Digital Rights Management in PC video games: how far the game industry will go to prevent piracy

Beerend Lauwers

Abstract

Digital Rights Management methods are often used in computer video games to enforce the copyright of the content. Recently, the game industry has experimented with several controversial DRM methods, but the history of invasive DRM is older than these experiments. This paper discusses the three common types of DRM currently used in video games and any controversies surrounding them. It also touches upon the opinions of several game companies concerning DRM and discusses the ethical repercussions of current DRM types, as well as a suggested solution for both customers and game companies.

1. Introduction

As with other digital media, Digital Rights Management (DRM) methods are used in computer video games to enforce the copyright of the content. Video game producers and publishers alike have produced or adopted several techniques that prevent making an illicit copy of the game. Some of these techniques are embedded into the game itself while others use a protected framework to ensure copy protection. Unfortunately, many of these techniques are quite invasive to the user and/or his computer system, and some of the methods used sometimes prevent a user that has legally acquired a copy from playing it. This paper will discuss the most recent of these techniques and their implications on customers. Furthermore, it will touch upon the opinions of several game developers and –publishers concerning DRM. Finally, the ethical repercussions of the current DRM types will be discussed along with a suggested solution and its benefits and drawbacks for both the customers and the game companies.

2. Methodology

Full-text databases were initially queried with the terms “drm AND games” and “drm AND video games”, with later revelant terms (such as “StarForce AND drm”) being used as well. Several websites were also consulted for DRM-related articles.

This research method was used to fulfill the following steps:

- Distill the common types of video game DRM methods;
- Give a few examples of each aforementioned type;
- Discuss the pros and contras of each type, any controversy surrounding the type and its effectiveness against piracy;
- Give an overview of the opinions of several game developers and –publishers concerning DRM;
- Discuss the ethical repercussions of the current DRM types.

3. Results

In the current video game market, three common types of DRM can be identified: Software-based DRM, framework-based DRM and always-online DRM. Other protection types are available, but these either protect the hardware on which the game is played, or protect the media on which the game is stored **[85]**.

This paper presumes that one already has access to the unencrypted installation files of the video game.

3.1. Software-based DRM with online activation

The most ubiquitous form of DRM used in video games is software-based DRM. This method consists of a third-party DRM mechanism that is usually installed along with the game. On installation of the game, the mechanism ensures a legal copy is being installed, for

instance through use of a CD-key and/or online activation/registration.

Examples of third-party software-based DRM mechanisms are SecuROM and StarForce, both of which are automatically installed upon installation of a game that uses them. By default, these mechanisms are not uninstalled when the game itself is removed, although removal tools have been provided **[1, 2]**.

The advantage these packages provide is that the software itself is protected, so an elaborate security framework is not required. They are also easily integrated in applications and have been widely adopted by the industry **[65, 66]**.

However, because the protection is client-side, it can be bypassed with programs that prevent the game from authenticating with the mechanism, effectively cracking the protection (hence, these programs are often called "cracks"). The cracked game is then often redistributed through illicit channels, allowing users to appropriate and install the game without being prompted for any type of authentication or verification. In order to prevent this, the security mechanisms are often tightly integrated with the game. Some companies integrate the mechanism in such a fashion that playing the game after removing or bypassing the security mechanism results in unexpected behavior that renders the game unplayable. One security mechanism, called FADE, even progressively worsens certain gameplay mechanics until the game effectively becomes unplayable. The user who pirated the game will have become frustrated and hopefully have been persuaded to purchase the game if he wishes to continue playing **[3]**.

Unfortunately, this tight integration sometimes backfires, with legal copies also displaying the behavior that should only occur with illegal copies, much to the aggravation of customers **[4, 5, 6]**.

