellite or IP. Such costs only compound the adoption burden, suggesting that physical media may be the best method at the early adoption phase. Therefore, technology companies should be most focused on building products that can facilitate rapid exchange of content and not necessarily on the most sophisticated infrastructure network capabilities.

8.5.3 Change Dynamics

It becomes quite apparent that Digital Cinema technology companies are left with a "chicken and egg" problem. New technology becomes more affordable through incremental adoption and R&D learning. However, leading Exhibitors are the wrong market segment to pursue in the initial stage because they do not perceive sufficient value in such investments costs.

This research takes the position that Digital Cinema's value is tied to the availability of HD content. Consequently, it may be more appropriate to target entrepreneurs that

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⁵ 1% of sales was chosen as the ceiling point at which an Exhibitor would be willing to take on additional Digital Cinema operating costs assuming revenues are constant. Anything more is considered a material financial impact that would not be acceptable without clear revenue benefits.

operate small specialized/boutique theatres as the first potential customers of Digital Cinema systems. Madstone Films, an independent company that finances and showcases its own movies on Digital Cinema systems, is an example of an appropriate early adopter. The company produces and displays in digital format that does not compete with leading Studio releases. Although there are many HD recording formats, it is the “24p”⁶ format that is most important to Digital Cinema’s future.

24p, the digital HD shooting format that offers the closest quality to film, has made significant advancements in the past 2-3 years. Industry experts expect it to be a leading method to shoot content in the near future. *Star Wars Episode II* is the most well-known release that was shot on 24p video. The International Telecommunications Union, a prominent standardization body, has already certified this format as a global production standard for movies and television shows. The global standardization to 24p is a key development for Digital Cinema’s adoption. It will make it cost effective for more HD content to be produced worldwide as 24p technology costs fall. Already, 24p production can reduce production budgets by as much as 50% compared to film. The proliferation of 24p recording will encourage more HD content to be produced. This content diversity will help drive entrepreneurs to identify content that has niche market demand. In turn, this will be the source for value in the first Digital Cinema systems.

Having examined Digital Cinemas, the first window release, it is logical to examine how technology will impact motion picture distribution at the next level. That level is the pay-tv industry and specifically, the emergence of VOD. VOD is the product that cable operators have used in their battle with satellite operators to be the leaders in subscription television.

9 VOD and the Cable/Satellite Industry Battle

In our research, VOD is defined by two platforms: cable VOD and Internet Protocol (IP) VOD. They are contrasted below:

- *Cable VOD*: MPEG-2 streaming video delivered over broadband digital cable architecture to a digital set-up box and viewed on a television.

Cable VOD is analogous to renting a video without actually renting a DVD or VCR cassette. VOD subscribers select content from an on-screen library menu and cable operators will then stream the video from servers to a subscriber’s set-top box connected

⁶ 24p is short for HD video captured in progressive-scan resolution at 24 frames per second. Traditional film is shot at 24 frames per second. This recording format is most aligned with film since frames per second is a key standardization attribute.

to a television. VOD technology also gives consumers the ability to pause, rewind and fast-forward content just like a VCR. When the rental period expires, the movie is erased from the subscriber's set-top box. Consumers pay for each VOD title request. Besides cable VOD, cable operators also provide subscription VOD (SVOD), which is VOD offered at a monthly flat rate. This flat rate billing provides viewers with unlimited access to a digital library of content. Currently, most VOD are movies, TV series and sports. Movies are far away the key anchor services for VOD, attracting large diverse audiences and revenue streams. However, some VOD programming companies are also actively marketing special-interest VOD services, targeting genres such as hobbies, recreational activities, fitness, self-improvement and education. The goal is greater market segmentation of what, when and where entertainment content can be enjoyed.

At the end of 2002, there were over 7 million VOD-ready households in the United States. This number could easily double, if not triple, by the end of 2003⁷. Currently, almost all of the major cable operators are market-testing VOD. Charter, Insight, Adelphia, Cablevision, Comcast, Cox, Insight, Mediacom and Time Warner Cable are all testing or actively deploying VOD services.

- *IP VOD*: Internet streaming video delivered to a personal computer

In IP VOD, subscribers browse authorized website, view trailers of available titles, pay for a movie rental with a credit card and download content. After downloading the film, subscribers generally have 30 days to begin viewing the film unless specified otherwise at the time of rental. Once a film is started, consumers generally have 24 hours to watch it. Subscribers can watch films any number of times during this 24-hour period with VCR functionality, including pause, rewind and fast-forward. The download time depends on the size of the movie file, connection speed, and the amount of traffic on the Internet. Normally, it takes 40 minutes to an hour with an average DSL/Cable broadband connection. After the rental period, the file becomes inaccessible.

Currently, IP VOD is relatively insignificant in the market. The major IP VOD providers include Movielink, Intertainer and CinemaNow. Combined, these providers have total registered users of less than half a million. Most movie content available at these websites could only be described as "B" movies because they are low-risk titles in the event of system hacking and illegal content dissemination.

Although VOD may seem like an ancillary product within the current release window structure, its potential to lead industry change is massive. In theory, VOD could render the entire video rental industry obsolete. This scenario is unlikely in the near term because incumbents have serious investments in the current business model. However, the VOD issue is most relevant in the high stakes battle between cable providers and dish satellite networks. The massive investments to deploy VOD are important to the future structure of the subscription television industry. In the following VOD is examined as follows:

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⁷ Source: Company reports, industry reports, Williams Capital

1. A technical overview of VOD infrastructure;
2. Factors in VOD adoption and the emergence of satellite networks;
3. Availability of VOD content;
4. VOD forecasts and expected industry change dynamics.

9.1 VOD Infrastructure

A typical VOD system is broken into several major categories as depicted below.

Figure 4: VOD Delivery System

These components are described in further detail:

- **Set-top Box:** A set-top box allows subscribers to select video from a TV menu screen. It will then decode the request and send the message across the access network to an application server located in a service provider's network. The set-top box then receives digital video streams from the video server and displays the video on screen with full VCR functionality.
- **Application Server:** The application server is the head-end or hub that is the counterpart to the set-top box. The application server authenticates users, checks subscription details, organizes billing and delivers film selections. There can be

many application servers in a network dedicated to different applications or segments, such as movies on demand, sports on demand, etc.

- **Content storage:** Digital asset management software has to be in place to manage the content, content groups and content information for each asset in the system.
- **Video Server:** The core hardware to deliver video streams. The keys to the success of these servers are their scalability and fault tolerance. For VOD to reach critical mass, the service provider's video server architecture must be sufficiently robust to offer thousands of titles over a dozen different subscription packages. For example, where there are two million subscribers, accessing 2,000 films using 10 different subscription packages and 5 different interactive applications, the complexity is exponentially huge ($2,000 \times 10 \times 5 = 100,000$ variations). There have been significant improvements in video server technology in the last 5 years. Video servers that used to cost thousands of dollars per stream are now around \$300 per stream.

Without a doubt, the infrastructure for change can be implemented, but the question is whether widespread adoption will take place such that VOD has the opportunity to induce significant industry change. Whether VOD will be widely adopted depends mostly on the following two factors: (i) cable operator's willingness to deploy VOD; and (ii) the rivalry of cable and satellite providers. These issues are examined in further detail.

9.2 Factors affecting VOD Deployment

Cable operators face high capital expenditure costs and low profit margins in deploying VOD. Therefore, it is critical to perform a breakeven analysis to determine whether there are realistic profits to cable operators from investing in VOD.

9.2.1 Infrastructure Costs and Product Margins for VOD

One of the most important value propositions of VOD is its ability to provide impulse buyers with instantaneous service. Hence, "denial of service" to a cable VOD subscriber is inexcusable; one disappointed subscriber could disrupt potential lifetime customer value. To avoid denial-of-service problems, cable operators must purchase servers, maintain storage and allocate bandwidth for enough simultaneous VOD services during peak viewing times – typically weekends. This bandwidth and infrastructure is largely idle during non-peak hours. VOD subscribers' non-linear demand pattern significantly increases the cost of VOD deployment. However, based on Seachange International data, it is estimated that cable operators need to spend only \$107 per subscriber to upgrade digital cable systems to VOD.

This estimate does not consider the opportunity costs of bandwidth reserved and consumed by VOD. Opportunity costs are not easily available and industry participants have apparently not tried to calculate them. Although cable operators invested \$70 billion dollars to upgrade their systems to digital infrastructure, no information is

available on how much capital expenditures should be appropriated to VOD. Therefore, the \$107 VOD capital expenditure per digital cable household is most probably an underestimate.

Cable VOD competes with other entertainment alternatives— mainly the local video rental store. Hence, the pricing of VOD must at least be comparable to that of video rental stores to be competitive. The maximum price cable operators can charge for new content (approximately 30 days after DVD release to the rental market) is around \$4. Around 50% of the subscription fees go to Studios (the licensor). Cable operators therefore only get \$2 for each new-title subscription. Considering other marketing and operating costs for each movie title, it is estimated that cable operators get less than \$1 per hour of net revenue. Nevertheless, estimates show that VOD provides significant marginal revenues to cable operators that makes it a profitable venture. As a result, VOD is being deployed at a rapid pace and it is the fastest growing sector of the cable TV industry. In the past 2 years, household penetration of VOD surpassed the initial penetration rate of home computers, was at double the penetration rate of VCRs, and triple the initial penetration rate of both basic cable and the Internet⁸. However, the profitability of VOD has been overestimated because cable operators have excluded the opportunity costs of the bandwidth reserved for VOD services. Moreover, although VOD has decent revenue potential, it alone does not seem to explain cable operators' enthusiasm for providing this service. Upon deeper examination and research, it appears that VOD deployment is directly tied to the fierce competition with the satellite industry. This industry battle has been significant, and competition has bred product and service innovation as evidenced by VOD growth.

9.3 Satellite Competition

Since 1994 (the inception of DirecTV), the number of satellite subscribers has jumped from 4 million to over 20 million users, with a CAGR of 23%. In contrast, the cable industry's CAGR was 2% during this time period. None years after its debut, DirecTV has surpassed all but two cable operators in the number of subscribers, making it the third largest multi-channel video provider in the U.S. Meanwhile, EchoStar is ranked fourth among multi-channel video providers. Not only has satellite demand grown at a much faster rate than cable, its growth has come from stealing cable's most profitable consumers.

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⁸ Deutsche Banc Alex Brown, US cable industry outlook, September 6, 2001

Figure 5: Cable Growth versus Satellite Growth

Source: National Cable & Telecommunication Association

Not surprisingly, satellite and cable subscribers are similar in nearly every way. They have comparable incomes, education levels and online shopping habits. However, one key exception exists – satellite subscribers on average buy more services. According to Forrester Research, although satellite subscription prices are competitive with cable, satellite subscribers pay an average of \$42 a month, \$8 more than the average cable household. Roughly 50% of satellite subscribers purchase premium channels and a third of them rent pay-per-view programs. In contrast, only a third of the cable customers subscribe to premium channels and less than a third of them rent pay-per-view programs.⁹

Further examination of data from the same source reveals the severity of cable customer defections to satellite. 48% of cable defectors bought premium cable channels and 36% rented cable pay-per-view. In comparison, only 35% of the existing cable customers have premium channels and 26% of them rent pay-per-view. Most interesting, roughly 22% of cable defectors used to have digital cable, the best cable product to fight satellite defection. This data shows that digital cable may not be as attractive as cable operators had initially hoped.

