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# The Future of Digital Rights Management in Digital Video

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THE FUTURE OF DIGITAL RIGHTS MANAGEMENT IN DIGITAL VIDEO

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BY

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## Abstract

The rise in the popularity of internet-based digital video has created a major revolution in the way consumers acquire content. Users no longer need to watch a television show live or obtain a physical disc in order to view a movie. However, this transition comes with a price: Digital Rights Management (DRM). Every digital video file requires a user to be locked into a particular combination of software, hardware, and business plan in order to be authorized for viewing purchased content. DRM was just as prevalent during the introduction of digital audio, but DRM was abolished from the format within four years. The goal of this paper is to attempt to divine the future of DRM and digital video by comparing the current marketplace to the case study of digital audio.

In order to estimate the lifespan of video DRM, this paper first examined the history of audio DRM and the factors that led to its demise. Two key factors were discovered: technological innovations that helped push audio piracy into the mainstream and the market forces that forced the copyright holders to relax their DRM requirements. Those factors were used to analyze the current state of video DRM. While disruptive technologies are still being developed to compete against DRM, a combination of the Digital Millennium Copyright Act's stifling of innovation and the rise of online streaming content has prevented the creation of a universal technological solution that would push for DRM-free video. As for the market forces, users treat video content differently than audio. Video content is more disposable, with users preferring to rent content for a single viewing while digital audio lends itself to an ownership culture. This difference in how users treat their content does not create the level of piracy necessary to make DRM-free

digital video a reality. The paper concludes that despite the internet's massive ability for the free dissemination of data, digital video DRM will be a factor in the foreseeable future.

## Introduction

Three examples make a trend. Consider these: a computer company getting into the home theater PC business admits the main use of its product is watching illegally downloaded movies. An executive of a consumer electronics company says that if pornography helped popularize technologies like videotape a generation ago, then music and movie *piracy* is in the driver's seat today. Finally, a venture capitalist lets on over lunch that the real high-tech executive of the decade should not be Apple's Steve Jobs or the cofounders of Google but Sean Fanning, the kid behind the short-lived but trailblazing music "sharing" service, Napster (Gomes 2010, 38).

The cycle has played out several times over the last few decades. A new technology is developed that allows for the duplication of a copyrighted work, copyright holders complain that the new technology will destroy their business, and arguments are fought in the courts and the legislatures. The result of each battle shapes the future of technological development for decades. This cycle has accelerated thanks to the growing amount of intellectual piracy over the internet.

Currently, the biggest battle surrounds digital video. Ever since the introduction of the DVD and with it the ability to create perfect digital copies, the movie studios and the Motion Picture Artists Association (MPAA) have been attempting to install controls that would stop piracy of protected material. As the business model has migrated from physical discs into downloadable content, the studios have required that Digital Rights Management (DRM) be included and verified before a user can access legally purchased digital video materials. Their argument is that DRM prevents the spread of their property over the internet's thriving file-sharing services.

Those in opposition to DRM argue that the biggest strength of the digital age is the ease in which users can share information with the world. They view DRM as a

significant barrier for the future development of the internet and consumer technology. By relaxing the DRM requirements surrounding video, users can utilize their Fair Use rights to rip, rearrange, and remix content to make interesting alternatives. In addition, the rules surrounding DRM make it difficult for technological innovation that is not sanctioned by the corporations that own the content. They believe that in order to help strengthen a free society, DRM should be abolished (Electronic Frontier Foundation 2010).

Because this DRM cycle has already played out over the last five years, it is important to go back and review how DRM was introduced in digital audio. DRM was an integral part of music purchased from online stores when it was first introduced, but eventually it was expunged from the service. Once the history is reviewed and the key elements that drove the abolishment of DRM are defined, the elements can be compared to today's climate in order to determine how the events of the past can inform the future of the industry.

## **Audio**

On April 28, 2003, Apple released the iTunes Music Store alongside the third generation iPod. For the first time, users were able to legally purchase music over the internet from a well-known company. It was a revolutionary move for the industry, attempting to reconcile the need of users to acquire digital music online with a corporation's profit margins. All of the major music labels decided to participate in the store, but only if DRM was included to prevent users from purchasing tracks and immediately uploading their data to file-sharing services. The iTunes Store was an



immediate success, selling over 25 million tracks by the end of the year (Wingfield and Smith 2003).