SecuROM and StarForce support online activation methods **[7, 67]**, with the game developer deciding what options are available to the user and how the activation should occur. It is here that we see how some game companies are experimenting with different authentication methods for video games using software-based DRM, and the reactions of the customers to these methods:

2K Games required users to activate their copy of *Bioshock* and allowed the game to be installed on two computers at the same time. Uninstalling the game gave back a license. Due to issues with the activation server, some people did not receive a license again. Different computer accounts also required a separate license. These problems forced customers to contact 2K Games in order to receive more license keys, with call centers only located in the USA **[8,9]**. Users who pirated the game did not encounter these issues, as the SecuROM mechanism was removed from the pirated version of the game. Many paying customers were upset with this ordeal, some actively pirating the game they bought legally **[10]**. 2K Games removed later removed this limit **[11]**.

Electronic Arts used a similar system in *Mass Effect* and *Spore* which allowed the game to be installed three times. Uninstalling the game did not return a license, and users had to contact EA in order to install the game more than three times. EA also required the user to authenticate the game online every ten days, but this requirement was removed due to the intense backlash of the community **[12, 13]**. A class-action lawsuit was filed against EA for including SecuROM in *Spore*, citing that the security mechanism was installed without permission onto the user's computer under a super-user account, which gave the mechanism privileges that even the user himself did not have **[14]**. In later versions, SecuROM protection could be integrated with the video game code, no longer requiring it to be installed and loaded externally. This resulted in the security mechanism running at a user-level privilege **[26]**.

The security mechanisms themselves have also been known to disrupt the normal operation of computers. SecuROM may crash the file explorer program of Windows if virtual drives have been mounted **[15]**, while StarForce was known to cause freezes or crashes on some systems due to the security mechanism being recognized as a rootkit by anti-virus software **[16]**. Due to a design error discovered in 2004, StarForce could be used by a (malicious) user to gain access to root-level privileges on any system that had StarForce Software Protection Professional 3.0.0 installed **[17, 18]**. Anecdotal evidence also suggests that StarForce systematically deteriorated optical drive performance, ultimately rendering the drives useless **[19, 20]**.

When confronted with the allegations that their mechanism deteriorated system performance and stability, the StarForce company threatened to sue the websites that reported on them, citing that the "article violates approximately 11 international laws", and that they "also contacted the FBI" for cases of harassment. **[23]**. The company also issued a challenge in 2005, offering $1,000 (increased to $10,000 in 2006 **[68]**) to the first person who could prove that installing StarForce on their system resulted in a non-functional optical drive. If a person was unable to prove this, he would be added to a list of "losers" available on the company website **[24]**.

The company later made modifications to its protection system to increase compatibility with end-user systems, stating they "got the lesson" when several "important clients" no longer wished to use the mechanism after a class action lawsuit regarding StarForce protection was filed against Ubisoft, a French game developer and –publisher **[21, 22, 25]**.

This form of DRM is used to protect a game from being pirated after the first few weeks of its release, a duty it usually manages to fulfill **[25]**. It is a relatively inexpensive way to protect the initial sales of a game **[26]**, but is inadequate for long-term protection.

The biggest issue (would-be) customers have with this form of DRM is the addition of limited installations. Some paying customers may find the usual limit of three to five installations limiting, but some companies allow a license to be returned when the game is uninstalled **[8]**. Still, many have been turned off by the limitation and the issues it brings forth, stating they will no longer buy games that feature this kind of DRM **[69, 70]**.

3.2. Framework-based DRM

An up-and-coming form of DRM is framework-based DRM, which uses a (protected) framework in order to prevent illicit copying of games. Steam, created by Valve Software, is the most well-known DRM framework **[71]**. Impulse, created by Stardock, is the second most popular DRM framework **[28]**. Another framework is Games For Windows, but it does not include several features that the other two frameworks offer and only supports a limited number of games (as of May 2010) **[72, 73]**. Hence, it will not be further discussed. These frameworks also incorporate methods for online game distribution. While these methods are not directly related to DRM, their integration with a DRM framework is said to reduce the threshold of purchasing a video game due to its security and ease of use **[29]**.

The way these systems function are as follows: A customer creates an account with the system and selects one or more games in a "virtual shop" environment. Then, the customer proceeds to the checkout and pays via a secure channel. The licenses for the games are then bound to the customer's account and the games are downloaded to the hard drive of the customer. Then, the games are validated once, after which the user can play while online or offline **[30]**.