However, cable operators have found VOD to be an effective agent to reduce defection – the percentage of subscribers dropping digital cable service in a given month drops from 6% to 4% in VOD-enabled regions¹⁰. Moreover, the costs of deploying VOD are reducing. Recognizing this trend, the first priority of major cable operators has been to deploy VOD to fight customer defection. Although cable operators would prefer making profits from VOD, they are content to break even (or even incur minor losses) just to prevent subscribers from switching to satellite services.

⁹ Forrester, Satellite wins Cable's Best customers, March 2002.

¹⁰ Forrester Research, How cable TV can beat satellite, April 2002

Satellites, restricted by their capacity, cannot serve individual VOD streams to millions of subscribers nationwide. Consequently, satellite companies compete with VOD using pay-per-view movies on multiple channels, starting every 15 minutes. This value proposition is inferior to that offered by cable VOD. First, cable operators can provide a digital library of hundreds of movies to subscribers, who can choose whatever titles whenever desired. Satellite subscribers can only access a narrow collection of titles at any given time. Moreover, since most satellite subscribers still do not have Personal Video Recording (discussed later), they cannot enjoy the rewind, stop and fast-forward features enjoyed by cable VOD subscribers.

9.4 VOD Content Acquisition

As discussed above, VOD is an important strategic tool in the industry battle between cable and satellite companies. However, one critical question remains as to whether VOD will proliferate. That question is whether Studios will provide VOD content. Our research has shown that Studios are not excited about VOD. However, Studios will provide VOD content to cable operators under two premises: (i) profits from the current release window are maintained; and (ii) piracy is kept at bay.

9.4.1 Continuation of the Existing Release Window

As discussed earlier, Studios use a time-lapse distribution release method to maximize revenues. This model has worked well in the past and hence Studios strive to maintain the status quo. Consequently, Studios will support VOD if and only if VOD increases revenues while keeping the existing release window structure intact. This is why current VOD is available 30 to 60 days after DVD/VHS release and not before it. Although the VOD release window may move closer to 30 days after DVD/VHS release, it is highly unlikely to move any closer. The chart below shows how Studios prioritize distribution methods to maximize profits.

Table 4: Comparison of VOD, DVD/VHS Sell-through and Rental

	Revenue model	Importance	Margin
VOD	Revenue sharing: movie studio share VOD rental revenue with cable operators	Insignificant	Approximately 50% of VOD sales.
DVD/VHS Sell-through	Mass distribution: movie studios distribute their DVD/VHS product through major merchandisers such as Wal-Mart.	Most significant	Highest. Approximately 80-85% of the DVD/VHS sales.
DVD/VHS Rental	Video rental store purchase DVD/VHS from studios and obtain authorization to rent them out. No revenue sharing	Significant	Lowest, less than 40% of the DVD/VHS rental revenue.

9.4.2 Mitigating Piracy

Generally speaking, Studios have different attitudes toward cable and IP-based VOD. Studios are comfortable with cable VOD because it is a “closed-system” that is difficult to hack. Therefore, 4 of the 7 major studios, Sony, Fox, Universal Studio and Time Warner actively promote VOD on their websites. MGM and DreamWorks are also providing new releases to cable VOD. Disney plans to provide VOD content once the company is satisfied with certain piracy security issues. It is safe conclude that Studios

will base their decision regarding cable VOD on its revenue potential rather than piracy concerns unless any significant piracy technologies emerge in the cable market.

On the other hand, IP-based VOD exposes Studios to a higher risk of piracy. Given the popularity of P2P networking and current anti-piracy technology, Studios have refused to put premium releases on IP VOD. Some research agencies argue that Studios are optimistic about IP-based VOD and have shown their support by creating Movielink, a joint venture established by MGM, Paramount, Sony, Universal Studio and Time Warner. However, Movielink does not necessarily indicate optimism. Rather, Movielink was probably created because Studios are unclear about IP-based VOD and sought a “beta” service for testing.

9.5 Projected VOD Platform Winner

Because of the aggressive infrastructure upgrades of cable operators and endorsement from Studios, cable VOD is now well positioned to reach mass adoption in the next 3 to 5 years. IP-based VOD, on the other hand, may have a much harder time to take off. Cable will be the dominant carrier of VOD for the following reasons.

- Consumer viewing habits: Cable VOD has a clear competitive advantage over IP-based VOD. Apparently, most people prefer watching video on a TV rather than a PC screen. A survey by Forrester shows that only 18% of Internet users regularly watch streaming video, and only 7% say they would pay for movies online¹¹. High-tech companies such as Motorola and Cisco do manufacture DSL-based set-top boxes that bridge from PC-based broadband connections to TV. However, this solution may cost more than \$300 to consumers, an expensive proposition for a small consumer segment.
- Support from Studios: Our research with Studios confirms satisfaction with potential cable VOD revenues. But piracy clouds any enthusiasm for IP-based VOD. Most Studios are hesitant to provide new content to IP VOD, a sentiment that does not appear to be likely to change any time soon. Lacking compelling content, IP-based VOD will have a hard time drawing subscription revenues.
- Strong customer relationship: At the end of 2002, there were over 7 million VOD-ready households. VOD-ready households are on track to reach 36 million in 2005¹² representing 75% of the digital cable TV market. Given the existing billing relationship and familiarity between cable households and cable operators, the latter will enjoy a huge competitive advantage in marketing their VOD services over IP-based VOD providers.

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¹¹ The first figure, regarding streaming video usage, comes from an online survey of 11,000 North American Internet users conducted in the fall of 2000. The second, on willingness to pay, comes from an online survey of 5,644 American consumers, which Forrester conducted in conjunction with Greenfield Online in October 2000.

¹² Yankee Group June 2001

From 2000 to 2002, digital cable households grew quickly from 6 million to 19.2 million subscribers with a CAGR of 50%. This growth is similar to that of satellite in its early years. It is believed that digital cable had a higher potential growth rate because of its huge existing customer base; satellite operators needed to start from scratch. After the initial growth of digital cable, growth is expected to slow to that of satellites. Assuming CAGR for digital cable subscription to be 18%, 37 million households should be converted to VOD by 2006. This large subscriber base should yield roughly \$4 billion in annual revenues to cable operators, an attractive and powerful value proposition.

9.6 VOD Summary

The expected emergence of cable VOD provides consumers with a new channel for entertainment distribution that complements current consumption options. It is an option that has the general endorsement of Studios because it provides them with a potential method to increase revenues. However, the underlying technologies that have allowed Digital Cinema and VOD to be born have also lead to the emergence of Personal Video Recorder (PVR) technology, a technology that coupled with HDTV, gives consumers an unprecedented ability to enjoy television content via a method *unexpected* by Studios. This technology is the third stage of the “experience chain” that has potentially significant impact on the entertainment industry.

10 PVR as a Disruptive Device

PVR is analogous to VCR except that the storage medium is now a digital hard drive or even possibly DVD disks. Like a VCR, PVR allows users to fast-forward, rewind, and pause video content. What distinguishes PVR from VCR most strikingly is the ability to automatically search and record content at very high capacities and without degradation in repeated playback quality. The technology in service format can even recommend content based on a user’s past viewing habits. Many PVR devices come with multiple tuners to allow consumers to record different channels simultaneously. Most controversially, certain PVR devices have a 30-second skipping mechanism aimed to bypass commercials, effectively killing the normal business model of broadcast TV advertisements. Unlike the VCR in which the users need to painstakingly rewind or fast-forward, PVR gives users instant access to any part of the recorded content. It is a technology that severely aggravates the current consumption model of television content. Although its adoption has been slow, its potential for change is significant enough to warrant a review of how the technology could be adopted to build trilateral benefits to consumers, PVR manufacturers and broadcast content providers.

10.1 PVR Technology

PVR works by converting a standard analog TV signal to a digital signal that is stored on a hard drive and then converted back to analog during playback. However, there are two exceptions to this conversion. First, incoming digital signals such as digital cable and satellite are recorded straight from the source without analog-digital conversion. Second, there is no re-conversion on digital HDTV. The figure below¹³ shows how a typical PVR system works. When there is no digital to analog conversion, there is simply no degradation, giving the user extremely high quality content.

Figure 6: Typical PVR System

10.2 Economics

PVR led to new market entry with the debut of TiVo in 1999. The barrier to entry in this market is low since core PVR technology device is simply a hard disk and a CPU with enough processing power to perform audio/video compression. Currently, there are many different PVR-type devices in the market, but their adoption has been slow. Most research has attributed this to poor consumer awareness and confusion. Furthermore, consumers view standalone PVRs as a luxury good given their relatively high prices. There are 624,000 TiVo users and roughly 1.5 Million satellite PVR users out of over 20 million satellite customers. Only about 1 out of 20 US consumers has even seen a PVR in use. These statistics suggest that PVR suffers from a serious shortage of perceived value to consumers. Consequently, it appears that something is needed to encourage wider adoption. Identifying this driver first requires an examination of: (i) what PVR devices are available; and (ii) how they are sold.

¹³ TiVo case, Kellogg School of Mgmt

10.3 PVR Providers & Business Models

Most PVR technologies today are widely available to consumers through a standalone PVR box, cable and satellite set top boxes, PCs and soon as DVD/RW recorders. The underlying technology for all these devices is the same. However, the key technology and revenue model differences are summarized below with further details available for each specific device category.