For the music labels, it was an attempt to evolve to meet the needs of a changing market. For Apple, it was a calculated move to help improve the market share of the iPod:

Apple has clearly designed all the parts of the iPod/iTunes system to create a “lock-in” effect that increases the loyalty of the iPod user base. Where this effect comes in is when an iPod user has already made a substantial investment in FairPlay-encoded content (and perhaps also in iPod accessories). Because that content cannot be used by a non-iPod player, the cost of switching to another system is effectively raised beyond simply the cost of new hardware. This makes it more likely that an obsolete iPod is replaced with another iPod (Sacconaghi Jr., Yin, and Garfunkel 2006, 60).

With the success of the iTunes Store, other companies such as Microsoft, the revamped Napster, and Wal-Mart immediately began developing their own systems to cash in on the new marketplace. Various DRM systems were devised: the conglomeration of the PlaysForSure initiative, Apple's ever-evolving FairPlay, and server-based DRM used in Wal-Mart's initial store. DRM was an integral part of the business model.

Fast forward six years later, and Apple announced that all of the music tracks in the iTunes Store would be sold without DRM (Cardew 2009). In the interim, Digital Rights Management changed from required technology to protect the intellectual property of the music labels into a hindrance for the future of the industry. The change was a result of two driving forces: technological innovations that helped to create and shape the digital music industry and consumer pressures that forced copyright holders and the companies that sold their product to eventually remove all forms of DRM.

## Technological Innovations

The first wave of technology that changed the way the user viewed their audio collection was the development and standardization of the personal computer as a music jukebox in the mid to late 1990s. As CD-ROM drives became cheaper and more reliable, programmers began to write encoding programs that would "rip" the data from a compact disc and store it as a lossy file on the user's hard drive. Soon programs such as Windows Media Player, MusicMatch Jukebox, and WinAmp became an essential part of a home computer (Mossberg 1999). Various audio codecs battled to become the dominant standard for the industry, with the open-source MP3 competing against RealNetworks' RealAudio and Microsoft's Windows Audio. Users were able to condense their collections into a format that favored portability and sharing.

Napster took these collections and shared them with the world. Created by Shawn Fanning, a computer science student at Northeastern University in Boston, Napster enabled users to acquire music for their collections by searching and downloading files from other users via the internet. Prior to Napster, there were plenty of options for finding illicit music downloads on the internet (USENET, IRC, FTP, search engines, etc.), but they were unreliable and it was difficult to locate a specific song. Napster combined the communication tools of Internet Relay Chat, the file transfer technology inherent in Windows, and applications that allowed the searching of hard drive data to make the sharing of music files as easy as clicking a mouse.

Napster was an immediate success when it debuted in 2000, peaking at 26.4 million registered users during its two year lifespan (Greenfield, Taylor, and Thigpen 2000). Users flocked to this new style of music acquisition, finding themselves plugged

into a worldwide net of music lovers willing to help Napster users discover and share new tracks for consumption. The application mirrored the experience of friends trading collections, just on a larger scale (Giesler and Pohlmann 2003).

While Napster was quickly shut down through legal challenges, it popularized the concept of peer-to-peer sharing of music via the internet. The replacement technologies (KaZaa, BearShare, BitTorrent, etc.) were quickly embraced by the former users of Napster and the percentage of the population that used P2P systems continued to grow. This popularity helped to solidify the MP3 codec as the audio standard in the minds of the average user, because it was a universal format that could be played by any program in the market (Moody 2003).

The final major technological revolution began with the introduction of the iPod. First released by Apple in 2001, users were finally able to listen to their digital music collection away from their computer. The concept was an immediate success, and other companies quickly introduced rival hardware to take advantage of the emerging market. The iPod quickly dominated the marketplace, gaining as much as 72% of the market share. The MP3 player soon became a necessity for the average user instead of a luxury.

By 2003 users were able to easily acquire, rip, and share their digital audio collections outside of the typical revenue streams of the era. The market was ripe for a new paradigm to monetize the changing marketplace.

## **Market Forces**

Apple parlayed the success of the iPod into the sale of digital music through the development of the iTunes store. They were able to eventually sign deals with all the

major music labels to sell individual tracks online for play on the user's computer and associated iPods because the purchased music was controlled through DRM. The ultimate business goal was to lock a user into a specific combination of store and device, ensuring that the user would remain a customer of Apple because of the inherent expense in switching services. Microsoft followed suit, creating the PlaysForSure initiative which allowed a multitude of devices to play tracks purchased from Microsoft-aligned stores and subscription services (including the newly-rebranded Napster). This plan was successful in the newly emerging digital audio marketplace.

