

THE EFFECTS OF ENDOGENOUS SWITCHING COSTS ON CONSUMER CHOICE

A Case Study - Apple's iPod and iTunes Music Store



Scott Worthington
University of Puget Sound
May 2005

TABLE OF CONTENTS

| | |
|--|----|
| <i>Abstract</i> | 3 |
| <i>1. Introduction</i> | 4 |
| <i>1.1 Technical and Informational Background</i> | 9 |
| 1.1.1 Overview of the iTunes Music Store (iTMS) | |
| 1.1.2 Codecs and Digital Rights Management | |
| <i>1.2 The Digital Music Market</i> | 14 |
| <i>2. Industry Structure</i> | 18 |
| <i>3. Strategic Barriers to Entry</i> | 20 |
| <i>3.1 Switching Costs as Barriers to Entry</i> | 21 |
| 3.1.1 Network Effects and the “iPod Economy” | |
| 3.1.2 Branding | |
| 3.1.3 Bundling and Tying | |
| 3.1.4 Lack of Secondary Markets for DRM Protected Files | |
| <i>4. Decision Paths</i> | 25 |
| <i>5. Performance Implications</i> | 30 |
| <i>6. Conclusion</i> | 33 |
| <i>7. Glossary</i> | 35 |
| <i>8. Appendix A - A Brief Timeline of iPod and iTMS Development</i> | 36 |
| <i>9. References</i> | 38 |

THE EFFECTS OF ENDOGENOUS SWITCHING COSTS ON CONSUMER CHOICE

A Case Study - Apple's iPod and iTunes Music Store

Scott Worthington
University of Puget Sound
May, 2005

Abstract

Apple Computer's iPod and iTunes Music Store have taken the digital music industry by storm, but its general refusal to license or allow compatibility of its proprietary digital rights management has prompted lawsuits, attempts to hack the iPod's software by competitors, and even Congressional hearings on the matter.

Images courtesy of Apple.com.



Seemingly, Apple has attempted to maximize long-run profits by gaining market market share early in the market's existence by establishing switching costs. However, a more intriguing paradox is that so many consumers are buying into a closed format. Are users forced into Apple's products once they have bought in? What long-run effects do switching costs have on the performance of the industry and what performance implications arise?

I. Introduction

Apple's iPod digital music player and the accompanying iTunes Music Store (iTMS) have almost single-handedly reversed the prospects for the once-floundering recording industry, whose profits had drastically declined -- allegedly due to illegal file sharing (BBC, 2003). Both products dominate their respective markets, with the iTMS representing a consistent 70 percent of all online purchases, and the iPod representing 92 percent of all hard-drive based players sold and 65 percent of total digital music players (Becker, 2004). Even as the market leader, the iTMS has yet to generate significant profits despite having sold more than 400 million tracks. The music industry has been tough negotiating with the store, as profit per song is reportedly a meager four to ten cents (Taylor, 2003). Basic analysis of the industry reveals that the market is highly leveraged and relies almost entirely on volume. Apple's success would be immaterial had it not used the iTMS as a loss leader¹, achieving minimal margins from iTMS to instead help drive iPod sales, which have surpassed ten million units (Taylor, 2003). However, the company's use of restrictive Digital Rights Management (DRM), which will be examined in more detail, and its refusal to license it to others have created controversy. As illustrated in this case study, Apple has effectively used its first mover advantage and enlarged the switching costs of its users to prevent them from using a competitor's products, materially affecting consumer welfare and product choice in software, online music stores and digital music players.

In most markets, neoclassical economic theory idealizes perfect competition where a multitude of firms produce a variety of homogenous, substitutable products. However, many

¹ Apple does not disclose iTMS sales individually, and some think this is a ruse to discourage potential competitors.

markets exist where compatibility is needed for the products to provide the welfare they were intended to create -- think of a world where electric plugs were different from city to city, or if every type of automobile required different fuel. Competition itself does not necessarily remove standardization -- in fact, perfect competition requires homogenous products. Standardization, for example, allows a Verizon Wireless customer to call a Cingular customer, without any extra effort or loss of quality. Without standardization, the cost of product variety is high. In markets where compatibility is paramount, a tradeoff must be made between variety and standardization. Compatibility is often desired in markets with network externalities, which serve as a source of scale economies that arise from the demand side of the market (Rohlf's, 1974). Compatible technology increases the value and utility a consumer gains from a product, as it allows users to mix and match ideal services -- in this case, the use of any desired digital music player with any online music store. Apple has chosen to keep its products only compatible with the company's other companion products. By refusing to standardize or allow converters, software that is able to transform a DRM protected file into another file such as MP3 which can be played on the vast majority of players, Apple creates a market in which switching costs are high, because consumers who buy an iPod or a song from the iTMS no longer have the ability to listen to purchased music from other stores or purchase other players that will play their iTMS purchased tracks. This scenario causes a great disincentive for consumers to break from Apple's array of music related products, as consumers must give up whatever value they associate with the music they have purchased. Because the typical price for digital music players range from one hundred to four hundred dollars, it is not difficult for a consumer to have a purchased music collection valued more highly than the player itself.

Switching costs effectively raise rival's prices for consumers who look to switch producers. Switching costs can be further broken down into two subgroups, exogenous and endogenous (Haucap 2003). Exogenous switching costs are not created by producers, but instead represent natural occurrences when changing products. For example, there is a cost of gathering information about other producers, or the risk of switching to an unknown brand. Endogenous switching costs, which this paper will focus on, are costs *artificially* created by producers. Apple's method of implementing switching costs to to maintain its user base, centers around its compatibility, DRM usage and abundance of complements. Songs purchased from the iTunes are incompatible with any player except the iPod and the iPod cannot play songs purchased from other online music stores. Since the iPod and iTunes are the market leaders in a highly-concentrated market, a self-perpetuating local monopoly and a rise in switching costs emerges. The installed bases of both products are large, and users who switch to a different online music store or digital music player ultimately lose all previously purchased music and/or any complement products. This loss of complementary purchases must be factored in when a consumer ponders a new purchase. Competing firms are also at a disadvantage, as consumers who chose its products after already buying into Apple's must effectively throw away their purchases, and thus increases the real price of the competitor's product.

The restrictions placed on compatibility in software are the firm's choice alone, and are not implemented for reasons of technological expense or degree of feasibility. There is no technical reason for songs purchased from the iTunes not to be playable other than Apple specifically prohibiting it. Other examples of endogenous switching costs are contract

termination fees such as with mobile phone providers or through customer loyalty programs with coupons and other incentive programs.

Previous research provides contradictory results as to whether or not endogenous switching cost are harmful. Marinoso (2001) argues that the only policy concern will be excess product compatibility -- not incompatibility. In contrast, traditional concern with incompatibility is that strategic incompatibility will be used as a monopolistic tying device which can be used as an exclusionary practice towards competitors (Haucap, 2003). The software market in particular is notorious for the use of incompatibility to keep consumers "locked in" to a particular product -- an illustrative case is that of Microsoft's Office, which employs proprietary formats that cannot be perfectly converted by any other application. Switching costs are not inherently detrimental to consumer welfare. For example, some software products can need certain technologies that are only built into the company's other products. However, when endogenously placed on an otherwise standard product, switching costs appear to be nothing but attempts by firms to gain market share.

Compatibility has been a long-standing method of flexing market power in the technology industry. Classic examples are VHS and Betamax, Windows and Macintosh operating systems, Microsoft Office, and recently, Internet browsers. However, the iTunes compatibility issue is not present in the file format itself, but in the DRM -- ironically called FairPlay. The DRM sets limits on what the user can do with the downloaded files, such as how many computers can play the file or how many times a user can burn a compact disc of that file. Traditional research concludes that allowing compatibility maximizes firm profits because it not

only allows consumers to combine components from various competitors, but firms also have fewer incentives to cut prices (Matutes and Regibeau, 1988).

However, switching costs can also lead to greater profits due to firms gaining market power over their customers, and lead firms to not to always select compatibility, especially in the software industry. This power gives consumers a strong incentive to continue buying from the firm from which they have previously bought items (Beggs and Klemperer 1992). Another externality that this scenario produces is that when products are artificially differentiated by these switching costs, a firm's incentive to differentiate their products in any functional way is reduced (Klemperer, 1995). By analyzing Apple Computer as a case study, this paper will build from previous research and examine compatibility choice under asymmetric strategic and technological conditions and how it affects consumer choice. Section one gives a description of the digital music player and online music store markets and provides technological background. Section two examines Apple's specific uses of switching costs and other barriers to entry. Section three models consumer choice. Section four examines the industry structure, while section five discusses the potential performance possibilities that the structure has created and gives an explanation for choices that consumers have made so far in the digital music market. Section six looks at current policy and the potential for a standardization of DRM. Section seven then concludes and proposes an alternative to today's industry structure where individual firms are able to employ whatever propriety DRM they wish.