The biggest advantage this type of DRM heralds is its ease of use compared to other DRM mechanisms: users can purchase, download and play new games relatively quickly and effortlessly, with the framework itself enforcing DRM. When released in both digital and retail form, other forms of DRM (such as software-based DRM) are sometimes removed from the digital version **[31, 32]**. The issue of multiple installations is also thwarted, as licenses are permanently bound to a customer's account: if a user wishes to share a game, he has to share his account credentials **[33]**.

These systems are not without fault, however. Games have to be authenticated via authentication servers. If these servers are unavailable, authentication is impossible and the game cannot be played. This scenario occurred during the release of *Half-Life 2*, which left many customers unable to play their newly purchased game **[34]**.

When logging in, the Steam client application contacts an authentication server in order to verify the identity of the customer. A power outage in Seattle in 2006 took down these authentication servers for a day, leaving numerous users unable to access their entire library of games purchased on Steam **[35]**. It is obvious that this type of DRM relies heavily on high availability of authentication servers in order to function correctly.

Games are permanently bound to a single account. Steam accounts cannot be merged at all and games cannot be sold **[33]**, but hijacked accounts are usually easily retrieved **[36]**. Impulse says it will handle "reasonable requests" for selling a game through its support desk **[37]**.

When asked what would happen if Steam were to shut down, the CEO of Valve Software replied that they would "presumably disable authentication before any event that would preclude the authentication servers from being available" **[38]**. Impulse has stated that if it can no longer provide for the authentication servers, "an update will be produced and released that will remove the activation need" **[39]**.

This type of DRM requires a significant investment from the company that designs and supports the framework, but these costs can be recovered by adding a digital distribution system that allows third-party developers and publishers to sell their games on it, returning a percentage of each sale to the company that designed the framework. Both Steam and Impulse are set up in this manner. These frameworks also allow extra content and features to be included in the games: Steam provides Steamworks **[76]** and Impulse provides similar services with Impulse Reactor **[77]**. Pirated versions of the games do not have access to these services.

Usually, the retail versions of the games are cracked and distributed, but cracks for Steam itself are also distributed. The malicious user can then appropriate most Steam games and play them offline and on cracked game servers **[78]**. Protection-wise, these systems are no better than software-based DRM. But by offering games with large discounts and including extra services such as DLC, automatic matchmaking, cheat detection software and so on for free, they hope to reduce piracy through offering a superior service. Jason Holtman of Valve Software even described pirates as "just underserved customers" **[79]**.

Generally, users are more positively inclined towards this type of DRM because of its ease of use and non-invasiveness **[80, 81, 82]**. These users tend to think of the systems as simply a digital distribution platform and nothing else. Others are opposed to it, sometimes being opposed to any form of DRM **[83, 84]**.

3.3. Always-online DRM

This form of DRM is very new and is currently only in use in certain Ubisoft games, but it is sufficiently different from the other forms of DRM currently available to warrant its own type. It also displays quite well how far some game companies will go in order to prevent their games from being pirated, with several sources describing it as "draconian" **[40, 41, 42]**.

The DRM works as follows: after installation, a customer validates his copy online. In order to play the game, the customer is required to have internet access at all times, as the game communicates regularly with master servers. If the connection is lost, the game will pause and attempt to reconnect to a master server for a predefined period. If the game cannot contact a master server during this period, the player is returned to the main menu, where he can start the game again from the last (automatic) save point once internet access has been restored, as save files are stored on the master servers as well **[40]**.

This makes the master servers a very crucial single point of failure: if all the servers became unavailable, all games that use this type of DRM cease to function completely until a master server can be contacted again. This scenario has already occurred once; four days after the first games that use this type of DRM were released **[43]**. This situation is different from framework-based DRM in that games can still be played in the "offline mode" of the framework. This is not the case with always-online DRM.

The disadvantages of this type of DRM greatly outweigh its benefits: while having your game settings and progress saved in a cloud setting automatically is ideal for when you are playing from different locations, it is certainly not useful when playing with an unstable and/or low-bandwidth connection. The importance of the master servers also make them a target for blacklisting if an organization wishes to prevent these games from being played on computers it owns.