Table 5: PVR Products

	Standalone Box	Cable & Satellite Set Top Box	PC PVR	DVD/R/RW
Major Players	TiVo ReplayTV	Panasonic (Moxie DVR Systems) Satellite - DirectTV (TiVo) Satellite - EchoStar (own PVR)	Internal Add-ons (Hauppauge's WinTV, ATT's All-in-Wonder Radeon) External Add-ons (ATT's TV Wonder, ShowShifter with DivX) Maccintosh (EyeTV by El Gato) WindowXP Home Ent.	Toshiba (Expected)
Price Range	\$249 & up	\$800 & up EchoStar - addl. \$150 DishPVR	Add-ons: \$50 & up PC - \$1500 ~ \$2000	
Programming Guide	Fee Method	DirectTV - \$4.99/month - Free if premium package EchoStar - Free Cable - Broadband Satellite - Phone Line	Free Phone Line or Broadband	No Programming Guide
Storage Capacity	Up to 320 GB (160 hrs)	Store on DVDs	Depends on PC harddrive	
Network Ability	Home Network with other PCs and stand-alone boxes USB expansion slots	None set top boxes	Home Network only	
Other Revenues	TiVo - License to others (upfront software fee, upgrade software fee, & per-box royalty fee) - Advertising fee on its home page & show case			
# Users/ Subscribers	TiVo - 624,000	EchoStar DishPVR > 600,000 Just Under 1,500,000	N/A	N/A

10.3.1 Standalone Box

Different providers of standalone boxes have adopted different revenue models to penetrate the market. TiVo is the leader in this product class. TiVo's revenue model consists of selling PVR devices and collecting subscription fees (monthly or one-time lifetime price) for an advanced programming guide delivered via telephone line transmission. It also charges advertisers and paid programmers to be showcased on TiVo menu screens. In effect TiVo has taken on a network operator role, by having an exclusive "private network" of its users. Theoretically, TiVo can utilize its database of viewer preferences to perform targeted advertising as well. However with its small user base of 624,000 users (< 1% of the US market), the TiVo business model has not been effective and the company's net loss in 2002 was \$55 million. Consequently, the company has tried to move its business model towards technology services. Licensing TiVo technology to hardware manufacturers and pay-TV operators has become a core strategy. These licensing deals provide TiVo with a steady income source: an upfront payment for its software technology; additional funds when the software is updated; and a per-box payment royalty when the product is sold. Current licensees are Sony, Philips, and Toshiba. Pay-TV licensees, such as DirecTV, also charge customers an additional monthly service fee for PVR using TiVo technology.

It appears that the standalone business model has not proven sustainable because its performance does not create a "must have" proposition to customers given current prices. Even though the device has high consumer satisfaction, only 5% of all potential customers have seen TiVo in action, making it difficult for "word of mouth" diffusion to be effective. Furthermore, in retail stores, commission-based salesmen have little incentive to promote TiVo since it takes an average of 15 minutes to sell a TiVo versus 1 or 2 minutes to sell other similar-priced electronic products. This makes it unlikely for standalone PVR devices to be the industry threat to broadcast advertisers as many have believed.

10.3.2 DVD/R/RW PVR

Major hardware manufacturers have already introduced DVD recorders for television use. One important feature is that these players record videos straight to DVD and not a hard drive. Hence they do not use PVR technology yet. In a way, these players are not much different than traditional VCRs except in providing superior digital quality. The most important feature these players lack is an interactive channel guide. Users have to rely on their own TV programming guide to set the exact time for recording. Currently, DVD recorders cost over \$800. However, these device makers do have a very strong value proposition for their customers. Consumers that utilize the functionality of a DVD/R/RW are most probably consumers who will enjoy PVR functionality. Therefore DVD recorders with PVR technology will come to market soon. Toshiba's next generation of DVD recorders (due by year end 2003) have full PVR functionality via a built-in hard drive. A hard drive combined with a DVD recorder allows consumers superior flexibility in archiving content. However costs will be a significant barrier to adoption for the next few years; current DVD recorders and DVD media are still priced

too high to attract the mass market. Therefore DVD/R/RW PVR hybrids will remain in the technology savvy consumer segment for the near term.

10.3.3 PC PVR

PC PVR can be categorized into three types: internal add-ons, external add-ons, and complete PC PVR packages. All three choices give users the same PVR experience but unlike standalone PVRs, users must watch content on a computer screen rather than a television. Add-on products provide the programming guide service free of charge in the hope of winning over customers. Some add-on cards cost as little as \$50 suggesting that pricing is competitive with other PC accessories.

In building a complete PC PVR package, Microsoft collaborated with several computer manufacturers and chipmakers to develop the Windows XP Media Center Edition PC, rolled out in 2002 and priced from \$1500 to \$2000. Microsoft has long been experimenting in the home entertainment area, first with WebTV, the TV-enabled Internet service, a TV-PVR set top box, and now the Windows XP Media Center Edition. Although its previous attempts were unsuccessful, Microsoft is counting on the adoption of its newest entertainment center to be fueled by price drops in PC components and the increasing trend of using PCs for entertainment.

Although PVR PC costs are very competitive, the PC home entertainment market will remain a niche market for the computer savvy user because most consumers differentiate PC use from TV leisure entertainment. For regular viewing of TV and movies, consumers prefer simple devices over complicated PCs that face operating reliability, crashes, obsolescence and virus related problems. Therefore PVR PC will probably not be a factor in wide PVR adoption.

10.3.4 Cable & Satellite Set Top Box

Incapable of providing true VOD, satellite operators have rolled out set top boxes with PVR to counter cable VOD. They hope to use this technology to keep growing market share. In comparison, cable operators have been slow to add PVR functionality to set top boxes. First, cable operators can provide more lucrative VOD services. Second, cable operators have just spent billions upgrading their networks to digital cable. Another round of set top box upgrades would be too costly and serves no strategic aims. Charter Communications is the only cable operator pursuing the PVR system. In contrast, satellite operators offer PVR products. DirecTV charges an additional \$200 for a PVR set top box and adds a monthly fee of \$4.99. EchoStar only charges for the PVR set top box at \$150 and has no monthly fee. As a result, DirecTV consumers have been switching to Dish Networks for free PVR monthly service. Aggressively pursuing the PVR market, EchoStar has rolled out their latest product (DishPVR) in 2003 with HDTV decoding and up to 250 hours of standard program recording or up to 40 hours of HDTV recording.

Unlike standalone PVR and PVR PC products, satellite companies have a real opportunity to help PVR “cross the chasm” given their significant user base. Satellite

operators have aggressively incorporated PVR technology in set top boxes for survivability and perceive this technology as a compatible time-shifting solution that enhances their core services. Satellite PVR is the primary feature to counter cable VOD.

However, the current PVR pricing for satellite subscribers is not in alignment with its adoption potential. There are over 20 million satellite subscribers but only 1.5 million of them (roughly 7%) have PVR set top boxes. The current PVR prices of \$200 (plus \$4.99 monthly fee) from DirecTV and \$150 from EchoStar may have to be eliminated and satellite operators might consider giving away the technology for free to build loyalty in existing customers and to win over cable subscribers. Although this may appear to be too costly and risky for satellite operators, there is significant merit to this strategy if examined critically. Below is a break-even analysis of the satellite PVR giveaway hypothesis.

Assumptions:

- DirecTV will drop its additional \$4.99 monthly fee to compete with EchoStar. Therefore satellite operators will bear the PVR cost of \$200 per device.
- As satellite providers announce the free giveaway of PVR's, all current satellite non-PVR subscribers (18.5 Million) will demand a free PVR.
- A number of new customer (N) previously using cable services will sign up to satellite service due to free PVR devices.
- Life Time Value (LTV) of a cable/satellite customer is \$3,300¹⁴.

Estimation 3: PVR Breakeven Investment by Satellite Companies

<u>Cost</u>		
	Satellite bears PVR costs	\$ 200
X	(Customer base)	18.5 Million + N
<u>Benefit</u>		
	Life Time Value of a satellite customer	\$3,300
X	New customers from cable	N
Solving for Cost < Benefit implies that N > 1.2 Million new customers are required to break-even.		

From the above analysis, it appears that satellite operators can still be profitable after giving away PVR products, assuming there is no change in the customer lifetime value. Furthermore, this strategy is more attractive when one considers the gains in more subscription fees from a larger customer base. One significant risk is whether satellite operators can indeed win and maintain an appropriate customer base. However, the calculations appear to be reasonable: gaining at least 1.2 Million new satellite customers out of 71 Million total cable customers is only a 1.7% defection rate. This rate is much

¹⁴ Industry estimate.

lower than the current 4% digital cable defection rate to satellite. This analysis suggests that a free satellite PVR proposition can be defended from a business perspective.

Under this business strategy, at least 22 Million households will have PVR, which would be a 21% market penetration. With proven high satisfaction among most current PVR owners, this penetration rate should only go up through customer referrals and as hardware prices continue to fall. Cable operators may also jump on the PVR bandwagon and TV manufacturers could begin embedding this technology in to televisions.

10.4 Summary of PVR Adoption Dynamics

Given the low historical adoption rate of PVR (2% in four years), PVR cannot reach mass adoption unless an aggressive adoption model is promoted. As a standalone product, PVR lacks significant consumer value and is overly complex to market. As a DVD product or PC product, it is a niche consumer good to technology savvy customers. Therefore, PVR will only be adopted through aggressive price subsidies in a manner that is attractive to a wide set of consumers. Satellite operators are best poised to provide these subsidies because their survival is in jeopardy as they compete with digital cable services.

If PVR can reach mass adoption, then the disruption it creates for broadcast advertising may become a serious issue. In Section 13, potential business practice changes are outlined if widespread PVR adoption can occur. Currently, PVR is a luxury consumer electronics product that is still trying to seed initial market penetration. This is in contrast to HDTV, a product whose adoption seems all but assured. A brief discussion of HDTV follows because it is an important part of the changes taking place in how consumer experience video entertainment at home.

11 HDTV

Unlike the other technologies examined in this research, HDTV will only be discussed briefly because HDTV:

1. Has both government and private interests aligned to push adoption;
2. Is not significantly disruptive to the Studio window release revenue model; and
3. Needs only falling prices, to keep adoption progress going.

However, the presentation of HDTV is important because the adoption of more HD infrastructure has relevance to Digital Cinema. Furthermore, HDTV is another product that seems likley to help cable companies battle satellite companies for market share.

After years of stagnation, HDTV appears poised to replace traditional NTSC television standards. Its adoption is no longer in doubt because the government has legally mandated that terrestrial networks transmit HDTV signals. Furthermore, cable and satellite companies have adopted policies to increase HDTV content to consumers. We will only summarize HDTV as follows:

- Introduction to HDTV and the HDTV standard; and
- Apparent impact on the value chain.

11.1 Technology Attributes

Current traditional TVs (NTSC¹⁵) deliver pictures with a resolution up to 200,000 pixels. HDTV's have up to 2 million pixels. It is those extra pixels that create a picture that is ten times sharper than traditional TV. HDTV also has a screen that is significantly wider than it is tall (16:9 aspect ratio) and promises improved sound quality that is comparable to CD's or digital surround sound.

The current standard that the FCC (Federal Communications Commission) has adopted is a broadcasting standard developed by the Advanced Television Systems Committee. The current standard mandates HDTV signals transmitted over a single 6 MHz channel, which is the current terrestrial broadcasting mode. This system requires a compression of about 19Mbps data to fit a 6 MHz channel. Consequently, this signal is incompatible with current NTSC service and cannot be received by standard TV receivers without a converter box.