1.1 TECHNICAL AND INFORMATIONAL BACKGROUND

The pre-iTMS digital music world was full of piracy, copyright issues, and lawsuits from the RIAA itself and individual bands. Napster, a program written by Northeastern dropout Shawn Fanning, revolutionized file sharing with its ability to connect multiple computers together, forming a virtual network over the internet, known as Peer-to-Peer (P2P). Users were able to share unlimited amounts of music, and over 350 million tracks were available by 2002. Though eventually the Recording Institute Association of America (RIAA) sued Napster, who lost its lawsuit against the (RIAA) and was forced to stop allowing the distribution of all copyrighted material, many other file sharing applications have since surfaced. Although these applications encourage file sharing, many have avoided litigation due to the structure of their applications². The RIAA has resorted to suing the individual file sharers and not just the services they use. They sued over 5,500 individuals in 2003 and 2004 (Gross, 2004). The iTMS emerged from this environment of legal issues.

1.1.1 Overview of the iTunes Music Store (iTMS)

To solve the problem of illegal file swapping, Apple first had to determine what elements of P2P services were viewed as unfavorable to consumers, as it is difficult to compete with a free service. Before Apple could convince customers to choose its store, they first had to persuade consumers that they should purchase music online in the first place, rather than obtaining music for free. To do this, Apple had to introduce a compelling service, not just a bank of digital files. In response, Apple's iTMS is a full-fledged music store with advanced searching features and

² Instead of storing files on their own servers, new applications have used technology to facilitate sharing directly to and from user's own computers.

online exclusives. Each song in the iTunes catalogue is “perfect”³ quality because it does not contain hissing, popping or hiccups in the song. Downloads are fast, advanced searches allow users to discover new music, celebrities post their own playlists, album artwork is included, free tracks are given away, and each track has perfect “tags” associated with the file (such as artist, album and genre, allowing better categorizing in database-like programs such as iTunes).

Downloading from free P2P applications can be frustrating to consumers. It can be difficult to find entire albums, good copies of individual tracks, and files may be misnamed. In short, Apple greatly reduced the transaction costs for users, while providing a legal alternative. Legality issues and the threat of prosecution have contributed to some users abandoning use of P2P networks. However, in spite of Apple’s success, P2P applications continue to be used heavily. Currently, there are conflicting views on whether the amount is increasing (see Broido et al, 2004), but one can assume that the levels have not drastically changed, despite lawsuits.

Although Apple’s iTunes was not the first online music store, it has been the first considered overwhelmingly successful, and contains the largest catalog. The iTunes has more than 1 million tracks, including music from independent labels and all five major labels. With its licensing of Amazon.com’s “one-click” technology, users are able to store credit card information and purchase any song or album with one click. Single tracks are \$0.99 and albums are typically \$9.99. Songs are downloaded in digital quality (AAC at 128 kbps), can be burned onto compact discs, played on up to five computers, and transferred to an unlimited number of portable players (only iPods, however). Access to the iTunes itself is embedded in the iTunes music software, which includes CD ripping, burning and indexing tools, free Internet radio

³ See page 10 regarding compression. All music on the iTunes is 128 kbps AAC and is not a perfect replication of a CD audio file. However, to most listeners on average speakers, the difference is minimal.

stations, and the ability to share music over a network. Although the iTunes Store was initially only available in the United States, the store has since expanded to eighteen additional countries. Pricing is similar in other countries, but there are variances such as Canada, who charges \$0.99 Canadian Dollars⁴ and the UK which charges 79 pence⁵. This discrepancy in price has prompted the UK Consumer's Association to accuse the UK iTunes store of anticompetitive price discrimination, though Apple defends itself by pointing to distribution contracts differing in other countries.

1.1.2 Codecs and Digital Rights Management

Most computer users are aware, on some level, about the presence of file formats and codecs. The most basic distinction between them are what are known as extensions - the typically three character punctuation following the name of a file. Common files are Microsoft Word (.doc), Excel (.xls), Joint Photographic Experts Group (.jpg) and Adobe's portable document file (.pdf). An audio codec, a *portmanteau* of "coder/decoder", describes a program that transforms a raw data signal into an encoded form, which for this paper's scope results in an audio file. Codecs often rely on compression where a large file is reduced to a smaller file. For example, full quality (loss-less) audio files are typically 60MB in size, while a MP3 is only 4MB. These compressions are not perfect, and are considered "lossy" as full quality is not maintained in the compression. Typical extensions are (.mp3, .aac, and .wma). The iTunes Store is the one of two music stores that uses AAC (Advanced Audio Coding), based on MPEG-4, the successor to the traditional MP3 (MPEG-1 Audio Layer 3) versus Microsoft's WMA (Windows

⁴ \$0.82 US Dollars

⁵ \$1.51 US Dollars

Media Audio) codec. These different codecs create compatibility issues as firms decide to support only some of the many available codecs. However, it is important to note that this paper focuses on incompatibility of online music stores; music files directly imported from compact discs are playable on any digital music player.

All online music stores that contain music from the ‘Big Five’⁶ labels, who account for 85 percent of domestic music industry sales, use Digital Rights Management (DRM) (Adams and Brock, 2005). As described earlier, the DRM allows or disallows certain file usages. The DRM in itself is not a codec, but is used on top of a chosen codec. The record labels have insisted on the use of DRM as opposed to simply allowing unrestricted files to be sold, as they are concerned that online music stores would become a method for P2P (peer-to-peer) networks to gain access to entire catalogues of music. Without DRM, a file is easily transferable over the Internet. When DRM is used, it is much easier to control user’s privileges with each file limiting the number of computers that can play the file, deciding if CD burning will be allowed, etc⁷. Although the iTunes requires users to download singles or albums, other services, such as Napster To Go are subscription services where users pay a monthly fee for access to all available files. The iTunes uses open standard AAC, but with a proprietary DRM called Fairplay. Though standard AAC is compatible with many devices such as non-iPod digital music players

⁶ Vivendi Universal, Sony Corp., Time Warner, EMI Group, and Berelmann AG

⁷ There are methods to circumvent DRM, but most users are likely not aware, lack the knowledge to be able to use them, or simply do not wish to violate the iTunes’s Terms of Service Agreement. The simplest method is to burn an audio-CD of purchased music and then reimporting the files works well, but the sound quality is degenerated somewhat. This paper assumes that the vast majority of users will not employ these hacks or workarounds. Some hacks that have been effective initially are rendered unplayable in future iTunes software updates.

and home audio solutions, Fairplay protected AAC files will not play on any device other than an iPod⁸.

When the iPod was introduced in 2001, it used only conventional components-- MP3 files, no DRM as it was not yet invented, and standard firewire cables contrasted with today's proprietary DRM and hybrid firewire/dock connector cable. The major caveat was that it only ran on Apple's Macintosh computers, and not on Microsoft's Windows Operating System. This problem was remedied nineteen months later with a Windows compatible iPod and music software, and today iPods are compatible with both operating systems. It is important to note that the iPod can only be used with iTunes, except for the fifteen months when Apple had not yet introduced iTunes for Windows, and used included MusicMatch software on Windows models, and it is bundled with each iPod. Apple has since disabled users' ability to use MusicMatch as iTunes is available on both Macs and Windows.

Apple's choice of codec and DRM are significant as they have chosen both open (AAC) and closed (Fairplay) systems. Apple's success with AAC is important as more and more gadgets include audio and video codecs. This creates potential future licensing abilities, and more importantly, creates a large competitor to Microsoft's WMA. To consumers, codecs are important because only select digital music players are compatible with certain codecs, regardless of the inclusion of DRM. This limits consumer choice, as certain digital music players and/or stores are effectively unable to be chosen without incurring large switching costs.

⁸ Additionally, iPods support AAC, Protected AAC, MP3, MP3 VBR, Audible formats, Apple Lossless, WAV and AIFF formats.

1.2 THE DIGITAL MUSIC MARKET

The digital music player market is divided into two main categories -- hard-drive based players and flash based players. Hard-drive players typically use 1.0 or 1.8 inch miniature hard-drives, and are characterized by large capacities (as high as 80 gigabytes). Not surprisingly, they often are higher priced than flash models. Flash players use solid-state memory, such as those found in digital cameras, are typically much smaller and hold considerably fewer songs and are cheaper than hard drives⁹.