The protection this type of DRM offers is of the same quality as software-based DRM, protecting a title for approximately a month before it is cracked: *Silent Hunter V* was cracked within 25 hours of release **[44]**, and *Assassin's Creed 2*, *Splinter Cell: Conviction* and *The Settlers VII* were cracked within a month of their releases **[45, 46, 47]** (These cracked versions do not require a continuous internet connection in order to play). However, the investments required for the high availability of DRM master servers may make this method more expensive compared to the other types discussed in this paper. It remains to be seen if this type of DRM can be used on a large enough scale without a rapid increase of server costs. It is known that Ubisoft will continue to release games with this type of DRM **[59]**.

Currently, many users are discontent with games that utilize this type of DRM: some because they are unable to play the game (offline) **[48, 49]**, others because they feel they are being treated as criminals **[50]**, or both.

3.4. Opinions of game companies concerning DRM

Several game companies disagree with the notion of DRM entirely:

- Gabe Newell, the founder of Valve Software, stated that "no DRM should be offered that can be thought of as DRM". Instead, companies should offer better services to potential customers than pirates do **[51]**. Valve's Steam platform also offers large temporary discounts on video games and encourages publishers and developers to implement extra features and DLC in their games through Steamworks **[76]**. All these strategies have been suggested previously as viable anti-piracy tactics **[55]**.
- 2D Boy Games, an indie developer, released its debut title *World Of Goo* without DRM and calculated its piracy rate, coming out at 90% **[52]**. It compared this percentage with a game

of similar size and statute, *Ricochet Infinity* by Reflexive Entertainment. This game did include DRM and calculated its piracy rate was 92%. Battling the methods of piracy, they noted that for every 1,000 pirates being prevented from illegally downloading the game, one additional sale was made **[53]**. 2D Boy Games hopes that others will come forth with more data in order to draw conclusions **[52]**.

- Stardock, the creator of the Impulse delivery system, feels that same as Valve Software. Brad Wardell, CEO of Stardock, stated that "[the DRM problems with] Spore [were] the final straw that broke the camel's back" and that "someone who buys software does not want to be made to feel like a chump for buying it" **[61]**. The company actively develops a "Gamer Bill Of Rights", which states that "Gamers have the right to use their games without being inconvenienced due to copy protection or digital rights management" **[62]**.

Electronic Arts has recently been removing the software-based DRM in its digital versions of the games it publishes **[54, 55]**, possibly due to the backlash it experienced with *Spore*: after a multitude of complaints from aggravated customers who were discontent with the game's installation limitation, EA extended the installation limitation from three to five **[63]**. Shortly thereafter, it released *The Sims 3* without this installation limitation **[58]**.

Still, many game companies continue to use the more controversial DRM methods, often leaving the DRM methods in in the framework-protected versions **[60]**. Ric Hirsch of the Entertainment Software Association notes that "DRM is a reasonable response to high piracy rates" and feels that "just because some users circumvent DRM protections to gain unauthorized access to game software", it does not imply that "the technologies don't serve their intended purpose", as "no security technology is 100% effective" **[61]**. But Steam and Impulse may attempt to challenge that statement. They have announced a form of watermarking that can be used as an anti-piracy measure. The watermarking can be used to create unique copies of a game that are linked to the account of a customer, allowing leaked copies to be traced down to a single user. Both companies have stated they will make their watermark technology available to developers **[74, 75]**. It will be interesting to see how effective these techniques will be used against piracy.

4. Discussion: Ethical repercussions of the current DRM types

Game companies are experimenting with various authentication methods such as limited installs, recurring authentication (e.g. every 10 days) and always-online authentication (popular with Ubisoft). It is the opinion of the author of this paper that these methods undermine the trust in the customer and vice versa. The companies use a consequentialist point of view: a decrease in piracy is good; thus, *any* method to achieve this reduction is good. Unfortunately, this does not translate well into reality: customers feel as if they are handled as thieves when they encounter such limitations. The customers themselves are then quickly inclined to use the same tactics: *any* method that allows them to play the game is an acceptable method. It is obvious that this loop is self-feeding: The game company notes that piracy increases as disgruntled customers download a cracked copy of their legally acquired game and implements even more restrictive DRM, after which even more customers turn to DRM-less pirated copies. Meanwhile, the original disposition to pirate games has not diminished at all.