The digital television system employs MPEG-2 video compression to encode video. In the ATSC document, there are 18 compression formats listed as follows:

Table 6: Digital Compression Formats

Vertical lines	Pixels	Aspect ratio	Picture rate
1080	1920	16:9	60I, 30P, 24P
720	1280	16:9	60P, 30P, 24P
480	704	16:9 and 4:3	60P, 60I, 30P, 24P
480	640	4:3	60P, 60I, 30P, 24P

Notes:

(1) *P*: Progressive scanning

(2) *I*: Interlaced scanning

(3) *Picture rate: fields per second. For interlaced scanning, 60I = 25 frame per second*

The first six digital formats are generally regarded as HDTV formats, the third line of the table lists SDTV formats (Standard Definition TV, a digital television system with quality slightly better than NTSC), and the last four formats are lower quality formats not meant for television broadcasting. It should be noted that the ATSC formats are not FCC mandated formats, but rather a “code of conduct” agreed upon by ATSC members¹⁶.

¹⁵ NTSC stands for National Television Standards Committee and is the color television standard in use in the United States today.

¹⁶ ATSC members include all leading television industry manufacturers and service providers.

Although the FCC has approved a digital HDTV standard, it does not have jurisdiction over channel allocation in cable and satellite networks. Cable companies can freely choose whether or not to adopt HDTV broadcasting, and what standards they will use.

11.2 HDTV Standards

Because the HDTV standard does not mandate performance standards, it is not a true single standard. Broadcasters are free to choose their video compression format. The following table shows the format choice of the “Big Four” networks and one major U.S. cable company:

Table 7: Digital TV Formats

Networks/Cable	Formats
CBS	1080i
ABC	1080i
NBC	1080i
Fox	480p
Cox Communications	1080i

HDTV decoders will be compatible with all digital formats¹⁷. Therefore, consumers should not care which HDTV sets they buy because the intention is full compatibility with the multi-formats. Though the ATSC standard may seem confusing, it should not be an obstacle towards mass consumer adoption. Most HDTV tuners are designed to be compatible with multi-formats so consumers can choose the receiver they like without worrying about compatibility.

11.3 Evolution of HDTV

The FCC mandated that network-affiliated stations of ABC, CBS, Fox, and NBC in the top 30 markets build digital transmitting facilities by November 1, 1999. All other commercial stations must construct DTV broadcast facilities by May 1, 2002. As a result of this mandate, most stations and TV networks are trying to meet this goal even though many small-market broadcasters have balked at HDTV conversion. This suggests that the standards set will ultimately stratify the market into the “HDTV” and the “non-HDTV” providers. Although the rollout has been slower than anticipated, it has been progressing.

Unlike NTSC, HDTV is an “all or nothing” transmission. This means that the cable and satellite industries are best poised to deliver digital content. However, the absence of an FCC must-carry policy by cable and satellite has been the decisive impediment to delivering HDTV content in the service chain given that current cable and satellite subscribers constitute more than 70% of US homes. These companies have been slow to adopt HDTV because it consumes massive bandwidth resources. Therefore, it is the lack of content that has largely stranded HDTV to date. However, competition between cable and satellite companies has gotten fierce and this competition has helped drive HDTV

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¹⁷ DTV Guide, April 2002, Consumer Electronics Association

content. HDTV technology is now the standard on most large screen televisions (over 40”) sold today. Therefore, its evolution may be slow but it is assured.

11.4 HDTV Value Chain Impact

As previously stated, HDTV should not have a large impact on the Studio release window model because it simply enhances the consumer’s enjoyment of movies and television. In fact, Studios can probably generate additional revenues with HDTV by producing HDTV DVDs. Current DVDs lack HDTV quality; therefore there may be an opportunity to segment the DVD market¹⁸. However, this opportunity will probably be on hold until new DVD technology can increase the capacity of DVD disks to accommodate HDTV content on one disk. As discussed earlier, the underlying technology used to produce Digital Cinema content is the same for producing HDTV content. So long as HD content is recorded appropriately, there is an opportunity to produce downstream derivative products.

The competition between cable and satellite providers is highly tilted in favor of the cable industry. Cable operators are in a better position to offer more HDTV content than satellite networks. Most terrestrial broadcasters in the leading markets have HDTV transmission equipment in place. Therefore, the HDTV infrastructure changes will not be a bottleneck to consumer adoption. In short, there is significant clarity regarding HDTV because there is a unifying front growing to push adoption. Unlike PVR, HDTV’s are easy for consumers to understand once they walk into an electronics store and see HDTV. This is a powerful tool in pushing technological innovation.

11.5 Summary of Video Distribution to Theatres and Homes

To this point, we have covered video distribution technologies from the theatre to the home. Studios have been flexible in adapting content from one incumbent platform (theatres) to others (VCRs, VOD, DVD, etc.). However, there is another important delivery channel to explore, and that is wireless delivery. The combination of data compression technology and wireless communication creates the potential for a new distribution channel for VOWD. In the following section, the opportunities and obstacles for video distribution on wireless mobile devices through 2.5G and 3G networks are explored. Unlike the previous technology discussions, VOWD is the most immature product that is still addressing key technology issues. Understanding these issues and how they affect the viability of VOWD concludes the last technology disruptor covered in our analysis.

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¹⁸ For the curious, the difference in a regular DVD and HDTV is the number of progressive-scan resolution lines (480 versus 720).

12 Emerging Mobility

12.1 Technology Overview

In order for streamed video to be delivered through a wireless platform, content needs to first be encoded properly and then stored in a server. Carriers need to then provide sufficient bandwidth to deliver the content at certain frame rates and resolution. Finally, device manufacturers need to provide cell phones/PDAs that can receive and play the video content.

On the hardware side, color screens are then compulsory. On the software side, the operating system needs to support the video compression format. This process is illustrated below, highlighting the technical competencies needed to make VOWD a legitimate possibility. Specific details about these competencies then follow.

Figure 7: Wireless Delivery

TECHNOLOGY

Video compression
MPEG-4, MS Media,
RealNetworks

2.5G/3G
GPRS, CDMA1xrtt,
iDEN

Cell phone, PDA
Client-side platform:
MS CE, EPOC, BREW,
Palm OS

12.1.1 Video Compression

When content is created, it needs to be compressed using compressor/de-compressor (CODEC) software to be stored and transported. The media format needs to comply with 3GPP¹⁹. There are several competing CODECs including various forms of MPEG-4, RealNetworks, and Microsoft Media Technologies. There is no dominant standard to date. MPEG-4 video compression enables wireless media at variable bit rates (down to 9.6 Kbps) and has been selected as the multimedia standard for 3G networks by 3GPP. In comparison, Thin Multimedia has a proprietary wavelet codec called TCM-3 (Thin Client Media 3), a different codec from MPEG-4, but with an upgrade path to MPEG-4. This technology has been used by Korea's SK Telecom. Alternatively, Microsoft and RealNetworks, the compression technologies competing on the PC platform, each claim more than 125 million registered copies of their CODECs by 2001²⁰. There is little

¹⁹ The 3rd Generation Partnership Project is a collaboration agreement established in December 1998.

²⁰ Gartner: Streaming Video Over GPRS: Hype or Reality, May 4 2001)

opportunity for all three standards to emerge intact in the future. The winning standard will depend on their partnership with device manufacturers and content owners. This standards battle is the first stage in making VOWD a reality.

12.1.2 Wireless Network: 2.5G and 3G

Below is a summary of the potential 3G networks and their data speed ratings²¹.

Figure 8: Wireless Evolution

	Wireless Networks	Peak Speed (Kbps)	Expected actual speed (Kbps)
IS-41 Core Network	GPRS (2.5G)	115	20-40
	Edge	384	80-110
	W-CDMA	384	200-300
GSM Map Core Network	CDMA 2000 1x	153	60-80
	CDMA 2000 1x EV-DO	2400	200-300
	CDMA 2000 1x EV-DV	4800	200-300

From 2001 and 2002, major wireless carriers in the U.S. began to roll out next generation wireless network that are necessary if VOWD is to be brought to market. Below is a summary of the rollout upgrades by major U.S. cellular service providers.

Table 8: U.S. 2.5G Technology

	Technology	Peak Speed (Kbit/Sec.)	Advertised Data Rate (Kbit/Sec.)	Initial Rollout
Verizon Communications	CDMA2000 1XRTT	144	60 to 80	Jan-02
Cingular Wireless	GSM/GPRS	115	20 to 40	Jun-02
AT&T Wireless Services Inc.	GSM/GPRS	115	20 to 40	Jun-01
Sprint PCS Group	CDMA2000 1XRTT ²	144	50 to 70	Summer 2002
Nextel Communications Inc.	Enhanced iDEN ¹	NA	30 to 50	Jan-03

1. Short form for Integrated Digital Enhanced Network.

2. The first generation of CDMA2000 calls for speeds up to 144K bit/sec., but vendors claim typical speeds of 50K to 80K bit/sec.

In the U.S., there is no streaming video service provided on cell phones. Therefore one must look at the Japanese and Korean markets to see what may be viable on the different technology platforms. The data below summarizes NTT DoCoMo's FOMA²² i-Motion service.

²¹ The migration paths from 2G to 3G is available on International Telecommunication Union's web site at <http://www.itu.int>.

²² Freedom of Mobile Multimedia Access: NTT DoCoMo's 3G service based on W-CDMA technology, supporting up to 384 Kbps

Table 9: FOMA Platform

Video Processing	Encoding formats	MPEG4 simple Profile Level 0 and MPEG4 simple Profile Level 1 with 3GPP restriction
	Screen size	subQCIF (128 x 96 dots)
	Frame rate	15fps maximum
	Bit rate	Approximately 40 Bps
Audio Processing	Encoding formats	AMR
	Bit rate	12.2Kbps, 6.7Kbps
	Sampling rate	8KHz

According to this specification, a streamed video clip requires 47-52 Kbps to deliver acceptable performance. This screen size is actually below the resolution specified by QCIF²³ (144 by 176 pixels). NTT DoCoMo's better V-Live streaming video service (MPEG4 format on 3GPP-compliant FOMA phones) requires at least 64Kbps bandwidth. In Korea, the largest carrier (SK Telecom) adopted Thin Multimedia's TCM-3 technology, which claims to be capable of providing video-on-demand service on both CDMA1x and GPRS²⁴ network. However, bandwidth will fluctuate according to the number of users within a particular cell. Video streaming requires low bit rate errors and high-density cell sites. Coupled with spectrum constraint, this makes a commercialized video service (which would require minimum of 56 - 64 Kbps at 15 fps) difficult under current GPRS network although Thin Multimedia's technology has slightly lower bandwidth requirement. For CDMA technology, it is uncertain that the 1xrtt technology can deliver satisfactory streaming video in a stable and consistent manner. Nevertheless, by 2004, all major U.S. carriers will upgrade to GPRS or CDMA1xrtt (with the exception of Nextel which uses enhanced iDEN).

12.1.3 Devices and Client-side Platforms

Currently on the U.S. market, some cell phones and PDAs have video players but few can play streaming video (e.g. Nokia 3650 with RealOne player). For downloaded video, the video length is usually limited to 100 Kbytes, unless the device supports external memory expansion. For video applications, a color screen is very important. Current color-screen cell phones/PDAs are available in U.S., but remain too expensive for many consumers. Battery life is also a serious concern for both 3G and video applications as these technologies consume more electricity. Clearly, there are technology constraints that impede service quality.