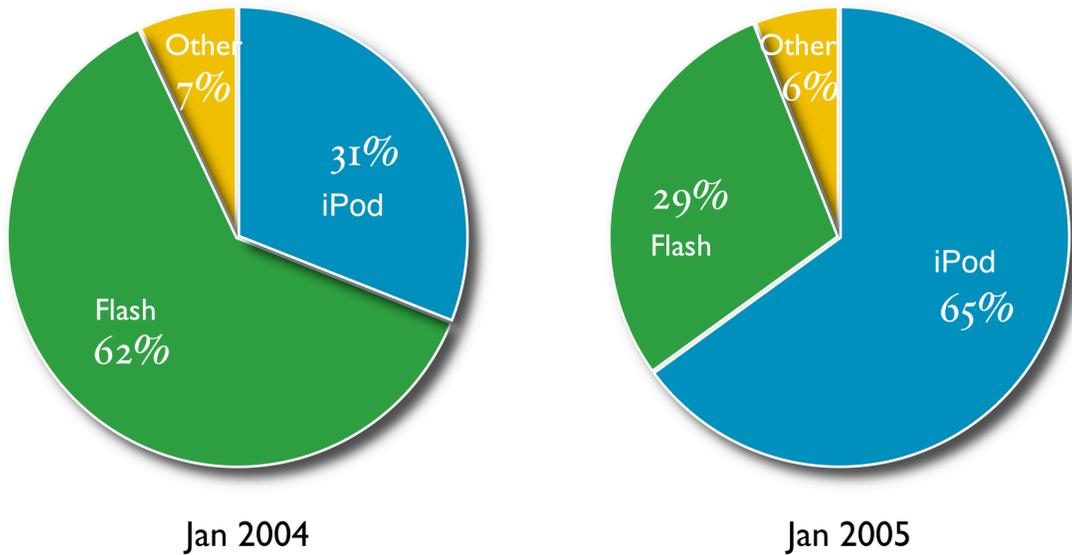
In January of 2004, Apple dominated hard-drive based players with 82 percent market share. However, 62 percent of all players sold were the cheaper flash based players, resulting in Apple's 31 percent overall share. However, that month, Apple targeted the high end of the flash market with the introduction of the iPod mini, which was priced less than Apple's full sized-player, while only marginally priced above most flash players, contained four to eight times the capacity. The player was a hit, and a year later the industry's market share positions changed dramatically.

The significance of the iPod's growth is illustrated in Figure 1. The iPod and the iPod mini earned a 92 percent market share with other hard-drive players making up only 6 percent of the total market. The flash share of the market was significantly decreased to 29 percent. In January 2005, Apple once again targeted the rest of the industry, this time introducing a small, flash-based player called the iPod shuffle. Though the product has only been on the market for one full quarter, it has had a significant impact on the industry. In the first quarter of 2005, the shuffle gained a 40 percent market share in the flash market. Most importantly for Apple, the

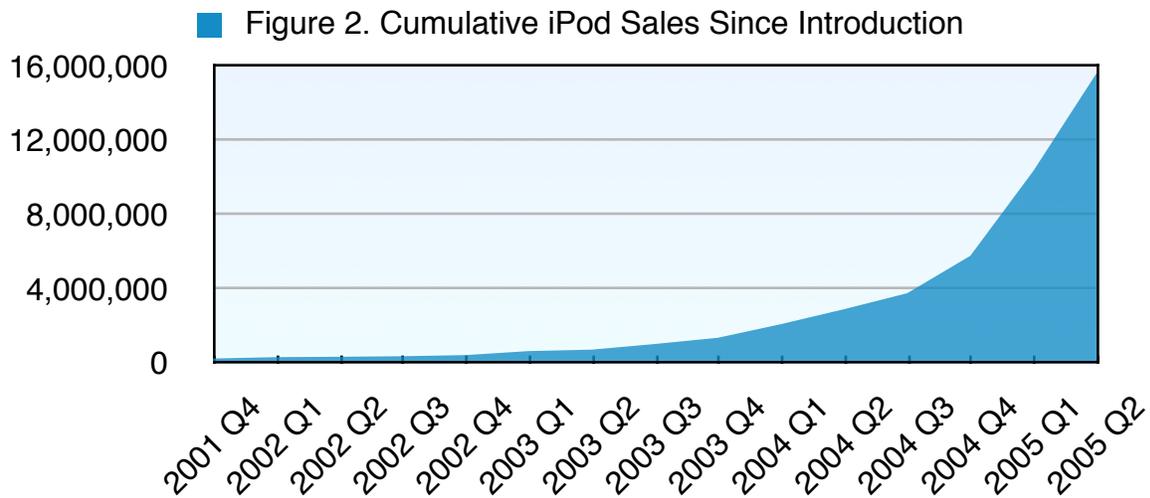
⁹ Typical storage capacity is 256 to 512 megabytes.

\$99 shuffle represents a shift away from higher priced products. Though the larger capacity iPods were considered competitively priced, the cheapest available player was \$249.

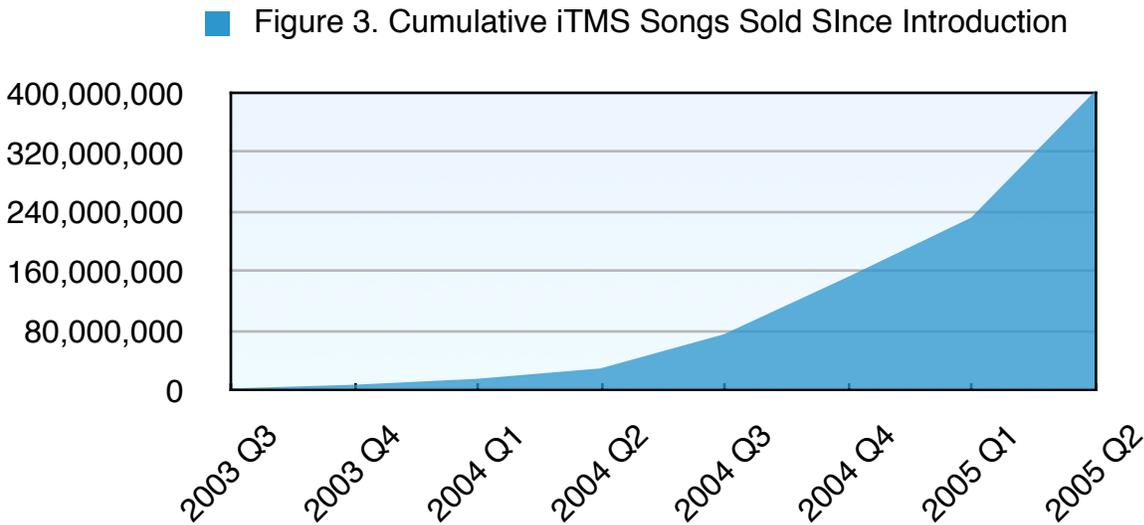
Figure 1. iPod Market Share



As Figure 2 depicts, iPod sales have dramatically increased since 2002, which not coincidentally, is the same period that a Windows compatible player was offered. Apple's computer market share of less than 5% offered little room for growth. As of April 2005, the company had shipped over fifteen million units and growth continues at an exponential pace.



The sales growth of the iTunes is depicted in Figure 3.



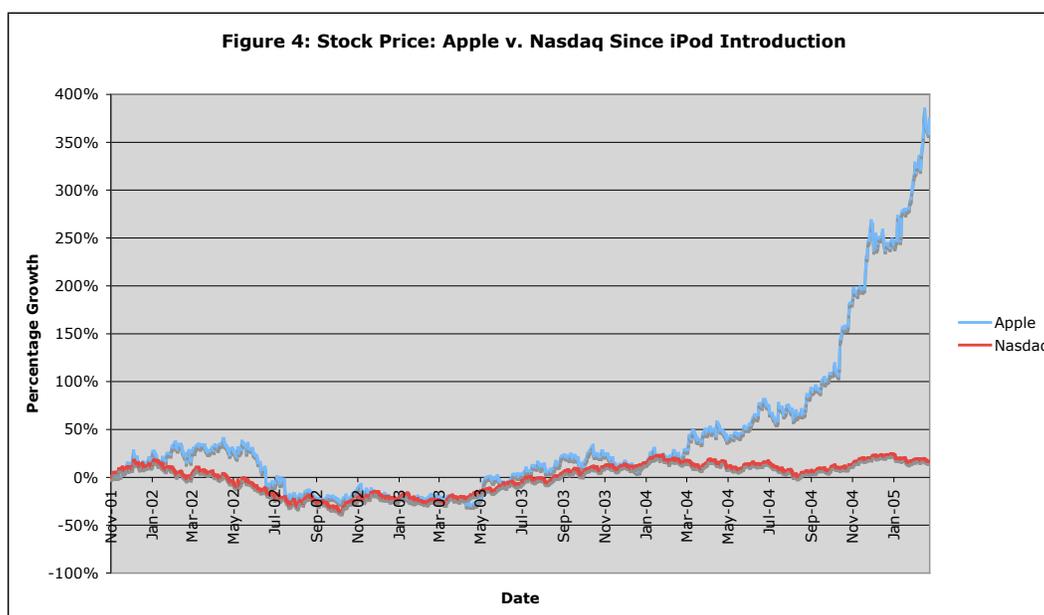
The iTunes first opened in the United States in April 2003 with a catalogue of over 200,000 songs. Today, that catalogue is over one million songs and the store has been introduced in eighteen additional countries¹⁰, reaching over 70 percent of the global music market, though countries such as Australia and Japan are notable exceptions. As of May 2005, the iTunes had sold over 400 million songs, a rate of over 1.25 million per day (Apple, 2005). In other words, for every iPod sold, 26 purchases have been made from the iTunes.