As the market matured, the major players realized that they needed to open up the system in order to continue to find profits. While the MP3 players were still being purchased, the number of new users poised to enter the marketplace began to dwindle. Eventually this issue led the executives of the online music stores to begin pushing for the abolishment of DRM, led by Steve Jobs of Apple. Apple's internal studies showed that 97% of music on the typical iPod lacked DRM, which showed that customers had no problem filling their devices with music from a non-iTunes source. Only 17% of iPod users purchased music from the iTunes Store on a monthly basis (Jobs 2007). He argued that the time had come for the music labels to relax their standards in terms of required copyright protection and let the market open up to increased consumer choice, with the secondary goal of allowing the music stores to compete in order to create the best product.

The first store to offer DRM-free tracks was Amazon.com, which opened its MP3 store in late 2007. Only selling tracks that they could legally sell as an MP3, they were an immediate success (Smith and Vara 2007). After Amazon began offering the option of

DRM-free music, other online stores were forced to follow or become irrelevant. As Apple started to renegotiate their contracts, more music transitioned to DRM-free versions until all DRM was abolished in 2009 (Frakes, Seff, and Snell 2009). Microsoft changed their agreements in order to remain competitive, and online DRM servers were shut down to the detriment of the users who suddenly found their music unplayable. Except for the subscription-based services, all other stores online were forced to remove DRM in order to compete.

With the death of DRM, users who purchased an audio track online would own it as long as they were in possession of the file and would be able to transfer the music to another appliance. There was no longer a reason to be "locked in" to a particular device or store. Businesses were allowed to compete for market share through their innovation, not as a result of DRM-enforced inertia.

## **Video - Similarities and differences**

At its surface, the new video market appears to be on the same path that audio forged a few years earlier. However, there are some key differences in the way that the copyright holders approached this new market in order to help strengthen their positions in the digital age.

## **Technological Innovations**

Just as users gained the ability to rip, convert, and remix compact discs around the turn of the century, the same technology needs to be as widely available for users to extract content from their DVD collections. It was the fact that the MP3 was so easy to create, obtain, and share that helped to evolve the marketplace to the point where DRM

became a liability. Without user-friendly, easily acquirable, and ubiquitous technological alternatives to the online stores, the copyright holders would have no reason to allow for negotiations about the removal of DRM.

Consumers have always wanted to merge their computers with their televisions. The personal computer is an excellent appliance for video playback of legal and illegal files, but until recently the average monitor size was not appropriate for family room viewing. Adding a video card to a personal computer would enable footage to be broadcast in a more consumer-friendly environment. With the release of the Video section of the iTunes Store alongside the iPod Video in 2005, the digital video revolution began. Legal portable video soon became a reality for most users. The current generation of game consoles are capable of playing most of the popular video codecs from a hard drive, memory stick, or home network and display the video on the living room big screen television. Set-top media boxes such as Apple's AppleTV, Google's proposed GoogleTV, and other media-center software packages such as MythTV, X-Box Media Center, and Boxee are vying for the user's pocketbook as the ideal audio/visual component for the living room.

The technology exists to rip and convert a DVD disc into portable video files, but unlike the audio CDs the technology has to contend with DRM. Just as many VHS tapes were protected by Macrovision, the emerging DVD market had its own anti-copying protections. The first major DVD encryption method, Content Scramble System (CSS), was cracked in 1999 for the purpose of allowing DVDs to be played in the unsupported Linux operating system (Camp 2002). With that knowledge, hackers gained the ability to copy the files from a DVD and manipulate the data. Despite the resulting application

(*DeCSS*) being declared illegal in the United States in 2000 (Eschenfelder 2005), the code is still freely available on the World Wide Web. This breakthrough allowed applications to be created to make backup copies of a user's collection, extract video or audio for editing purposes, store the data as an image file on the hard drive, and encoding into smaller formats such as MPEG-4. Any user with the proper audio/video codecs installed on their system could take the encoded files and view the content in a compatible device or burn the video to a DVD. Other encryption methods have been developed, but hackers are always quick to circumvent them because DVDs need to be compatible with older hardware.