Prior to these authentication methods, security mechanisms in software-based DRM were used to enforce copy protection, but these mechanisms often caused compatibility issues on customer's computers, which resulted in the same scenario as described above.

Framework-based DRM in combination with watermarking seems the best solution in solving this problem: game companies trust that their customers will not distribute their copy illegally, as the watermarking technique will inevitably lead to them, and customers will not have any reasons to resort to cracked copies, as the DRM is transparent and allows the customer to access any of his games from any computer. The current frameworks even throw in several extra features to sweeten the deal and further bind customers to this form of DRM. If all versions of a game would use framework-based DRM in combination with watermarking, illegal distribution of that game without anyone to trace the leak back to would become very hard indeed.

Still, these frameworks are not without faults. DRM-wise, they offer game companies an "all-or-nothing" approach: use the framework to distribute all versions of a game to minimize the chances of piracy, or hardly impact piracy at all. Customers are given a similar deal: trust the framework to permanently manage your game license, and you will be given transparent DRM and extra features. Uncoupling the game from the

framework is impossible after it has been bound to the customer's account. Government intervention may become necessary when this hypothetical equilibrium has been reached in order to prevent exploitation of both customers and game companies. In America, the Federal Trade Commission has already held a conference for customers **[64]**.

5. Conclusion

Computer video games are a large market, but it is troubled by rampant piracy, sometimes reaching percentages of up to 90%. Game companies implemented DRM methods to protect their games from being illegally copied, cracked and distributed, but recently many of these (experimental) DRM methods came under fire. Three types of DRM methods were identified: software-based DRM with online authentication, framework-based DRM and always-online DRM.

The most controversy originated from the first and last DRM methods, with the last DRM method being the most controversial to date: customers have to be permanently connected to the internet in order play the game, with the game pausing and returning to the main menu or simply refusing to run if this is not the case.

The opinions of several game companies were researched, with the framework-based DRM systems Steam and Impulse suggesting a watermarking technique linked to a customer's account for transparent, but strong, DRM.

Finally, a discussion concerning the ethical issues of the aforementioned DRM types was held, noting that the use of repressive DRM only resulted in more piracy. Framework-based DRM combined with watermarking was suggested as an alternative, along with its pitfalls: the DRM method would not actually prevent (or reduce) piracy if non-framework versions of a game were available, and the permanent bonding of a game license to a customer's account, with no possibility to opt-out. Government regulation may become necessary to prevent exploitation of both customers and game companies once this situation has been reached.

6. References

[1] Sony DADC . (2009). *SecuROM Removal Tool Information*. https://support.securom.com/removaltool.html, consulted on 25 May 2010.

[2] StarForce. (2010). *Sofware Protection. Update/Remove Driver*. http://www.star-force.com/support/drivers/, consulted on 25 May 2010.

[3] Rosenblatt B. (10 October 2003). *Macrovision Introduces "Gradual" DRM for the CD Gaming Market*. http://www.drmwatch.com/drmtech/article.php/3093361, consulted on 25 May 2010.

[4] Steam Forums. (Janurary 2010). *Drunk camera problem on legit version of GTA IV*. http://forums.steampowered.com/forums/showthread.php?t=1085305, consulted on 25 May 2010.

[5] Games For Windows Live Forums. (August 2009). *GTA IV Shaking Camera*. http://forums.gamesforwindows.com/p/6681/62183.aspx, consulted on 25 May 2010.

[6] Facepunch Forums. (August 2009). *GTA IV Thinks I'm a pirate!*. http://www.facepunch.com/showthread.php?t=797527, consulted on 25 May 2010.

[7] Sony DADC. (Date unknown). *Online Activation - Digital Rights Management - Solutions - Sony DADC SecuROM*. http://www2.securom.com/Online-Activation.91.0.html, consulted on 25 May 2010.