The iPod has greatly affected Apple as a company. Besides simply contributing to profits, and the skyrocketing stock price (Figure 4), the iPod has invigorated Apple's brand¹¹, and arguably increased demand for the company's computer segment -- a

¹⁰ Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

¹¹ Apple received a number 1 ranking in 2004 for brand awareness according to a survey of 2,000 advertising executives, brand managers and academics from brandchannel.com (Rusch, 2005).

phenomenon known as the halo effect¹². However, Apple's success with the iPod also illustrates its dependence on it -- iPod and iTunes revenues accounted for more than \$2.6 billion in Q1 and Q2 2005 alone, over 37 percent of total revenue for the two quarters. The company has much to lose if its digital music segment loses its market power. The company's stock has increased over 380 percent since the iPod was introduced, and it remains the driving force behind the company's valuation both for its revenue and the aforementioned halo effect (Kawamoto, 2005). Apple may have employed switching costs on the iPod and the iTunes because it is depending on the iPod to generate more music, peripheral, computer and software sales.



For consumers, Apple's dominance has been mostly positive, as the company's success has caused many more firms to enter the digital audio market. However, there is

¹² An effect in which customers are drawn to Apple computers after a positive experience with an iPod. This effect is said to switch anywhere from 10 to 20 percent of Windows users to the Mac.

growing concern of the power the company is able to exert over its competitors due to its use of switching costs.

2. Industry Structure

Many barriers to entry, which will be discussed in the following section, contribute to consumer lock in where large switching costs prevent consumers from changing producers. Also, switching costs make consumer demand more inelastic for each individual firm, which results in reduced rivalry (Klemperer 1987). A more inelastic demand can create monopoly power for an established firm as the firm can have more control over its customers. The Federal Merger Guidelines shed light onto what the government considers to be significant market power. The guidelines use the Herfindahl-Hirschman Index (HHI) as a measure of market power. The HHI is calculated by summing the square of market share for each firm. A HHI of less than 1,000 is considered to be a perfectly competitive market, between 1,000 and 1,800 is considered moderately concentrated, and above 1,800 is considered a highly concentrated market. Though I am not examining potential mergers, the HHI is useful to examine existing conditions as well. The hard-drive based digital music market (in figure 5) is 7,651. The HHI is also far above the 1,800 barrier for the online music store market (depicted in figure 6) with a score of 5,192.

According to the structural theory, another method of calculating market power is the four firm concentration ratio, which is simply a sum of the top four firms' market share. The hard-drive based digital music player market has a ratio of 96.3 percent and the online music store market has a ratio of 93 percent. However, thus far there has been no evidence of monopolistic or oligopolistic behavior.

Figure 5. Hard-Drive Based Digital Music Player Market Share

| FIRM | MARKET SHARE |
|------------------|--------------|
| Apple | 87.3% |
| Hewlett Packard* | 3.6% |
| Rio | 2.8% |
| Creative | 2.6% |
| iRiver | 1.5% |

*HP's player is a re-branded Apple iPod¹³
 Source: Nielson SoundScan, October 12, 2004

Figure 6. Online Music Store Market Share

| FIRM | MARKET SHARE |
|--------------|--------------|
| Apple | 70% |
| Napster | 11% |
| RealNetworks | 6% |
| MusicMatch | 6% |
| Walmart | 6% |

Source: Nielson SoundScan, October 12, 2004

The high concentration has not yet sparked any antitrust action, but Congress has shown that it is concerned with the incompatibility in the market, holding a compatibility hearing on April 6, 2005, and discussing the possibility of mandating one standard DRM technology. However, even Apple's competitors did not want the government to step in -- likely as they are pursuing strategies without full compatibility as well. Similarly, economists such as Schumpeter have argued that the software industry is a "winner take most" market where we should expect

¹³ Hewlett-Packard announced that rather than develop a competing product, HP would license Apple's iPod. HP agreed to pre-install iTunes on all of its computers in return and use its much larger distribution channels for the iPod. If HP's market share is combined with Apple's (as any HP sale is really a sale from Apple to HP) the HHI and four firm concentration ratio grows further to 8,280 and 97.8 percent respectively.

firms to attempt to dominate. Simultaneously, he argues that we need not be worried about domination from one firm due to the notion of fragility -- the idea that better or cheaper products come along and destroy existing monopolies.

3. Strategic Barriers to Entry

Although compatibility can be infeasible due to technological or cost issues, the iPod is incompatible because of an anti-competitive choice, creating an endogenous switching cost. The music file itself is not unique, as a standard AAC file, and the format would be playable on a number of listening devices if Apple had not chosen to use proprietary Fairplay DRM and refused to license it. Though the bulk of this paper focuses on the effects on consumers, what are the reasons for Apple to choose incompatibility when it appears that compatible products maximize profits?

Katz and Shapiro (1994) argue that an incumbent firm is likely to prefer incompatibility if the firm has a distinctly superior overall package, a large installed base, and a good reputation. While Apple with its iPod and iTunes readily fit this description, this view is short-sighted as it only focuses on a specific market. The technology must be viewed on its applications firm-wide, and in every market in which it operates in both the present and potential future opportunities. By focusing solely on the digital music market, important spillover effects and internal firm network externalities are ignored. In this case, firm network externalities include AAC, which is based on MPEG-4, which is also Apple's basis for codec development in its QuickTime multimedia application and other professional audio and video solutions. As evidence of this, when iTunes is downloaded, the QuickTime application is installed as well. Apple is continually

evolving as a software company, and it gains significantly from the spillover of its cross development of applications. By championing AAC, Apple is not necessarily attempting to make it, and the Fairplay DRM the standard. Instead, it is ensuring that its MPEG-4 software architecture is included in future codecs and devices such as DVDs, cell phones, personal video recorders and internet video, and perhaps future products, such as online DVD downloads.

Converters present a method to work around compatibility issues for competitors. Converters are products that allow consumers to achieve compatibility across different standards without difficulty, and can effectively reduce switching costs. In some markets, converters achieve only partial success, and do not allow perfect substitution from one technology to another (Gilbert, 1992). However, because the files are digital, the digital music market can allow perfect converters. In fact, after failed talks with Apple to license its DRM, Real Networks released its own converter, dubbed Harmony, that allows DRM protected WMA files to play on the iPod. Apple argued that Real has engaged in ‘computer hacker tactics’, and released a statement warning customers not to buy from Real’s store, as the files may not work in future upgrades (Smith, 2004). As promised, the next upgrade to iTunes in November 2004, broke Real’s converter. Apple’s insistence on keeping its DRM closed is an indication that the company wants to maintain switching costs. To consumers, this indicates that the choice of DRM and compatibility will likely be present in the market for the foreseeable future.

3.1 SWITCHING COSTS AS BARRIERS TO ENTRY

Strategic entry deterrence is considered a part of the post-Chicago line of thought, originated by Caves and Porter (1977) where companies seek to entrench themselves in a market

and thus maximize long-run profits. By enhancing its first mover advantage, Apple has successfully kept rivals at bay. The following are multiple features of Apple's strategy and the nature of the market that has reduced incentives for users to switch providers.

3.1.1 Network Effects and the "iPod Economy"

A plethora of third party accessories exist for each variant of the iPod lineup, and the overwhelming success of the player itself has created a large economy of complements. The world-wide accessory market for digital music players has been estimated to be as much as \$1 billion for 2005, and due to the iPod's proprietary dock connector and unique attributes, many accessories are only available for the iPod (Gibson, 2005). This iPod economy creates network effects as accessories developers are more likely to develop products for the most popular and marketable player. Each iPod user benefits from the plethora of third party products and increasing sales look to continue this trend. Market research by the Envisioneering Group has found that iPod accessory spending averages roughly 50% of the initial price of the player (Gibson, 2005). In other words, an average iPod user who purchased a \$300 player (before the introduction of the low cost shuffle) spends roughly \$150 on accessories. Though Apple does sell a few of their own products, most accessories are designed independently by other firms. Apple has, however, worked directly with some manufacturers, such as Belkin, to develop specific products such as the iPod Media Reader and Digital Camera Link. Apple has also created accessories, such as the Airport Express, which wirelessly plays music over a network, that work exclusively with iTunes. Other wireless music options do not allow the user to play purchased iTMS tracks as Apple will not let the tracks be played by any application besides iTunes.

3.1.2 Branding

Apple's successful iPod advertising campaign, the player's market share and its "hipster" status has resulted in a significant barrier to entry for other firms. The iPod brand is so synonymous with digital music that all digital music players are often described as "iPods". Like Kleenex and Xerox before them, Apple has created a product that describes the entire industry. British financial research firm Sesame discovered that two thirds of British teenagers know how much an iPod mini costs, but three quarters have no idea of the price of a pint of milk (Crofts, 2005). Also, the iPod's trademark white styling and headphones have created a brand image without even mentioning the player's name. Consumers are more likely to choose the iPod simply because it is the most well known player, and are less likely to fully comprehend the purposeful limitations that Apple has placed on the device.