In order to display streaming video, a device needs to have either a hardware player, or a software player. For video player companies, it is critical to partner with mobile chip manufacturers or device companies to build their technology standard into devices.

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²³ QCIF: Quarter Common Interface Format, standard for streaming video for mobile application specified by 3GPP

²⁴ Cellcom, Israel's #1 operator, will use Thin Multimedia's solution to provide video services on its GSM network.

Similarly, there is a battle to be the dominant cellular device operating system. The dominant operating system will dictate how VOWD will evolve. The current leading operating system specially designed for 2.5G and 3G cell phone is Symbian's EPOC, backed by major cell phone manufacturers like Nokia²⁵. Symbian OS phones were available in the first half of 2001. Both Emblaze and PacketVideo, leaders in the emerging video over wireless space, have optimized their video software for Symbian. On the other side, Microsoft has continued their partnership with Intel to the wireless platform in hopes of being the leading cellular OS provider. The company has already finished developing "Smartphone 2002" OS supporting both GSM and CDMA technology.

Qualcomm, the largest CDMA chip manufacturer, has developed the proprietary BREW²⁶ system. In the U.S., Verizon and ALLTEL have adopted the BREW platform for their data services. Interestingly, Palm has been a slow mover, and currently has not allied with any streaming video software providers (Emblaze, PacketVideo or Virage). They are adopting a wait-and-see approach. Even Linux is emerging as an operating system on handheld devices.

12.1.4 Conclusion of Technology Review

From the analysis of video technologies and client-end platform on cell phone platform, it is clear that VOWD is still in the introductory stage of the product life cycle. The market is waiting for a dominant design to emerge. One of the critical differences between mobile data services in the U.S. and in Japan is that NTT DoCoMo²⁷ can take the lead in setting a single standard for content providers and cell phone manufacturers. The U.S. carrier market is much more fragmented compared to that in Japan. One reason for the success of DoCoMo's low-bandwidth data service is that a dominant design – i-mode – has fostered subscription growth to 30 million in less than three years. In comparison, the largest U.S. carrier, Verizon Wireless, only holds a 23% market share. This is not strong enough to predict a dominant design for VOWD. Therefore, the existence of many variations of compression standards and client-end platforms create difficulty for the adoption of video on cell phone /PDA for the following reasons:

- Video software companies have to form partnerships with various operating system providers;
- Device manufacturers have to support multiple platforms;
- Wireless carriers have to decide on which type of system and format they will base their data content; and

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²⁵ Symbian is collectively owned by Ericsson, Nokia, Panasonic, Motorola, Psion, Samsung Electronics, Siemens and Sony Ericsson. It licenses software for data-enabled 2.5G and 3G mobile phones.

²⁶ Binary Runtime Environment for Wireless: a thin application execution environment that provides an open, standard platform for wireless devices.

²⁷ Has 60% of cell phone subscriber market.

- Video content providers need to choose CODECs and may have to support multi-formats.

The growth stage of video on cell phone /PDA will start with the emergence of a dominant design. However, significant growth is more dependent on business considerations – partnerships, complementary assets, and motivations – than compression technology. Most importantly, it is dependent on whether the appropriate content will be provided. Similar to other entertainment media, content is often the driver for mass adoption to stir.

12.2 Content – Value Proposition and Costs

12.2.1 Cell phone data content in general

Currently the most successful cell phone data service is NTT DoCoMo's i-mode. Launched in February 1999, the data rate was 9.6 Kbps until upgrades to 28.8 Kbps took place last May (NTT DoCoMo's FOMA was launched in selected area in October 2001). By May 2002, data subscribers (32,988,000) accounted for 80% of NTT DoCoMo's cellular base²⁸. Despite low data rates, entertainment services accounted for more than half of NTT DoCoMo's cellular data traffic. Entertainment services include games, character downloads, ring tones, wall papers, horoscope, fortune telling, Karaoke information, hit songs, FM radio information, club event information etc. 46% of NTT DoCoMo's content is games, entertainment, melodies and images.²⁹ Since DoCoMo introduced the next generation FOMA, only 112,300 people in 8 months have subscribed. This is disappointing considering that i-mode signed up 5 million people during the first year.

In South Korea, ring tones and picture downloads are dominant wireless applications, but information content has not been popular. The largest Korean wireless carrier SK Telecom has 8.4 million wireless Internet users³⁰ (service coded NATE) on its 2.5G network by March 2003. However, since SK Telecom launched its EV-DO service in January 2002, it only attracted some 230,000 subscribers for its EV-DO service out of its 17 million subscriber base by January 2003. In the U.S., ring tones take almost 80% of wireless Internet market according to Moviso, with pictures or games as distant followers. Two preliminary conclusions can be drawn from these findings: (i) entertainment applications are popular on cell phone platforms; (ii) low bandwidth data service has already been successful in some markets in Asia; and (iii) bandwidth is less critical than content availability in terms of data usage.

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²⁸ Gartner Research, NTT DoCoMo: i-mode Wireless Internet Services, 26 July, 2002

²⁹ Gartner Research: NTT DoCoMo: i-mode Wireless Internet Services, 26 July, 2002

³⁰ User is defined as a person who uses wireless Internet services more than once per month via a handset, PDA, and VMT, etc.

12.2.2 Video on Cell Phone

Unlike the content we see in traditional distribution channels, content on handheld mobile devices has unique characteristics and consumption patterns. Because the goal of this research is to explore the opportunity for cell phone /PDA as a new distribution channel for video products, the focus is on commercial video content rather than user-created content.

In general, handheld devices have a small screen size (low resolution), short battery life in high bandwidth networks, and high portability. The current QCIF³¹ video standard has 15 frame rates per second (compared with 24 fps for film and 30 fps for NTSC TV). That rate serves as a basis for the type of video that may emerge. Commercial video content on handheld devices can therefore be categorized into entertainment products and information products.

Entertainment Products

Traditional video entertainment includes movies, TV programs, and video games. Due to the short viewing times and lower display quality, long content is not appropriate for wireless handhelds. Traditional entertainment content focuses on high quality audio/video to deliver a pleasant experience to viewers who sit and enjoy entertainment. However, for wireless handheld devices, the experience is totally different. Few consumers will set aside time beforehand to access entertainment on a portable device. Therefore, mainstream entertainment content from Studios and TV networks cannot be easily moved to the mobile platform.

To date, successful entertainment content on cell phones have been device personalization (ring tones, wall paper etc.) and simple games. Currently some major Studios (Sony Picture Entertainment, Universal Studios, and 20th Century Fox) are forming partnership with carriers, cell phone manufacturers, and game publishers to bring their content on to wireless platform for film-based games, ring tones, and pictures. However, it is still not clear whether it is appropriate to bring mainstream video entertainment content to wireless devices. Globally, Korean telecom carriers are the pioneers in delivering commercialized video content on 3G networks. SK Telecom's 3G mobile multimedia service "June" provides customers with movies, TV programs, MTV's on cell phone. Since last November, Korea's SK Telecom has launched four wireless films including "Project X", "Egg and Gangster", "My good Partner" and a new love story for its new CDMA2000 1X EV-DO network. The typical length of each episode is about 2-2.5 minutes. The budget for the new release is about \$500,000. These movies have been produced by independent studios specifically for the mobile platform. As a result of SK Telecom's heavy marketing efforts, its EV-DO subscribers grew 73% in January 2003. Although this growth may not be directly related to just these short movies, they have certainly added to the appeal of high-bandwidth mobile access.

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³¹ The format specified by 3GPP.

Besides entertainment, VOWD has the potential to be a significant platform for advertising. For example, Viacom's MTV had a wireless promotional campaign for its Video Music Awards on AT&T and Sprint. MTV also reached an agreement with Motorola on a 3-year \$75 million joint marketing agreement³². Because cell phone advertising has the potential to target specific audiences better, it must be used carefully to prevent consumer backlash from excessive advertising spam. Based on current events, video promotion clips on mobile devices seem likely to be more popular going forward.³³

Information products

Traditional information content includes news, sports, weather etc. In the PC world, on-demand news video has not been very successful. Although all four major networks have video streaming from their websites, demand has been weak. It is still unclear whether people will pay for general information video on-demand.

Basic economic theory argues that given many substitutes and low switching costs, charging premium prices will be difficult. Therefore, information content that is significantly differentiated and targeted at niche markets may have a better prospect than general video information services. In addition, people tend to access information on cell phones on an ad-hoc basis and are usually clear about what they seek. As a result, time sensitive, information video content may be most viable on mobile devices where users are focused on results and not passive entertainment.

Because current video content is not well-suited for wireless devices, new content must emerge for VOWD to be popular. The device interface, time, location and video-watching needs are different from the products of traditional content providers such as Studios. There will be a need to differentiate video content over wireless devices to provide a compelling value proposition to consumers. Among others, interactive entertainment and live broadcasts of activity-based or location-based information contents are examples of new content necessary to create real demand for video over wireless devices.

12.2.3 Cost to Consumers

Like all emerging technologies, consumer costs must be examined to add analysis depth and realism. The following chart shows data charges on 2.5G networks by selected U.S. carriers.

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³² MTV content will appear on Motorola cell phones' menu

³³ In February 2002, NTT DoCoMo, Dentsu Inc. and ActiveSky conducted a three-week trial of streaming mobile advertising in greater Tokyo.

Table 10: Current Wireless Data Services Pricing

	Charge by Data Volume	Unlimited Access
AT&T mMode	\$2.99 to \$19.99 per month with 0 to 8M data included, over quota rate is 2 cents to 0.6 cents per K byte	No
Verizon Express Network	\$35 with 10M (0.8 cent after), \$55 with 20M (0.6 cent after)	\$79.99 per month
Sprint PCS Vision	Additional 1 cent per K byte on voice only plan	\$10 in additional to voice plan
Cingular	\$19.99 (100 K incl., \$0.2 per K after)	\$59.99 per month

Source: Company websites

For streamed video at a 56 Kbps data rate, one-minute of video would have a file size of 420 Kbytes. At 0.6 cents per K byte (the lower bound pricing rate), one-minute of video would cost consumers \$2.52 in airtime alone. Therefore, flat rate charging is more appropriate for streamed video applications.

Data charge by Kbytes seems appropriate under slow network speeds, but under high network speeds of 2.5G and 3G, the cost to consumers for heavy bandwidth applications such as video streaming would be too high. The following table shows a comparison of monthly average revenue per user (ARPU) of U.S. carriers and NTT DoCoMo.