[8] BoingBoing. (August 2007). *BioShock game bundled with DRMalware*. http://www.boingboing.net/2007/08/22/bioshock_game_bundle.html, consulted on 25 May 2010.

[9] MaxConsole Forums. (May 2007). *2K: Tell your brother to buy his own Bioshock, you didn't buy it for the whole family*. http://forums.maxconsole.net/showthread.php?77804-2K-Tell-your-brother-to-buy-his-own-Bioshock-you-didn-t-buy-it-for-the-whole-family, consulted on 25 May 2010.

[10] 2K Games Forums. (August 2007). *How many installs do we get ? Transfer of ownership ?*. http://forums.2kgames.com/forums/showthread.php?t=5527, consulted on 25 May 2010.

[11] IGN. (20 June 2008). *Bioshock Install Limits Removed*. http://pc.ign.com/articles/883/883281p1.html, consulted on 25 May 2010.

[12] Chalk A. (7 May 2008). *Mass Effect, Spore To Use Recurring Validation*. http://www.escapistmagazine.com/news/view/83689-Mass-Effect-Spore-To-Use-Recurring-Validation, consulted on 25 May 2010.

[13] Breckon N. (9 May 2009). *Electronic Arts Responds to Copy Protection Outcry, Removes 10-day SecuROM Check for the Troops*. http://www.shacknews.com/onearticle.x/52618, consulted on 25 May 2010.

[14] US District Court Of California. (22 September 2008). *Class Action Complaint*. http://www.courthousenews.com/2008/09/23/Spore.pdf, consulted on 25 May 2010.

[15] File.net. (Date unknown). *File Information - How to remove CmdLineExt.dll error problem*. http://www.file.net/process/cmdlineext.dll.html, consulted on 25 May 2010.

[16] Tech Support4World. (19 November 2009). *AVG Anti-Rootkit Scan Crashes Computer*. http://www.support4world.com/avg-anti-virus/avg-anti-rootkit-scan-crashes-computer, consulted on 25 May 2010.

[17] SecurityFocus. (8 November 2004). *StarForce Professional Software Protection Local Privilege Escalation*