3.1.3 Bundling and Tying

As discussed earlier, the iPod only works with iTunes software, both the jukebox application itself and the music store. A user cannot manage an iPod (change playlists, add songs, etc) without using iTunes. Though MusicMatch used to be supported, recent software updates by Apple disallow users to use the software. The U2 special edition iPod also comes with a \$50 rebate for the iTMS exclusive digital box set for U2 that retails for 150 dollars. Additionally, Apple has recently implemented a new bundling scheme that allows new iPod purchasers to gain access to sixteen free downloads from the iTMS. These bundled freebies, and their tied status to iTunes and the iPod increase switching costs without the consumer actively seeking them out. It is important to note that the iTMS itself is bundled within the iTunes

application. To gain access to the iTunes Store, iTunes users simply navigate to the iTunes Store link, right next to saved playlists. Links are also placed next to every song in a user's library, so that it takes the user to the specified artist's page with more of their tracks available. Purchased music is also automatically added to a user's library. Other music stores are web pages to which one must navigate. Because iPod users must use iTunes, and iTunes is integrated so deeply within the application, it is logical to assume that at the very least iTunes users are exposed to the iTunes Store more than other stores.

3.1.4 Lack of Secondary Markets for DRM Protected Files

The most common approach for consumers to overcome the costs associated with switching (or upgrading) is selling specific components of their existing products to subsidize a new purchase. Secondary markets have recently gained much sophistication as garage sales have given way to online auction sites such as eBay. The increased ease of buying and selling used products effectively reduces search and transaction costs and allows buyers and sellers to reach a much larger target audience. For example, if a current iPod and iTunes user decided that he or she instead wanted to use a different digital music player and a different online music store they would look to sell both the player and the songs (as they will not be playable on another player). However, while consumers can sell their iPods, it is currently impossible to transfer ownership of DRM protected files. This was put to the test in September 2003 when George Hotelling attempted to sell a track purchased from the iTunes Store on eBay. His auction was removed by eBay and Apple responded to the attempt by upholding its legality, but disregarded it as "impractical" (Fried and Hansen, 2003). The only current method to allow others to play music purchased by another user is to give that user complete access to the seller's account (which also

ruins the market for selling singles as only access to a user's *complete* account is possible). With no practical ability to sell music, the files themselves retain no monetary value once purchased, and switching costs increase drastically.

The lack of a secondary market can increase switching costs even if a user has not actively purchased any music. Typically four songs a week are offered to be downloaded free of charge. Creating even further switching costs are audio books that are sold on the iTMS. Some books can sell for less than printed versions, but others sell for much more on the iTMS than printed books. For example, Dan Brown's *The Da Vinci Code*, whose hardcover sells for \$15 from Amazon.com and the audio book for \$32 on the iTMS. Either way, an audio-book represents a much more significant investment in the service than a 99-cent single and because it represents a sunk cost in the service, exacerbates switching costs. Thus, in a sense, DRM has decreased the value a consumer obtains from a song.

4. Decision Paths

To better understand why consumers are choosing incompatibility, it is necessary to determine the existing conditions surrounding the choice. We propose that there are three distinct products that consumers choose from in this market; hardware, software and music stores. Sometimes these consumers make their choice based on all three products, but others are forced into subsequent choices based on their first choice alone. Apple has been successful in terms of market share, because whenever consumers select one of its offerings and then look to use a complementary product, they are either more likely to opt for Apple's products or are forced to choose Apple's products. It is

important to note that a significant portion of iPod purchasers do not necessarily make decisions based on features and technical specifications, but instead on the phenomenon of the iPod fad. By choosing the player simply because it is popular, consumers ignore the choices that are available.

We can represent consumer choice options with decision paths that depict buying options for consumers. These options vary from consumer to consumer, depending on how far an individual is already sunk into a particular path. Figure 7 depicts the hardware choice. The online digital music market is still in its infancy, and only represents \$1.9 billion of \$33.6 billion (Legrand, 2005), 5.65 percent of global music sales. At this time, few people get a majority of their music from the online stores. Thus, most users will use their current music collection, which is compatible on all players as there is no DRM on ripped¹⁴ files or other files from using P2P services in the past. As a result, most consumers will not worry about compatibility with online stores and it does not factor into their purchase decision. As market share figures indicate, over 65 percent of all consumers, and over 91 percent of consumers who purchase a hard drive player specifically purchase a variant of an iPod. As a result, the vast majority of purchasers have already had subsequent decisions made for them if they choose to enter additional markets. Consumers who have chosen the iPod have locked themselves into one specific path because if they wish to use or purchase products in the other two categories they must use other Apple offerings and cannot choose any alternatives.

¹⁴ Files that have been directly extracted from an audio CD.

Figure 7.

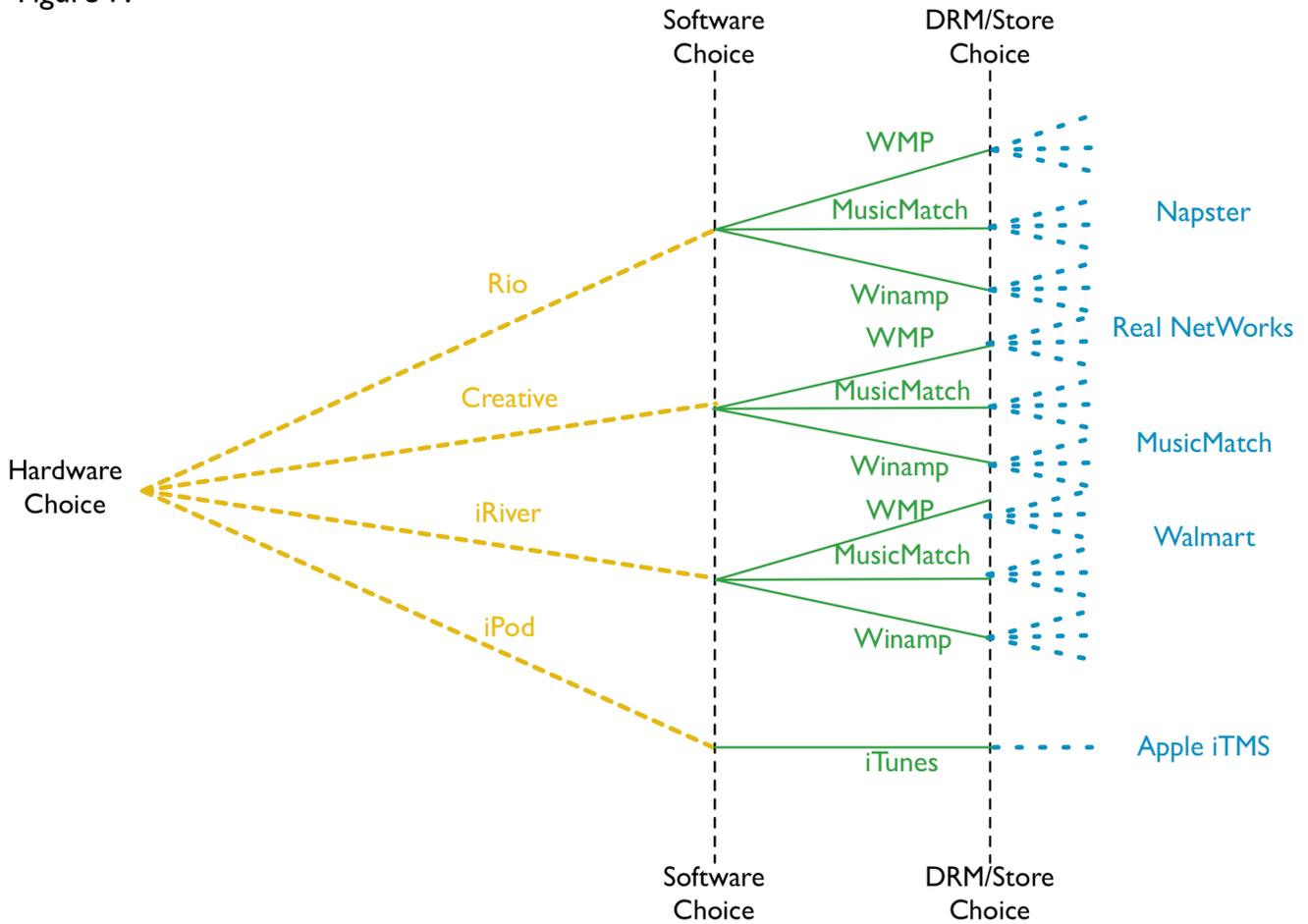


Figure 8 depicts a similar situation, but for consumers who are first interested in purchasing their music online. To simplify the decision tree, music stores are categorized into two groups -- Microsoft and Apple. This categorization is made because Microsoft and its DRM is behind the vast majority (all but two) of all online music stores. Though each store sells a fairly standardized audio file, many of the stores have successfully differentiated themselves on a number of categories, including the depth and breadth of the music catalogue offered, pricing, and other features, such as celebrity playlists and higher quality audio files. Not all users of online music stores use digital music players. The files can be played on a computer or burned onto a CD. Here, once again, when a

consumer selects Apple's iTMS as their source of digital music files they will use Apple's iTunes software, and if they do decide to purchase a digital music player in the future it will have to be an iPod if they wish to play their purchased music on the device.