Users who want to copy or convert their movie collections have a myriad of solutions, available to anyone with an internet connection. A simple Google search will list guides and links to software for the sole purpose of ripping DVDs. However, none of these software packages have been universally accepted as a solution. Each time a possible business plan is created to enable more consumer control over their media collection it runs afoul of the Digital Millennium Copyright Act (DMCA).

The DMCA was the latest plan by copyright holders to control the ability of computers to make perfect digital copies of media. This was preceded by the Audio Home Recording Act (AHRA) in 1992 with the goal of enforcing existing DRM plans and collecting royalties from the sale of devices that existed solely to make perfect digital copies of media. Signed into law before the MP3 codec was released in 1995, it was unsuccessful at stopping the ripping of compact discs because the personal computer was not a dedicated instrument of piracy. Hard drives and CD-ROMs were capable of perfect duplication, but their primary purpose was the storage and retrieval of data. While the

computer could be used for piracy, this was a secondary feature. The computer's flexibility led to its immunity from the Act (Landau 2002).

The music industry also attempted to use the AHRA to shut down the fledgling MP3 player industry. Diamond Media created an MP3 player called the Rio in 1998, which had the capability to store an hour of MP3 content. The Recording Industry Association of America (RIAA) sued to prevent the sale of the device without the protections required by the AHRA (Allemann 2000). Because the Rio was able to make a perfect copy of an MP3, the RIAA argued that it was in violation of the AHRA and sales should stop until it could be modified to become compliant.

The judge presiding over the case did not agree. MP3s uploaded to the Rio were locked to that particular device. The Rio did not create its own files, only transferred copies that were made in another location. There was no way to export the tracks from the Rio onto another computer, so the device already had built-in DRM. In addition, the ability to use the Rio as a Dictaphone helped classify the Rio as a multi-use device. Just like the personal computer had a multitude of uses beyond just ripping music, the Rio was more than just a digital Walkman. The result of the ruling was that MP3 players were legal extensions of a user's Fair Use rights (Starrett 1999). The precedents set in the case helped define the abilities of current MP3 players.

The DMCA's goal was to further protect the rights of copyright holders as the power of the personal computer and the internet continued to expand. With the exploding popularity of the internet and the potential threat to the newly-emerging DVD market, the



media companies felt that they needed to protect their investments. The DMCA was a major victory for the studios.

The main article of the DMCA relating to DRM is:

No person shall circumvent a technological measure that effectively controls access to a work protected under [the copyright] title (*DMCA 1998*).

In other words, any program or technology that exists to circumvent or nullify existing DRM schema is illegal and cannot be sold or disseminated in the United States. The DMCA was essential in the case against *DeCSS*, which allowed users of the software to access scrambled content without paying for a CSS decoding license. Even posting a link to the *DeCSS* software is a violation of the DMCA.

The combination of the DMCA and DVD encryption has been used repeatedly to restrict the development and distribution of a simple, user-friendly DVD-ripping solution. The first major test was *Macrovision vs. 321 Studios*. 321 Studios created a suite of software entitled *DVD X Copy* that enabled users to make copies of their DVD collections. The user had the option to remove all forms of copy protection, including Macrovision's anti-analog DRM. Macrovision sued, stating that the removal of their copy protection was a violation of the DMCA. After a three year fight in the courts, Macrovision won and 321 Studios was forced to stop selling the product (Katz et al. 2004).

A more recent example came in 2008 when RealNetworks released their RealDVD software. RealDVD's purpose was to rip the contents of a DVD to a hard drive while still maintaining the DRM protection inherent in the disc. RealNetworks believed that because they owned a license to legally decrypt protected DVD content and it was

incorporated in the system, they were within their rights to design software that would enable users to "space shift" their data from physical discs to a hard drive in a restricted format. The ripped data could not be shared with other users (Salcedo 2008).

The Motion Picture Association of America (MPAA) quickly filed lawsuits to stop the sale of RealDVD. They argued that that because the software enabled users to view the content of DVDs without the physical disc being present, they violated the licensing agreement of the CSS license (Netherby 2009). The case quickly went against RealNetworks, and they settled with the MPAA in 2009 (Shwiff 2010).

Because a majority of DVDs sold in the United States are protected by some form of copy protection, it is impossible to design a software package that can emulate the jukebox-style audio functionality of iTunes or Windows Media Player. Any business plan dependent on the breaking of DVD encryption has to be prepared for legal attacks if the company wants to ultimately be a success.