Table 11: ARPU Statistics

	U.S.	NTT DoCoMo
Voice ARPU \$	52.34	53
Data ARPU \$	0.89	13
Total ARPU \$	53.23	66

Sources: Morgan Stanley, Gartner Research

In 2002, the data contribution to monthly ARPU for NTT DoCoMo is about \$13. At 78.8% i-mode penetration, average data spending per i-mode customers is roughly \$17. It is interesting to note that the United States and Japan have similar voice ARPU. Considering the fact that the Japanese are more likely to access the Internet through cell phones, one can assume that the monthly spending on data services in the U.S. should be roughly \$20 if data services are to reach mass adoption. For video streaming to become a popular activity on cell phones then, this \$20 should be a flat monthly charge for data.

12.3 Incentives & Economics across the Wireless Value Chain

In this section, each participant in the wireless value chain is examined to determine the economic dynamics and motivations for VOWD. The focus is on identifying the VOWD obstacles in the value chain, who may lead content aggregation, and what kind of business model can best facilitate video streaming services. To determine the motivation and incentives of each participant, the following forces are deemed most relevant:

- Strategic priorities;

- Competitive pressures; and
- Risk and return.

The following chart shows major participants in the value chain:

Figure 9: Wireless Industry Participants

12.3.1 Video Content Owners

Studios have already begun moving some derivative content on to the mobile platform. The following chart shows various partnerships of Studios and TV networks on the cellular platform. Current partnerships relate to games, ring tones, and pictures. No video content is currently licensed.

Table 12: Partnership Agreements

Partners	Examples
Cell phone manufacturers	Nokia's Starcut with Universal Studios, Motorola with MTV
Technology solution providers	Qualcomm with various studios, Emblaze with ESPN, PacketVideo with SPE, 20th Century Fox, Warner Bros.
Wireless carriers	Major carriers with Sony Pictures, Sprint PCS with Disney, ESPN and ABC
Wireless marketing companies	SkyGo with ESPN
Game publishers	THQ Wireless with 20th Century Fox
Independent content aggregator	Moviso with MTV, Universal Music Group, Sony Music

Source: News release and company websites

Currently, mobile data services are a low priority for Studios and TV networks who are more concerned about Digital Cinema and traditional home entertainment distribution markets. As previously stated, mainstream Studio content is simply inappropriate for mobile viewing, and the market is still too immature for these companies to devote significant resources to the wireless initiative. It is possible that wireless video advertising for mainstream Studio content may be pursued, but only after VOWD has taken off. Current leading content owners – Studios and TV networks –do not have the incentives and/or pressure to push content on the wireless platform. The one exception is Sony Pictures. Expanding content to mobile devices is part of Sony's core strategy to build a huge connected platform for AV, PC and mobile devices. In early 2003, Sony announced its new strategy theme, "A World About U".

As discussed earlier, new entrants must appear to provide content that is better customized for mobile devices and its unique consumption pattern. Innovation must come from outside the current content leaders. Similar to the events in Korea, independent studios must catalyze and originate short films on mobile devices. New entrants will also emerge as information providers begin tailoring services specifically for mobile usage (see analysis in Content section). In short, content for VOWD must come from new thinkers that are not the current leaders in video entertainment.

12.3.2 Video Processing Companies

The competition is getting fierce for companies pushing their proprietary solution as the dominant standard. Microsoft's strategic focus is the handheld operating system and delivering Windows powered devices and media players. In contrast, companies such as RealNetworks, Emblaze and PacketVideo are focusing on the audio/video delivery technology in pushing media solutions in mobile devices. These companies are aggressively forming partnerships with device companies, chip manufacturers and content partners. RealNetworks already has access to much content and a partnership with Nokia to build their technology into Nokia's cell phones. Emblaze has established Roaming Eyes as its content syndicator and has recruited partners including Cnet, ESPN, Reuters, NY1, and Tomorrow TV. PacketVideo has over 30 partners including 20th Century Fox, Sony Picture Digital Entertainment, and Warner Bros. These companies all believe that first mover advantages are critical to tipping VOWD to their technologies and ultimately, their own survival.

Figure 10: Example of Roaming Eyes Solution:

12.3.3 Wireless Carriers

By the end of 2002, the U.S. had 141 million wireless subscribers; this is 48% of the U.S. population³⁴. Table 13 shows market share data for the major U.S. carriers.

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³⁴ U.S. population estimated to be 291 million, courtesy of the U.S. Bureau of the Census.

Table 13: Major Carrier Rankings

Ranking	Company	Subscribers (000s)	Market Share
1	Verizon Wireless	32,491	23.0%
2	Cingular	21,925	15.5%
3	AT&T Wireless	20,859	14.8%
4	Sprint PCS	14,760	10.4%
5	Nextel	10,612	7.5%
6	T-Mobile	9,913	7.0%
Industry Total		141,349	

Source: Company filing

For data services, no U.S. carrier has been successful in generating strong demand. AT&T has 300,000 m-mode subscribers to date (1.4% of their total users). Verizon has 150,000 – 200,000 users on their Express Network (0.6% of their total subscribers). Sprint has 630,000 Vision subscribers (4.3% of total users). Clearly, 2.5G penetration is still very low with the weighted average of the above 3 carriers to be 1.66%. Only Sprint PCS is pricing aggressively to attract more users to their 2.5G services. This low penetration suggests that carriers may not be bullish on selling data services if they may conflict with voice service resources. This is examined in further detail next.

Profitability of Voice and Data

The following calculation shows revenue per Kbyte for voice signals:

Table 14: Voice Profits

VOICE	
Voice data rate (Kbps)	8 Kbps*
Voice data rate (Kbytes/s)	1 Kbytes/sec
Per minute charge	<\$0.1
\$ per Kbyte	\$0.0017

Assuming analog voice signal is translated to digital signal by vocoder at 8 Kbps

In addition, the following table shows revenue per Kbytes for data signals (excluding unlimited plans):

Table 15: Data Prices

Plans charging by Mbyte		\$ per Kbyte
AT&T mMode	\$2.99 to \$19.99 per month with 0 to 8M data included, over quota rate is 2 cents to 0.6 cents per K byte	0.0025 to 0.02
Verizon Express Network	\$35 with 10M, \$55 with 20M	0.00275 to 0.0035
Sprint PCS Vision	Additional 1 cent per K byte on voice only plan	0.01
Cingular	\$19.99 (100 K incl.)	0.2

From the above comparison, current data plans offer more revenue per Kbytes transmitted. However, non-flat fee data rate plans are designed for low-bandwidth data services. Earlier we suggested that flat rate monthly charges were deemed most appropriate for commercial video applications. For a flat rate plan then, assuming voice revenue is at maximum of 0.17 cent per Kbytes, the following chart (Figure 11) shows the maximum data download before data services generates less revenue for the given spectrum resources than voice services.

Figure 11: Wireless Data Pricing Analysis—Breakeven Megabytes

Assuming consumer data spending (for airtime alone) at mass adoption levels will be \$20 per month, the monthly data download that would make carriers indifferent to voice or data services is only 28 minutes of video. This capacity is too small. Moreover, video applications are more likely to be consumed during the day (there is little need at home or at night) when voice traffic is high. This actually suggests that carriers may not have an incentive to push video applications if there are resources and capacity trade-offs between data and voice services.

Previous calculations have shown that current data charges by data volume generate more revenue per unit of resources than that from voice. Furthermore, the success of data applications in Asia has demonstrated that low-bandwidth data services (particularly SMS) can generate significant revenue if a compelling business model is set in place. There is no guarantee that high-bandwidth data services will generate higher revenue per unit of resources.

Another important problem for carriers in providing high-bandwidth data services is spectrum resource. Under current carrier networks, spectrum capacity is already tight in some markets. Video applications are especially capacity-consuming. Currently over 98% of ARPU is contributed by voice. Carriers do not want to disturb voice service with unproven demand for video applications. From a carrier's resource perspective, VOWD may cannibalize voice services. This issue is a clear problem in building industry enthusiasm for VOWD.

The Viability of 3G Upgrades

From the technology analysis, video streaming seems most appropriate on 3G networks, specifically EDGE/W-CDMA and CDMA1xEV-DO, although current CDMA1xrtt may also be able to deliver the service. Every carrier will need more spectrum capacity as wireless usage expands. To upgrade from 2.5G to 3G, carriers need to acquire additional spectrum. It is expected that FCC will auction an additional 175 MHz of spectrum to support 3G around 2005/2006. The total new investment in this spectrum may exceed \$10 billion; this may postpone the adoption of 3G until 2005-2007. A significant difference between U.S. carriers and NTT DoCoMo is NTT DoCoMo does not pay for its spectrum.

There are ways to increase capacity on existing spectrum such as: (i) building more base station radios to cell sites; (ii) adding new cell sites; and (iii) upgrading vocoder technology, which basically means upgrading to 3G. Most of these measures require significant capital outlays and new cell phones to consumers. In the U.S., carriers often subsidize cell phone purchase. From 2001 to 2002, wireless carriers' cell-phone subsidies in the U.S. rose 18%, from \$3.8 billion to \$4.5 billion³⁵. The rollout of 3G may potentially require large capital expenditure on cell phones given the U.S. marketing model. This is a significantly different business environment than that of NTT DoCoMo.

In addition, the capital expenditures for upgrades from 1xrtt to 1xEV-DO and GPRS to EDGE/W-CDMA are much higher than the previous upgrades. The 3G upgrade is estimated to be roughly \$50 billion dollars to the top 6 U.S. carriers³⁶. High-bandwidth products such as video are not likely to generate more dollars per unit of resources consumed. Furthermore, low-bandwidth products have been proven to be profitable in other markets. This makes it difficult to believe that carriers will simply “build” 3G believing that content, services and customers will follow. This is aggravated by the tight financial position of the telecommunications industry. Stock prices of leading wireless carriers have dropped 80%-90% in the past 3 years (AWE, PCS, and NCTL). In the bond market, Sprint PCS and Nextel have bond rating below investment grade. AT&T Wireless has a BBB rating. Debt to total capitalization (market value) for AT&T Wireless, Sprint PCS and Nextel was 41.7%, 82.6% and 51.0% respectively by the end of 2002³⁷.

From the above analysis, it appears that demand for high-bandwidth data services are not strong enough to promote carriers to further upgrade their networks to 3G. However, they may upgrade because of the need for more voice capacity. Voice traffic is unquestionably the dominant traffic on cell phone networks and will remain so for at least

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³⁵ Estimates by wireless consultancy InCode Telecom in La Jolla, CA

³⁶ A simple estimate for upgrade cost from 2G to 3G: Average cost of 3G base station \$750,000 * 86000 base stations in U.S. + \$10 billion spectrum cost = \$75 billion. Top 6 carriers have 78% of base stations, which translates to \$58.5 billion cost. 2.5G upgrade will cost \$8.5 billion for top 6 carriers. Remaining spend will be roughly \$50 billion for top 6 carriers. (Source: US Bankcorp Piper Jaffray, SG Cowen)

³⁷ Company filings.