Figure 8.

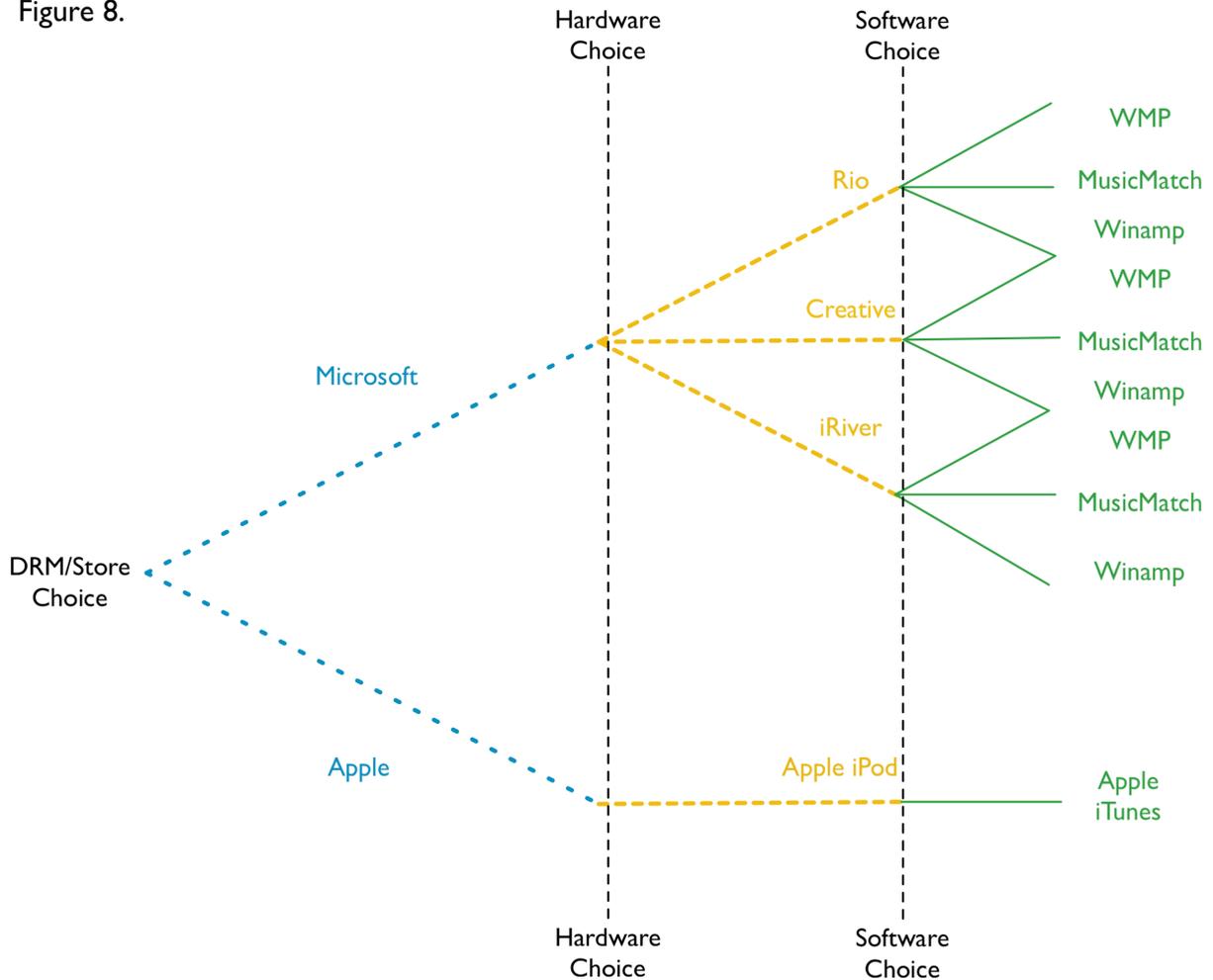
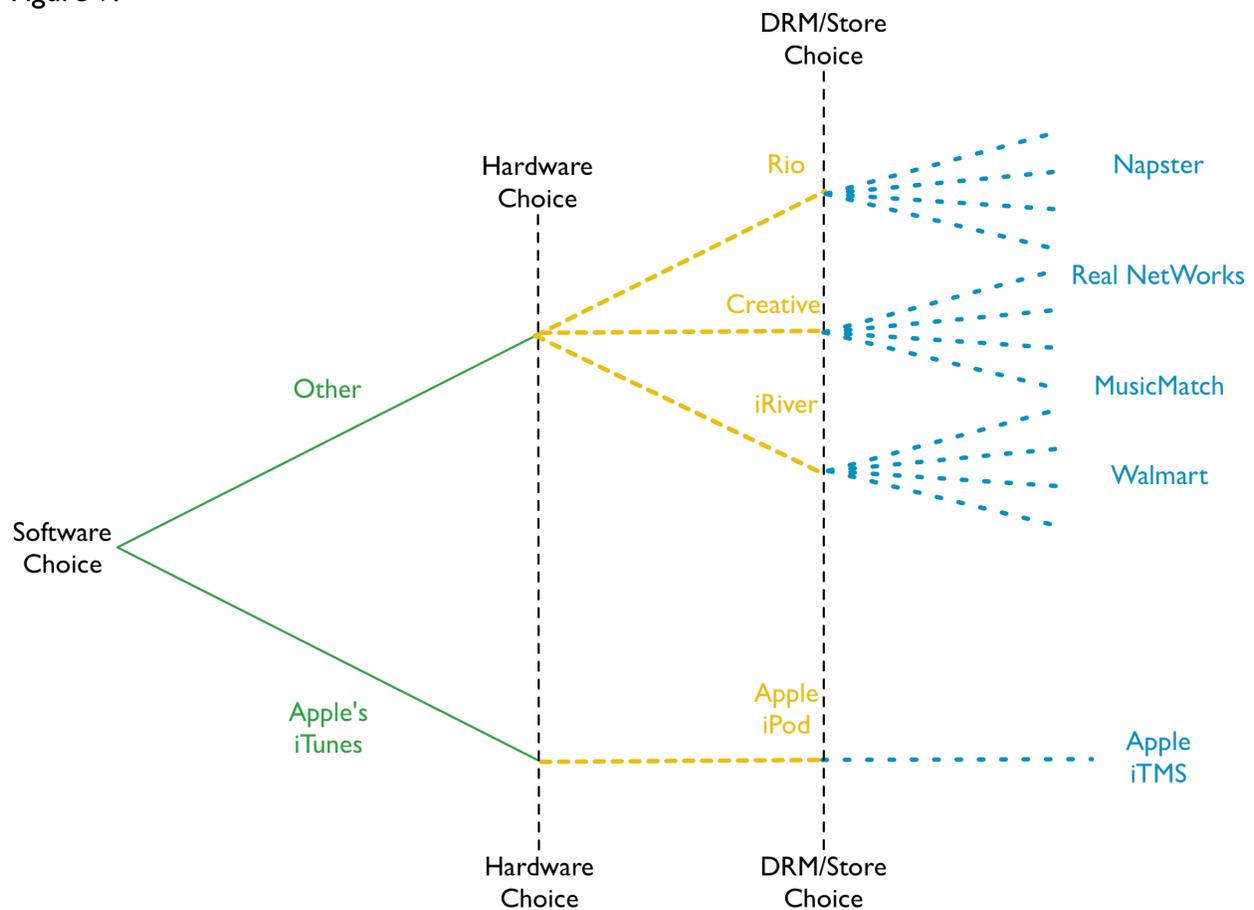


Figure 9 illustrates a somewhat different concept. There has been anecdotal evidence that users simply use Apple's iTunes software as a digital music jukebox on their computers and do not necessarily own a digital music player or use an online music store. These users are not concerned about compatibility issues because they are not

spending any money on the software, as it (and most other music software) is free.

However, these users are more likely to use the iTunes and then later an iPod due to the integration of the software and the music store. Also, as mentioned earlier, these users may simply obtain free promotional tracks from the iTunes from weekly freebies or from other contests (such as Pepsi's) who award free iTunes songs when purchasing its products.

Figure 9.



These decision trees convey both how consumers can easily become locked in to Apple products, and how one's decision effectively cuts off the multitude of choices available in the market due to the exit barrier imposed by incompatibility. Though it is

possible for consumers to switch content providers or digital music hardware, the costs associated with that switch may be significantly high enough to deter the majority of consumers. A possible externality associated with consumers who are unhappy being tied to a particular firm for all three markets may be more likely to turn to P2P services. Although certainly illegal, the popularity of P2P has remained high and looks to continue its growth (Sinrod, 2004). These consumers may opt out of the path dependency that incompatibility creates and instead focus on the hardware purchase alone.