Despite these setbacks, digital ripping of video content thrives. DVD-quality copies of major movies are released to the internet days in advance of their commercial release. 96% of all Oscar Nominated films have high quality copies available on the internet by Oscar night (Baio 2010). Television episodes are usually available for download via BitTorrent or USENET within an hour of the end of the broadcast. Users no longer are forced to wait for a television series to be broadcast in their country because they can download copies ripped in another market. A study of typical BitTorrent traffic concluded that 99% of all content in file-sharing networks is in violation of some form of copyright (Felten 2010).

The technology exists to assist home users in creating their own home video jukebox, but the marketplace does not help the spread of the technology. The DMCA is currently preventing progress in that area, to the satisfaction of the studios. Because an alternative business plan is not allowed to exist, there is no incentive for the MPAA and television networks to change their positions regarding DRM. Should a case succeed in striking down some of the DMCA protections that the studios enjoy, they may have to reconsider their positions.

### **Market Forces**

Electronic video entertainment (DVDs, Blu-Ray, Video-on-Demand, etc.) is still a significant portion of the United States' economy, accounting for \$20 billion in sales in 2009. While digital video sales increased by 32% in the last year (Digital Entertainment Group 2009), the market is beginning to show signs of weakness. DVD sales are dropping rapidly, and Blu-Ray releases are not selling fast enough to fill the gap. Brick and mortar DVD rentals declined in the first quarter of 2010 while online rental services such as Netflix and Blockbuster Online continued to gain market share.

The rise in the prominence of streaming media has revolutionized the way users treat video content. Streaming video was very primitive around the turn of the century, as the bandwidth and technology required for on-demand video had not been developed to the point where it was feasible. Until recently, the user's relationship with online video was fairly limited. That relationship changed with the debut of YouTube in 2005. Because YouTube allowed users to upload their own content for rebroadcast via a browser-neutral interface, both the company and the concept of on-demand video quickly gained the attention of the internet populace.

The new technology was quickly embraced by enthusiasts and pirates alike. With some minor video editing and a few clicks of a mouse, users could upload whole movies and television series onto the web. Because YouTube initially relied on feedback from users to determine copyright infringement, anything could be uploaded and viewed within minutes (Meisel 2009). Just as Napster helped make finding a specific audio track easier, sites like YouTube made finding a specific video clip as simple as a Google search.

The response by the copyright holders was not initially positive. The arguments were similar to the cases used during the rise of Napster: YouTube's business model existed to make a profit off of the infringement of copyrighted material. The most prominent ongoing case is *Viacom v. YouTube*, in which Viacom argues that YouTube should pay for the profit that they gained thanks to the broadcast of clips from popular Viacom shows such as *The Daily Show* and *The Colbert Report*. YouTube took the same argument as Napster: they are protected as a service provider under the DMCA's safe harbor laws (Allen 2007). Despite the lawsuits, YouTube's business model was strong and clones quickly popped up across the web.

While the corporations were fighting YouTube in court, they also began to understand the power of streaming media to improve their bottom line. Soon the networks and studios began to embrace the new paradigm on the web. The CBS network made a deal with YouTube to create their own channel on the site, ABC built its own streaming application, and NBC and FOX partnered to create Hulu, an alternative online streaming destination. Even Viacom, while suing YouTube, was using the service as a marketing tool by secretly uploading clips (Kravets 2010).

Hulu is the most successful of the major streaming initiatives, eventually convincing ABC to join the service in 2009. Because of YouTube and Hulu's influence, there are very few shows on television that do not have streaming alternatives available after the broadcast. The networks provide the on-demand content that users crave, but still retain control over how it is distributed. The typical service only displays a few of the most recent episodes for consumption, and inserts advertising to gain income from the broadcast of episodes. The networks also update their systems to foil third-party applications that broadcast content without the permission of the provider.

Meanwhile, users treat video content in radically different ways than audio. Audio content by its nature lends itself to collecting. Users who purchase a CD in a store and rip the content to their hard drive or download an album online will keep the digital files as long as they have access to the bytes that make up the tracks. Because storage capacity continues to increase in size and decrease in price, there is no reason for users to purge their collections of rarely-used files. Once a user has purchased/downloaded an album, the user will keep it for life.