5 years. However, current GPRS upgrades do not improve voice efficiency, whereas 1xrtt almost doubles voice efficiency. GSM network carriers may want to upgrade to EDGE or even W-CDMA to improve voice capacity, especially in places where capacity constraints are acute. Among the 4 largest non-CDMA carriers, AT&T has the most spectrum resources among all wireless carriers in the U.S., and thus AT&T may not upgrade immediately. Nextel plans to acquire additional spectrum from the FCC. This leaves Cingular and T-Mobile with the most incentive to upgrade. They are 2 of the top 3 debt-rating wireless carriers. Since 1xEV-DO only improves data capacity, CDMA carriers may be more cautious to upgrade unless there is sufficient demand. 3G services are expected in some U.S. cities by 2004³⁸, but the conversion process will be slow and may extend over the 5-year horizon. Commercial video applications have not been a reason for carriers to upgrade their network, but if carriers do choose to upgrade, it is very likely to be one of the 3G applications.

Competitive Pressure and Content Partners

With cell phone penetration about 50%, subscriber growth rate is expected to slow. In the top 20 U.S. markets, the penetration rate is closer to 60%. When a market reaches saturation, the growth of one carrier will have to be at the others' expense. Carriers will then have to differentiate their services to avoid price competition and win new customers. In the voice service, service is difficult to differentiate. Therefore, the decline of voice ARPU is simply inevitable.

Facing pressure in lost voice ARPU, carriers will be motivated to provide satisfactory data services to boost total ARPU and keep attrition rates low. Currently, major carriers like Verizon and Nextel are still focused on selling data services to business customers who tend to have higher ARPU. Consumer data applications are a lower priority along with commercial video streaming. A change of strategic focus is necessary by U.S. carriers if consumers are expected to adopt handheld data services.

12.3.4 Device Manufacturers

Currently none of the top 6 U.S. wireless carriers sell cell phones supporting streamed video. Only AT&T and T-Mobile support the Nokia 3650 which has a video player. However, most carriers support the Pocket PC/PDA standard and major cell phone companies have already begun partnering with technology firms to build streaming video capabilities into these devices. However, storage is a significant issue in video streaming on handheld devices. Streaming video requires enough cache to function smoothly (i-motion capable cell phones can only play 100 Kb video now). To meet the requirement of streaming video, device must have more built-in memory or support memory expansion cards.

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³⁸ NTT DoCoMo's investment in AT&T Wireless requires AT&T to launch W-CDMA technology in certain areas of Dallas, San Diego, San Francisco, and Seattle, or agreed upon alternate cities by December 31, 2004, covering approximately 8 million POPS. Verizon is also capable of providing 3G in San Diego and Washington D.C.

Device manufacturers have an incentive to push new video-capable phones because if they become popular, they will benefit substantially. Nokia established a company named Starcut in early 2000 as its mobile movie entertainment aggregator. Starcut takes care of content design and implementation to facilitate the fusion of mobile media and entertainment. It has a licensing agreement with Universal Studios. Sony Ericsson is another company that has the motivation to push video applications on cell phones. Clearly, the device technology companies are most interested in trying to stimulate video services for the handheld market because it is a method to increase hardware sales.

12.3.5 Independent Content Aggregator

In addition to the players in the value chain, companies acting solely as content aggregators for mobile platforms are beginning to emerge. The most prominent example is Moviso, which was acquired by Vivendi Universal Net USA in 2002. Partnering with key mobile carriers, mobile service providers, and media/ entertainment /consumer brands, Moviso provides ring tones and picture downloads for mobile phones. Moviso claims about 70% market share in this category. For ring tones and pictures, Moviso's value-added activities are content recreation, format conversion and multi-platform supporting (supports four media types and seven major handset protocols). For video applications, Moviso may still provide value in porting data to different hardware but compared with content processing companies, Moviso's value-added services to both carriers and content producers are somewhat limited.

12.3.6 Conclusions on the Wireless Value Chain

The following table summarizes our analysis of various participants in the wireless value chain, and our estimates of the future trend. We believe that, unless every party in the value chain has economic benefits and incentives in place, video on wireless distribution cannot become a mass market business even with sufficient consumer demand. First, carriers lack the expertise and incentives to assist content producers develop the market. Second, there are significant variations in hardware and formats due to the lack VOWD standards. Regarding the potential content aggregators, early aggregators are expected to be technology solution providers.

Table 16: Value Chain Summary

	Motivation	Potential To Be Content Aggregator	Early Movers
Video Content Owners	Medium • Outside strategic focus (excl. Sony) since traditional contents may not appropriate; • Can leverage current products by producing derivatives • Studios/TV networks with successful Internet contents may have more incentive.	Low • Customers do not like tie-in with single content owner • Conflict of interest	• Sony Pictures, ESPN • New entrants who providing non-traditional contents
Content Processing companies	High • Core business; • Competing for standard; • New firms striving for survival	Medium to High (early) • Standard war requires content support • All major players have already started to build content	RealNetworks, Emblaze, PacketVideo etc.
Wireless Carriers	Medium to Low • Need 3G investment and subsidize new 3G video-capable phones • Spectrum /capacity constraint • Less profitable than low bandwidth applications • Firms first upgrade to 3G may have incentive to differentiate their service (in a matured market)	High (late) • More control over content quality • Avoid tie-in one processing technology (compared with current Verizon model)	Cingular, T-Mobile upgrade to EDGE
Device Manufacturers	Medium to High • Selling more devices • Just one function of the device and demand is still not proven	Medium to Low (early) • Create demand for new devices • Move from product to service (build-in menu) • Sourcing content is not strategic focus • Lack production capacity	Sony, Nokia
Independent Content Aggregators	Medium to High • Leveraging established relationships with carriers, and media companies	Medium to low • (Unlike ring tone and pictures,) Key value-adding activity is absent for video applications	Moviso etc.

12.4 Ways to the Future –Recommendations

12.4.1 Clearing Obstacles

From this analysis of technology, content demand, and service provider incentives, some of the obstacles in the wide adoption of VOWD have been identified. On the technology side, there is no dominant standard for video compression on handheld devices. This uncertainty makes investments risky for service providers who need to pick a hardware platform. On the device side, there are no carrier-supported cell phones capable of streaming video even though the technology is available. The problem is that manufacturers need to choose a technology that has the right content partners; otherwise they must support multiple formats, a costly proposition. However, the key problem is that carriers need to expand network speed and capacity by upgrading to EDGE/W-CDMA or 1xEV-DO. This upgrade process will be very slow and take over 5 years based on current conditions in the telecommunications industry.

It is clear that early video content providers will be traditional content owners, but they have little incentive to push this line of business. To solve the incentives issue, new entrants need to enter the value chain and provide more and new varieties of content suited for mobile devices. This can only happen after carriers make clear moves to enable and push VOWD. The critical part of the chain is still the wireless carrier. Actions that need to be taken on the carrier's part before the wide adoption of VOWD must include the following:

- Upgrade to 3G to increase speed and capacity of network;
  - Although current 1xrtt is capable to transmit video streams, the lack of economic incentives will stop its adoption.
  - Carriers need to have sufficient capacity to provide high bandwidth data and not have to face trade-offs between various products.
- Make content partnership a more formalized process and create clear and attractive revenue sharing plans;
- Set content standards and interface specifications;
- Carriers should support multiple video formats; and
- For non-flat rate plans carriers should adopt flexible and intuitive airtime charge rates such as:
  - Low bandwidth products may be charged on per piece or per mega byte basis; or
  - High bandwidth video products may be charged by the minute.

12.4.2 Adoption Process

The following chart summarizes the process of adoption in the early and growth stage of the product life cycle for VOWD.

Figure 12: Adoption Process for VOWD

Video processing and device/chip manufacturers will take the lead in content aggregation in the introduction stage as evidenced by RealNetworks, Emblaze, PacketVideo, Nokia, and Qualcomm. Early content will still come from traditional content owners because this is low risk experimentation that is not overly costly. However, new content specifically designed for handheld devices will emerge to drive the growth of video on handheld devices after the very early stage. Hopefully by that time, carriers will already have infrastructure in place to stimulate demand. The final content aggregator will then be the wireless carrier after initial trials video services. These carriers will have the power to set the process and interface standard. They may ultimately be the true beneficiaries of this new class of services, a markedly different structure compared to traditional video content where bargaining power lies with content licensors.

13 Final Research Conclusions across the Entertainment Value Chain

The easiest way to summarize the research findings is to update the diagram of the value chain for entertainment distribution with the key findings. For the most part, the chain will remain intact. However, there are certain changes that will take place, all of which are induced by the technology discussed in this analysis.

Figure 13: Revised Industry Structure

13.1 Digital Cinema Findings

The entry of more content suppliers should increase Exhibitor bargaining power in acquiring alternative content. If enough small-scale entrepreneurs can prove the viability of alternative content, leading Exhibitors would follow. In fact Exhibitors would have an incentive to follow since greater content supply would drive their bargain power up in content acquisition. If Exhibitors can drive acquisition costs down for alternative content, then it may even be possible to show alternative content admission-free to consumers to generate additional concession sales.

The impending move to HDTV will give consumers excellent viewing quality at home. Content that can be enjoyed at HDTV resolution (sports, live events, etc.) will be a significant value proposition to consumers. Therefore, Exhibitors should not pursue business models that seek to acquire content that will be associated with HDTV. Theatre content needs to be sufficiently differentiated such that the theatre experience remains unique. In short, change dynamics in the Digital Cinema space will not come from leading Exhibitors and Studios. It must come from new content providers and entrepreneurial Exhibitors that can build niche market demand. Companies engaged in

building and promoting Digital Cinema technologies should focus on building this potential Exhibition market to help seed the foundations of Digital Cinema.

13.2 Implications of VOD and the Cable/Satellite Battle

Four significant business implications have been identified with the impending release of VOD.

(1) The existing Studio release window is under threat. VOD will move up to the same release window as sell-through and rental DVDs.

Currently, studios maximize their profits from consumers by controlling the release window of movies. This window is timed and priced based on consumer willingness to pay. Research has identified the margin of DVD sell-through to be approximately 85% to Studios. Ideally, releasing sell-through DVDs before DVD rentals maximize profits. However, this structure is not the case now due to market dynamics. Generally speaking, the earlier the release window, the more profitable it is to Studios.

Studios will face greater pressure from cable operators to place VOD early in the release schedule, preferably right after theatrical release. Current DVD sell-through and rental releases are the same time as VOD-30 to 60 days after theatre exhibition. Industry experts believe demand should move VOD to as early as 30 days after DVD sell-through and rentals but probably no earlier. This belief does not appear to be accurate. The existing release window now depends on two things: (i) the revenue streams of Studios; and (ii) the bargaining power of distribution channels. VOD changes these dynamics significantly.