5. Performance Implications

Having established multiple switching costs as a barrier to entry, the real question remains -- why do consumers knowingly choose incompatibility and limit their own choice? Are they simply acting irrationally? Economists such as Klemperer (1995) argue that when firms are artificially differentiated by switching costs, they have less incentive to differentiate themselves in any real way. However, this has not been the case with iPod development (fully described in Appendix A). The iPod and the iTunes are both regarded as market leaders because of their status as technically superior products. Innovation has continued and prices have dropped while remaining competitive. Consumers appear to choose Apple because of the positive externalities created by the bundling and integration. This bundle is more efficient for consumers, and decreases search and transaction costs of attempting to mix and match. Instead of worrying about the many different file formats and DRM options, a consumer that uses Apple's bundle knows that his or her choices will all work together. The digital music player and online

music store markets are fairly complicated and riddled with compatibility issues on both sides. For example, if a consumer uses a Macintosh computer, their only choice is the iPod and the iTunes because Microsoft has not made its DRM protected WMA files compatible with anything but its own operating system of Windows.

If the current trend holds, would Apple be able to decrease consumer welfare by raising prices, or reducing innovation? In the short run, they cannot. The reasoning is as follows; the digital music market for both downloads and players are big growth markets. If a firm today attempted to gouge its customers by leveraging its market power and charging higher prices, consumers will refuse to buy into the system. Apple is unable to price discriminate between new and old customers, so it will need to charge the same attractive, presumably lower price to all users. Also, firms cannot be too incompatible as consumers make compatibility choices based on future expectations (Katz and Shapiro, 1994). A firm cannot take advantage of current customers because it must simultaneously appeal to new ones.

Though Apple is not likely to hold such lofty market share positions in the future the legacy of over 400 million (and counting) tracks with Fairplay DRM will live on forever. Even if Schumpeter is right and that Apple's dominance will eventually be destroyed, music is a unique good as it is consumed over the course of a lifetime. Favorite songs can be played hundreds of times and the DRM will be on those purchased tracks forever. Again, the DRM detracts from the value of the purchased song. So even if Apple's format is succeeded by another, consumers will be negatively impacted from their purchases in the past.

But what happens to consumers if Apple's dominance is not toppled? When digital music reaches a mature stage, the implications will be much more severe. Online music sales are expected to reach 17 percent of total music sales by 2010 and are expected to climb even higher into the future (Informa Media Group, 2004). Apple effectively has two choices: (1) Keep the Fairplay DRM closed to others, or (2) License Fairplay to other firms.

How will either of these two choices affect consumers? If Apple keeps its Fairplay DRM closed, consumers will continue to be faced by the same path dependency issues that were detailed in the aforementioned decision trees. Switching costs will remain at their current levels and consumer welfare will remain low. However, Apple has indicated through a deal with Motorola that they may decide to license Fairplay, though not directly enabling other software to play the files, but instead by allowing the use of iTunes on other platforms such as cell phones. While this solution may be a better alternative, consumer welfare will still remain low. Cell phones may be able to play DRM protected files, but only a select few models will have this capability. Switching costs will still be exacerbated and Apple will continue to have significant market power. Thus, consumer choice will expand slightly, but remain low.

The current market structure does not appear to be sustainable for the long term, and consumers would be better served by a scenario where the record labels themselves use their own standardized DRM and allow all manufacturers to freely use it. The current market appears to be inefficient. Why should the middlemen, who do not own the copyright to the product, be able to place their own copy protection on the file? This

system creates inefficiencies due to an extra step in the selling process and decreases consumer welfare as proprietary file formats and or DRM is able to be employed. Record label and consumer electronics competitor, Sony, already has its own music store. If they were able to successfully negotiate with the other four major firms they would have a large competitive advantage because they would control the music directly. This alternative seems possible, as other online music stores have compatibility issues with multiple operating systems and players as well.

6. Conclusion

In essence, Apple has taken the three separate markets of hardware, software, and music store and effectively made it a singular market. At this time, no other firm has its hand in all three options, and the convenience offered to consumers, coupled with the technological superiority of the products, has convinced millions to buy into Apple's system. However, these consumers may be decreasing their welfare in the long run. Apple may or may not allow other hardware or software to be compatible with its own, and this uncertainty alone detracts from the value of the purchased music. The future of DRM bears significant implications for both the nascent digital music market as well as the future of other digital media since it appears that more media will be sold digitally. To ensure compatibility, and maximize the utility of purchased music files, the RIAA, or other music industry groups should create a standardized DRM that makes the issues of compatibility obsolete among online music stores. Thus, firms will no longer be able to employ endogenous switching costs as a anticompetitive strategy, and consumer welfare will increase due to the ability to mix and match products from different firms. At this

point, consumers, in concert with the human condition, experience bounded rationality and are not able to predict the future and what format will become the standard. For now, it appears that consumers are acting rationally given the current market conditions. Unfortunately for consumers, software companies are employing the same methodologies in digital music as in their software offerings, and ignoring the inherent differences in usage and product life-span.

7. Glossary

Advanced Audio Codec (AAC) - An audio codec that is based on MPEG-4, the successor to the popular MP3 codec. It is used by Apple and RealNetworks for their online music stores.

Codec - Distinguished by extensions at the end of a file name (such as .acc), a codec is “*coder/decoder*”, a program that transforms a raw data signal into an encoded form, usually by implementing compression technology to reduce file sizes.

Digital Rights Management (DRM) - is used “on top of” a codec and allows or disallows certain file usages such as number of computers that are authorized to play a purchased track.

Flash Players - Digital music players that are based off of flash memory instead of mini hard-drives. Flash memory is solid-state, and has no moving parts. However, its capacities are much smaller than hard-drives. Typical memory storage is 256MB to 1GB.

Harmony - RealNetwork’s converter that is able to “crack” Apple’s iPod software, and render tracks purchased from any online music store playable the iPod.

MPEG Layer 3 (MP3) - The most well known and first widely used audio codec. Its compression technology revolutionized the recording industry.

Peer-to-Peer (P2P) - Software that allows users to freely share files with other users running the same software.

Recording Institute Association of America (RIAA) - A trade group that represents the U.S. recording industry. Have worked to protect intellectual property rights of artists.

Windows Media Audio (WMA) - Microsoft’s proprietary audio codec. Microsoft has been aggressive in promoting this format, and all online music stores except for Apple and RealNetworks use this format.

8. Appendix A - A Brief Timeline of iPod and iTunes Development

January 9, 2001

Apple introduces iTunes (Macintosh version only).

October 23, 2001

Apple announces the first iPod with 5GB of storage at a price of \$399. Works only on Macs by using iTunes as transfer and content management application.

December 31, 2001

Apple has sold a total of 125,000 iPods.

March 20, 2002

Apple announces a 10GB update to the iPod for \$499. The iPod is still a Macintosh only product, though workaround programs for PCs can be found on the Internet.

July 17, 2002

PC versions of the iPods are unveiled, including MusicMatch software instead of iTunes. Windows and Mac compatible players are distinct and are sold in different packaging. A 20GB iPod is also introduced. New prices are 5GB \$299, 10GB \$399, and 20GB \$499.

April 28, 2003

Apple launches the iTunes Music Store, but is only Macintosh compatible. Apple also unveils the updated third-generation (3G) iPod and the iTunes Music Store for Mac users. 3G iPods feature a Dock Connector port rather than the old FireWire port. New prices are 10GB \$299, 15GB \$399 and 30GB \$499. All third-generation iPods now work on either Macs or PCs out of the box.

May 4, 2003

Apple has sold 1 million songs via the iTunes Music Store.

June 23, 2003

Apple has sold 1 million iPods to date.

September 8, 2003

Apple refreshes the middle and top of the third-generation iPod line with higher storage capacities. A 20GB \$399 a 40GB \$499. Apple also announces that it has sold 10 million songs through the iTunes Music Store.

October 16, 2003

Apple releases both iTunes and the iTunes Music Store for U.S.-based PC users, while phasing out support for MusicMatch PC software. Apple also announces total sales of 13 million songs via the iTunes Music Store.

January 6, 2004

Apple debuts the iPod mini, a smaller 4GB version of the iPod available in five colors at \$249. Apple also introduces a 15GB full sized iPod at \$299.

January 6, 2004

Apple has sold a total of 2 million iPods to date.

January 8, 2004

Hewlett-Packard announces that it will license the iPod from Apple rather than develop a competing product. HP agrees to pre-install iTunes on all of its computers in return.

May 5, 2004

Apple has sold a total of 3 million iPods to date.

June 15, 2004

Apple releases the iTunes Music Store in three additional markets: France, Germany, and the United Kingdom.

July 12, 2004

Apple has sold 100 million songs via the iTunes Music Store.

July 19, 2004

Apple introduces fourth-generation (4G) iPods. New prices are 20GB \$299 and 40GB \$399.

July 26, 2004

Motorola announces that its next generation of cellular phones will be iTunes-compatible. RealNetworks' Harmony converter is released.

August 5, 2004

Apple has sold 3.7 million iPods to date.

August 10, 2004

The iTunes Music Store catalogue reaches 1,000,000 songs.

September 1, 2004

Apple has sold 125 million songs via the iTunes.

October 12, 2004

Apple has sold 150 million songs via the iTunes.