Users' relationship with video is more ephemeral, and has been in the years before the digital revolution. When the time comes for users to make a decision about procuring a movie, not only do they have to decide upon the film to view but they also need to decide whether to rent or buy. Economic models state that the decision is based upon the price of the material and the likelihood that the user will consume the media enough times to make up for the differences in price. However, when the user is presented with the option of rent vs. buy in a store the user tends to incorrectly estimate the number of viewings for a particular film. The rent vs. buy decision is also adjusted by the location of

the purchase (Blockbuster vs. Best Buy) and the genre of movie (action vs. documentary) (Milkman, Rogers, and Bazerman 2009). Because the video market has a built in rental option that does not have a universal match in the audio market, many users only want to view content a single time before discarding it.

The rise of online streaming services such as Netflix has taken advantage of this difference in attitude. Consumers are more likely to sign up for a "bulk" option that is more convenient, such as a subscription to Netflix or Blockbuster Online, even if they are unlikely to use it enough to warrant the price (Lambrecht and Skiera 2006). Because the user is not paying ala carte for content, they do not see an unutilized subscription as a loss of value (Soman and Gourville 2001). This difference also helps the service provider, saving them money in shipping and bandwidth. It creates a solid relationship that allows the user to receive the content that they want to consume at a level of commitment and cost that is appealing.

Many online retailers and rental companies had long realized that the future of video media is not the physical disc but on-demand streaming of content. Currently, the movie studios are starting to adjust their business models to allow for increased access to streaming content while still helping the sales of DVDs. New deals are being formed to create a special four-week release windows between the release of a film on a DVD and its availability in Netflix-like services. The goal is to spur the sales of DVDs with the promise of more films being cleared for streaming in the future. If this collaboration is successful, streaming content may finally reach the point where all video content will be on-demand via subscription in the coming years.

If on-demand content becomes the driving force in the industry, then there would be no reason for the studios to entertain the thought of removing DRM. Part of the forces that drove the eradication of DRM from digital audio was the prevalence of DRM-free copies. If most content is eventually streamed into the user's living room, then DRM is required to enforce the security of the system. Users will have to be authenticated, and the service providers will be required to protect the integrity of the content. While this may be a perfect medium between "free data" and the need of the studios to protect their investment, it would never be considered a DRM-free solution.

## **Conclusion**

It is unlikely that Digital Rights Management will be removed from digital video content over the next few years. The DMCA's restrictive effect on technological innovation without the blessing of the copyright holders and the relative ease of on-demand streaming content are creating a marketplace where content is accessible via the internet instead of being stored locally. Just as data is migrating into the Cloud, users do not feel the need to obsessively collect video files of everything they consume for archival purposes like they would with audio. The current generation of video delivery systems are growing to hopefully meet the need of the general populace, unlike the music stores that appeared online after the MP3 revolution.

The eradication of audio DRM required a marketplace that forced the music labels to renegotiate. Video DRM would require a similar economic need for the studios to change their attitudes, but because content is so easily available and accessible via current business models it is unlikely that there will be a major revolution in technology that does

not directly involve the copyright holders. Although the will for DRM's eradication will always exist, it appears that digital video DRM will stay for years to come.

## **Future Work**

The environment is in a constant state of flux. DRM ideologies will continue to clash as new technologies, legislative proposals, and legal battles are introduced and have an effect on public opinion. Recently, a round of lawsuits were filed against users who downloaded independent movies online in a blatant attempt to coerce settlement fees. A hardware company is fighting the DMCA in court in an attempt to continue to sell their video jukebox solution to consumers. A new copyright protection act is working its way towards Congress. The fate of Net Neutrality could severely restrict the effectiveness of P2P networking and new streaming content options.

At the same time, new markets of digital content are beginning the battle over DRM. The surge in the popularity of eBooks thanks to devices like Amazon's Kindle and Apple's iPad has pushed the industry into similar DRM territory. Books bought from one store cannot be transferred to a competing store's device. Software developers, and gaming companies in particular, are developing more sophisticated DRM schemes to attempt to reduce the amount of piracy with the side-effect of possibly locking out legal copies. As hackers crack the software's DRM, the developers design more restrictive schemes.

There is so much rhetoric on both sides of the argument that it is difficult to gain hard data on the future course of DRM. One area of study would be the changing attitudes of the consumer towards digital media, DRM, and piracy. Has the rise in online



streaming and subscription options helped reduce the need for piracy for the typical user?

Does participation in a service such as Netflix increase or reduce the need to download video, and why? What is the real financial penalty to a corporation that insists on including DRM, and can the benefit from removing DRM be quantified?

With appropriate studies and objective results, it may be possible to design a solution that is as beneficial to the consumer as to the corporation.

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