Ideally for Studios, DVD sell-through should be released earlier than rentals. However, with revenue from rentals growing rapidly, rental businesses like Blockbuster substantially increased their bargaining powers, forcing Studio to compromise and move the rental window parallel with sell-through. Studios have refused to move VOD releases earlier to not jeopardize sell-through revenues. However, VOD provides studio with higher margin than video rentals. Therefore, if video rentals are released with sell-through, it is reasonable to expect VOD to move to the same release window. The only reason that has not happened yet is that VOD is still an insignificant revenue source. With the deployment of VOD infrastructure, VOD revenue will grow rapidly and replace a substantial percentage of the revenues from rentals. If that is the case, the power balances among Studios, video rental companies and cable operator will shift. VOD will become a bigger revenue stream and Studios will probably acquiesce to cable operators and move VOD in parallel with video rentals.

(2) Consolidation of Cable Operators

Cable operators used to be entrepreneurial startups in specific geographic locations. Some operators are still run by the original owners but the number of small-scale operators is dwindling. The top 5 U.S. cable operators serve 78% of cable subscribers. These companies have increased in size primarily by acquisition. Today, there are only two major competitive technologies (cable and satellite) in delivering video

entertainment, and the number of player in these competing technologies are relatively few (2 in satellite and 5-6 significant players in cable). This will only get smaller. The number of firms in cable industry approximately depends on the following formula:

$\text{Profit} = (\text{Total market revenue}/\text{number of firms}) * \text{gross margin} - \text{Fixed costs}$

When fixed costs rise at a higher rate than either revenue growth or gross margin, the number of firms must fall to maintain equilibrium. The variables of this equation are described below.

Fixed Costs

Traditionally, cable operators were regional monopolies that charged rates are under government regulation. In 1994 satellite operators emerged and took away significant cable subscribers. To compete with satellite operators, the cable industry started a never-before-seen multi-billion infrastructures upgrade beginning in 1996 totaling over \$70 billion.

Total Market Revenue

Multi-channel subscription is nearing saturation. 87% of U.S. households subscribe to either cable or satellite services. Therefore, the competition of cable and satellite has reached the stage of zero-sum competition. Large growth in cable industry is therefore not expected.

Gross Margin

During a 39-month period from 1996 to 1999 – during which time cable rates were regulated and satellite were still relatively unknown to most U.S. consumers, cable price increase average more than 7.6 percent annually³⁹. Since cable rates were deregulated in 1999, cable price increases have moderated in the face of competition. From April 1, 1999 (the date of cable rate deregulation) through June 30, 2002, annual cable price increases averaged only 5.15 percent. Gross margin is not expected to pick up in the foreseeable future.

Number of firms in the cable industry

With mounting fixed cost, stagnant industry growth and gross margin, the number of cable operators has to decrease to maintain reasonable profitability.

Cable industry consolidation can be rationalized given these factors. Many individual cable operators are unsure whether their capital expenditure can generate sufficient enough revenues. Uncertain about the future, they must either sell their business or postpone capital expenditures. Generally, cable operators slow to upgrade have higher defection rates to satellite. For example, AT&T Broadband has almost 20% of cable

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³⁹ U.S. Bureau of Labor Statistics

subscribers. Assuming market shares are proportional with capital expenditures, AT&T Broadband must spend \$14 billion in 7 years to upgrade its infrastructure to digital. Although they are hesitant to make such a huge investment, in 2002, AT&T broadband lost 481,000 subscribers and their EBITDA margin dropped to an industry low. Charter, the fourth largest cable operators, also lost 357,000 subscribers last year. Not surprisingly, these two operators have the lowest percentage of upgraded infrastructure. Given this “do or die” situation, AT&T sold their business to Comcast. More cable operators will withdraw from the industry because they are unwilling, or unable, to upgrade systems.

(3) Stagnant Growth of Satellite

Satellite enjoyed much higher growth than cable operators due to its technological advantage – more channels and better picture and audio quality. However, with the cable industry upgrades to two-way broadband infrastructure, the cable industry is quickly moving from an inferior to superior technology – higher channel capacity, true VOD, more HDTV channels and high-speed Internet. By 2002, over 80% of the U.S. households were served by cable systems with 750 MHZ of frequency bandwidth capacity, a much larger capacity than that of satellite. Cable operators can transmit around 1000 digital channels while satellite can only transit about 200 digital channels. As HDTV channels take up 4 times as much bandwidth as regular digital channels, satellite operators have a huge disadvantage in providing HDTV. Therefore cable will reverse its disadvantage in the previous battles and may end up winning the war.

(4) Video rental Stores Will Suffer a Big Blow

Video rental stores will become the biggest victims of VOD. When VOD reaches 35 to 40 million households by 2006, it will bring in significant revenues and force Studios to move VOD to the same release window as that of rental. Hence, video rental will lose almost all of its competitive advantage over VOD.

Table 17: Video Rental versus VOD

	Video Rental	VOD
Price	Equal	Equal
Convenience		Advantage
Availability	Advantage (Within driving distance in most areas)	Disadvantage (Only available to 7 million households by the end of 2002)
Content	Advantage (First release window after theater)	Disadvantage (30-60 days after video rental)

13.3 New Business Models Upon Wide Adoption of PVR

It is highly unlikely for PVR to reach mass adoption under standalone business models. However, satellite operators have a real incentive to drive this technology in their competition with cable. This channel is the best method to proliferate PVR. If accomplished, the technologically disruptive behaviors of PVR may be possible. In the world of widely adopted PVR, the traditional advertising-revenue based business model of the broadcasting industry must change. Some potential scenarios are outlined.

13.3.1 Targeted Advertising

Since user viewing histories can be potentially gathered, advertisers can buy usage data, analyze consumer viewing preference, and better target advertising. For example, if the data shows that most people that watch West Wing also watch certain sport channels, advertisers of sport equipment could advertise during West Wing and get better marketing results. Furthermore, advertisers can advertise selectively to targeted PVR users depending on specific viewer history. For example, an airline ad will only appear on the screen of the PVR user who recently watched the travel channel.

13.3.2 Shorter, Enticing Parts of Content

Advertising may begin using shorter, high profile image ads that are viewable during digital fast-forwarding. Broadcasters could even make ads appear on the sides or top and bottom of the screen during the program or whole commercial segments so viewers cannot avoid ads. The first and last spot in commercial slots will become most costly since those are more likely to be watched.

13.3.3 Embedded Advertising in VOD and DVDs

As regular TV advertising becomes less and less effective, advertisers will focus more on other means of advertising such as on magazines, Internet, banners, VOD, and DVDs. New advertising schemes in VOD and DVDs take embedded ads one step further by preventing users from fast forwarding advertisements. Advertisers could pay content/VOD providers to have embedded commercials. With additional revenues, VOD and DVD providers could sell this content at a lower price. The natural question is whether or not there is a market for VOD or DVDs with embedded commercials at a fraction of the price of uninterrupted regular VOD or DVDs. Consumers sensitive to costs may prefer a \$1 VOD titles with commercials over a \$4 regular VOD title or choose a \$5 DVD with commercials over a \$20 regular DVD.

13.3.4 Cheap Broadcasting and Advertising

With the traditional peak/off peak TV program and advertising pricing model less important, the window for broadcasting and advertising could be expanded to 24 hours a day. Networks and broadcasters will exploit these unused time slots and bandwidth.

The first change would be increasing number of TV programs shown at off peak hours. The cost difference between broadcasting and advertising at the peak and off peak hours

may become much less. To reach an equivalent viewing audience size, program producers and advertisers can expand broadcasting content at non-peak hours since PVRs do not discriminate based on when programs are broadcast. Furthermore, niche programming may be more effective since PVR technologies can identify consumer market segments.

13.3.5 Better Advertising and Content

About 70 to 80% of PVR users regularly skip commercials. PVR users also spend about 75% of their time watching recorded programs and 25% on normal broadcasted programs. This means that the PVRs will not undermine all advertising, just poorly focused advertising. TiVo learned that the most popular commercials are still watched by most users.

Ineffective TV advertising may cause TV advertising costs to drop significantly. Broadcasters would have no choice but to improve the quality of TV programs to catch the 20-30% of PVR viewers that do not regularly skip commercials. There may be tremendous amount of incentive for content providers to produce high quality programs that benefit consumers.

13.3.6 Exclusive Broadcasting and Advertising on PVR Devices

As consumers rely heavily on PVR devices as the “portal” for accessing content, the PVR interactive menu can easily become an “exclusive” network broadcaster. The interactive PVR portal can also support a new form of advertising. Just like Internet portals Yahoo, PVR service providers can also advertise on programming guide pages analogous to Internet banners with click-through. Currently, there is already pop-up prompt advertising software called Wink that can work with TV programming guide.

13.4 VOWD Conclusions

VOWD is still not on the agenda of content owners and carriers at this stage. Neither streaming video services nor cell phones with streamed video capabilities are available in the U.S. market. This technology topic, compared to the other topics in this research, is the most nebulous.

VOWD will be heavily dependent on carriers’ upgrading to 3G networks, specifically from GPRS to EDGE (and beyond) and CDMA1xrtt to 1xEV-DO or 1xEV-DV. However, incentives to upgrade systems to 3G are unclear. Murky demand for high-bandwidth service, the existence of proven revenue models for low-bandwidth applications, the dominance of voice revenue, costs and carrier financial health are all barriers to 3G. On the other hand, the need for some carriers to improve voice efficiency, and competition among carriers puts pressure on service differentiation and may provide some inertia for 3G upgrades, specifically EDGE. Nevertheless, completion of a large-scale upgrade is beyond a 5-year horizon.

With respect to commercial video content on VOWD, the impact to Studios and TV networks should be limited. It is unlikely for VOWD to become a significant channel for

established content owners to deliver video entertainment. However, it may well be a business opportunity for new entertainment/informational content providers. News, sports and other time-sensitive information contents may first appear on handheld devices, but the ultimate driver for VOWD may need to come from new content creators. The growth and importance of emerging business will determine whether carriers will act as video content aggregators. Technology solution providers and device/hardware manufacturers are likely to be early content aggregators, but eventually, carriers will have to provide support for multi-formats and devices and become the ultimate content aggregator. In addition, in latter stages of market development, current wireless content aggregators may enter the video content segment by providing multi-platform support. To facilitate this process, carriers need to have a formalized process for content partnership, a clear technical interface, and a motivating revenue share model that works. Although streamed video to handhelds is technologically feasible, there are too many uncertainties to predict its adoption, let alone its ability to induce disruptive change.

14 Closing Remarks

The research embodied in this report summarizes how new technologies are leading to products and services that may change how entertainment content is enjoyed by consumers. Some technologies, such as HDTV, are less disruptive to current business practices while others such as VOD seem to have significant disruptive effects. The goal of this research has been to examine the effects of technology in disruption and evolution of video distribution channels. Of course, overall, the clear beneficiaries of new technology have been consumers. Their enjoyment of motion pictures and related entertainment is destined to be better than ever.

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15.4 Interviews

Following the guidelines of the University of California Office for the Protection of Research Subjects, all interviews performed for this research are confidential and not available for public release.