October 26, 2004

Apple launches the iTunes in the EU (Austria, Belgium, Finland, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain). Apple also debuts the iPod photo, sold in 40GB \$499 and 60GB \$599 versions. The special edition U2 iPod is also introduced and includes a \$50 coupon towards the purchase of a \$149 Apple-pioneered "digital box set "The Complete U2". Apple also has sold nearly 6 million iPods to date.

December 1, 2004

Apple launches iTunes Canada.

December 16, 2004

Apple has sold 200 million songs via the iTunes.

January 7, 2005

Apple launches iTunes Ireland.

January 11, 2005

Apple has sold 250 million songs via the iTunes.

January 11, 2005

Apple releases the iPod shuffle, a flash based player in two versions: 512MB for \$99 and 1GB for \$149.

February 23, 2005

Apple updates iPod mini. Lowers price to \$199 and adds a 6GB version at \$249. Also updated was the iPod photo with a 30GB version at \$349 and a 60 GB version at \$449.

March 2, 2005

Apple has sold 300 million songs via the iTunes.

April 6, 2005

Apple has sold 350 million songs via the iTunes.

May 9, 2005

Apple has sold 400 million songs via the iTunes. Additionally, the iTunes is expanded to four additional countries: Denmark, Norway, Sweden and Switzerland.

9. References

- Adams and Brock (2005). *The Structure of American Industry*, Eleventh Edition. New Jersey: Prentice Hall.
- BBC News. (August 2003). "Stopping the Pop-Swappers." BBC News UK Edition Online. Available: <http://news.bbc.co.uk/1/hi/magazine/3117505.stm>
- Becker, David. (October 2004). "It's All About the iPod." Cnet News.com. Available: http://news.com.com/2100-1041_3-5406519.html
- Beggs and Klemperer (1992). Multi-Period Competition With Switching Costs. *Econometrica*, Vol. 60, No. 3, 651-666.
- Besen and Farrell (1994). Choosing How to Compete: Strategies and Tactics in Standardization. *The Journal of Economic Perspectives*, Vol. 8, No. 2, 117-131.
- Broido et al. (2004). Is P2P dying or just hiding? Presented at Globecom 2004. (November 2004).
- Caves and Porter (1977). From Entry Barriers to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition. *The Quarterly Journal of Economics*, Vol. 91, No. 2, 241-262.
- Choi, J. (1994). Irreversible Choice of Uncertain Technologies with Network Externalities. *RAND Journal of Economics*, Vol. 25, No. 3, 382-401.
- Crofts, R. (2005, January 31). Teenagers Know iPod Cost Better Than Milk - Survey. Manchester Online. Available: http://www.manchesteronline.co.uk/personalfinance/sl146/146330_teenagers_know_ipod_cost_better_than_milk_survey.html [2005, January 31]
- Economides, N. (1989). *The American Economic Review*, Vol. 79, No. 5, 1165-1181.
- Economides and Salop (1992). Competition and Integration Among Complements, and Network Market Structure. *The Journal of Industrial Economics*, Vol. 40, No.1, 105-123.
- Farrell and Saloner (1985). Standardization, Compatibility, and Innovation. *The RAND Journal of Economics*, Vol. 16, No. 1, 70-83.
- Farrell and Saloner (1992). Converters, Compatibility and the Control of Interfaces. *The Journal of Industrial Economics*, Vol. 40, No. 1, 9-35.
- Farrell and Shapiro (1988). Dynamic Competition with Switching Costs. *The RAND Journal of Economics*, Vol. 19, No. 1, 123-137.
- Fisher et al. (2004). iTunes - How Copyright, Contract, and Technology Shape the Business of Digital Media - A Case Study. The Berkman Center for Internet & Society at Harvard Law School.
- Fried and Hansen (2003, September 8). Apple: Reselling iTunes Songs 'Impractical'. CNET News.com [Online]. Available: http://news.com.com/Apple:+Reselling+iTunes+songs+'impractical'/2100-1027_3-5072842.html [2003, September 8].
- Gibson B. (2005, March 4). Average iPod Owner Shelling Out \$150 on Accessories, Study Finds. The Mac Observer [Online]. Available: <http://www.themacobserver.com/article/2005/03/04.9.shtml> [2005, March 4].
- Gilbert, R. (1992). Symposium on Compatibility: Incentives and Market Structure. *The Journal of Industrial Economics*, Vol. 40, No. 1, 1-8.
- Gross, G (2004, October 1). RIAA Sues Another 762 Over File Sharing. PCWorld.com. Available: <http://www.pcworld.com/news/article/0,aid,118028,00.asp> [2004, October 1].
- Haucap, J (2003). *Review of Network Economics*, Vol. 2, Issue 1 (March 2003), 29-35.
- Heide and Weiss (1995). Vendor Consideration and Switching Behavior for Buyers in High-Technology Markets. *Journal of Marketing*, Vol. 59, No. 3, 30-43.
- Informa Media Group (2004). "Music on the Internet." (December, 2004). Available at: http://www.telecoms.com/marlin/30000000461/ARTICLEVIEW/mp_articleid/20017293635/mp_pubcode/IMG_press?welcome=true&proceed=true&MarEntityId=1113594313758&entHash=102acd399d8&UType=true
- Katz and Shapiro (1992). Product Introduction with Network Externalities. *The Journal of Industrial Economics*, Vol. 40, No. 1, 55-83.
- Katz and Shapiro (1994). Systems Competition and Network Effects. *The Journal of Economic Perspectives*, Vol. 8, No. 2, 93-115.
- Katz and Shapiro (1985). Network Externalities, Competition, and Compatibility. *The American Economic Review*, Vol. 75, No. 3, 424-440.

- Katz and Shapiro (1986). Product Compatibility Choice in a Market with Technological Progress. *Oxford Economic Papers*, New Series, Vol. 3, Supplement: Strategic Behavior and Industrial Competition, 146-165.
- Kawamoto. (February 2005). "Apple splits stock as iPod sales soar. Cnet News.com. Available: <http://earthlink.com.com/Apple+splits+stock+as+iPod+sales+soar/2100-1047-3-5572554.html>
- Klemperer, P. (1987). Markets with Consumer Switching Costs. *The Quarterly Journal of Economics*, Vol. 102, No.2, 375-394.
- Klemperer, P. (1995). Competition When Consumers Have Switching Costs: An Overview With Applications to Industrial Organization, Macroeconomics, and International Trade. *The Review of Economic Studies*, 62, 515-539.
- Klemperer, P (1992). Equilibrium Product Lines: Competing Head-to-Head May be Less Competitive. *The American Economic Review*, Vol. 82, No. 4, 740-755.
- Kristiansen, E. (1998). R&D in the Presence of Network Externalities: Timing and Compatibility. *The RAND Journal of Economics*, Vol. 29, No. 3, 531-547.
- Legrand. (March 2004). "IFPI: 2004 Global Biz Flat." Billboard Radio Monitor Online. Available: http://www.billboardradiomonitor.com/radiomonitor/news/business/top_news/article_display.jsp?vnu_content_id=1000847434
- Matsuura, J. (2002). Law and Technological Change: Digital Media.
- Matutes C. and Regibeau P. (1988). "Mix and Match": Product Compatibility Without Network Externalities. *RAND Journal of Economics* Col. 19, No. 2, 221-234.
- Matutes and Regibeau (1989). Standardization Across Markets and Entry. *The Journal of Industrial Economics*, Vol. 37, No. 4, 359-371.
- Matutes and Regibeau (1992). Compatibility and Bundling of Complementary Goods in a Duopoly. *The Journal of Industrial Economics*, Vol. 40, No. 1 37-54.
- Nilsson, T. (1992). Two Kinds of Consumer Switching Costs. *The RAND Journal of Economics*, Vol. 23, No. 4, 570-589.
- Rohlf, J. (1974). A Theory of Interdependent Demand for a Communications Service, *Bell Journal of Economics*, (Spring 1974), Vol. 5, 16-37.
- Rusch R. (2005, January 31). Readers Pick Apple in 2004. Brandchannel.com [Online]. Available: http://www.brandchannel.com/start1.asp?fa_id=248 [2005, January 31].
- Schilling, M. (1998). Technological Lockout: An Integrative Model of the Economic and Strategic Factors Driving Technology Success and Failure. *The Academy of Management Review*, Vol. 23, No. 2, 267-284.
- Shapiro, C. (1985). Patent Licensing and R&D Rivalry. *The American Economic Review*, Vol. 75, No. 2, Papers and Proceedings of the Ninety-Seventh Meeting of the American Economic Association, 25-30.
- Sinrod, Eric. (October 2004). "The Rise and Fall (?) of P2P Music Downloading." USA Today Online. Available: http://www.usatoday.com/tech/columnist/ericjsinrod/2004-10-27-sinrod_x.htm
- Taylor, Chris. (September 2003). "Invention of the Year." Time Magazine Online. Available: [<http://www.time.com/time/2003/inventions/invmusic.html>]
- Wernerfelt, B. (1991). Brand Loyalty and Market Equilibrium. *Marketing Science*, Vol. 10, No. 3, 229-245.