Vulnerability. http://www.securityfocus.com/bid/11628/info, consulted on 25 May 2010.
[18] Juniper Networks. (Date unknown.) *STARFORCE PROFESSIONAL SOFTWARE PROTECTION LOCAL PRIVILEGE ESCALATION VULNERABILITY*. http://junipernetworks.co.za/security/auto/vulnerabilities/vuln11628.html, consulted on 25 May 2010.
[19] Daemon Tools Forums. (April 2006*). Can starforce kill a dvd-burner?*. http://forum.daemon-tools.cc/f20/can-StarForce-kill-dvd-burner-10844/, consulted on 25 May 2010.
[20] Author unknown. (Date uknown). *Boycott Starforce*. http://www.glop.org/StarForce/, consulted on 25 May 2010.
[21] Kotaku. (31 March 2006). *$5M Class Action Lawsuit Against Ubisoft for Starforce*. http://kotaku.com/164303/5m-class-action-lawsuit-against-ubisoft-for-StarForce, consulted on 25 May 2010.
[22] Thorsen T. (13 April 2006). *Ubisoft officially dumps Starforce*. http://www.gamespot.com/news/6147655.html, consulted on 25 May 2010.
[23] Doctorow C. (31 January 2006). *StarForce threatens to sue me for criticizing its products*. http://boingboing.net/2006/01/31/starforce_threatens_.html, consulted on 25 May 2010.
[24] DSLReports. (15 December 2005). *Starforce: If We Break Your PC, You Get $1,000*. http://www.dslreports.com/shownews/70434, consulted on 25 May 2010.
[25] SavyGamer. (2 Janurary 2010). *Digital Rights and Wrongs: The state of DRM*. http://savygamer.co.uk/2010/02/01/digital-rights-and-wrongs-the-state-of-drm/, consulted on 25 May 2010.
[26] Sony DADC. (2006). *SecuROM Frequently Asked Questions*. http://www.securom.com/support_faq.asp, consulted on 25 May 2010.
[27] BioWare Forums. (May 2008). *Copy protection/Activation*. http://meforums.bioware.com/viewtopic.html?topic=628375&forum=125, consulted on 25 May 2010.
[28] Graft K. (19 November 2009). *Stardock Reveals Impulse, Steam Market Share Estimates*. http://www.gamasutra.com/php-bin/news_index.php?story=26158, consulted on 25 May 2010.
[29] Dumitrescu A. (24 January 2009). *Weekend Reading: The Quiet Anti-Piracy Revolution Represented by Valve's Steam*. http://news.softpedia.com/news/Weekend-Reading-The-Quiet-Anti-Piracy-Revolution-Represented-by-Valve-s-Steam-102739.shtml, consulted on 25 May 2010.
[30] Steam. (2009). *Offline Mode - Features - Knowledge Base - Steam Support*. https://support.steampowered.com/kb_article.php?ref=3160-AGCB-2555, consulted on 25 May 2010.
[31] Rosenthal D. (22 March 2010). *Steam Users See SecuROM Removed from Bad Company 2*. http://www.gamepolitics.com/2010/03/22/steam-users-see-securom-removed-bad-company-2, consulted on 25 May 2010.
[32] Caron F. (22 December 2008). *EA games officially come to Steam, sans DRM*. http://arstechnica.com/gaming/news/2008/12/ea-games-officially-come-to-steam-sans-drm.ars, consulted on 25 May 2010.
[33] Steam. (Date unknown). *Steam Subscriber Agreement*. http://store.steampowered.com/subscriber_agreement/, consulted on 25 May 2010.
[34] Contractor UK. (18 November 2004). *Half Life 2 fires up web users*. http://www.contractoruk.com/news/001819.html, consulted on 25 May 2010.
[35] Goldstein M. (15 December 2006). *Steam Unavailable; Seattle Area Power Outage*. http://www.shacknews.com/onearticle.x/45062, consulted on 25 May 2010.
[36] Steam. (Date unknown). *Reclaiming a Hijacked Steam Account*. https://support.steampowered.com/kb_article.php?ref=2347-qdfn-4366, consulted on 25 May 2010.
[37] Stardock. (2010). *Impulse : Support : Activation Info*. http://www.impulsedriven.com/support/activation, consulted on 25 May 2010.
[38] Steam Forums. (16 July 2009). *What will happen if Steam go bust?*. http://forums.steampowered.com/forums/showpost.php?p=10642189&postcount=28, consulted on 25 May 2010.
[39] Impulse Forums. (10 November 2008). *What happens if Impulse/Stardock*. http://forums.impulsedriven.com/329649, consulted on 25 May 2010.
[40] Matos de X. (17 February 2010). *Ubisoft PC DRM doesn't sound like such a good idea anymore*. http://www.joystiq.com/2010/02/17/ubisoft-drm-doesnt-sound-like-such-a-good-idea-anymore/, consulted on 25 May 2010.
[41] Van Der Werf J. (28 May 2010). *Ubisoft DRM is "draconian," hurts legitimate customers*. http://firingsquad.com/news/newsarticle.asp?searchid=22811, consulted on 30 May 2010.
[42] Kalla R. (08 March 2010). *Ubisoft's New Draconian DRM Kills Gaming all Weekend*. http://www.thebuzzmedia.com/ubisofts-new-draconian-drm-kills-gaming-all-weekend/, consulted on 25 May 2010.
[43] IGN. (08 March 2010). *Ubisoft DRM Wreaks Havoc Over Weekend*. http://ve3d.ign.com/articles/news/53596/Ubisoft-DRM-Wreaks-Havoc-Over-Weekend, consulted on 25 May 2010.
[44] Jensen C. (3 March 2010). *Ubisoft's New DRM Cracked in Under 24-Hours – Updated!*. http://www.infoaddict.com/ubisofts-new-drm-cracked-in-under-25-hours, consulted on 25 May 2010.
[45] SceneDB. (21 April 2010). *Assassins.Creed.II-SKIDROW*. http://pre.scenedb.org/release/Assassins.Creed.II-SKIDROW.html, consulted on 25 May 2010.
[46] SceneDB. (30 April 2010). *Tom.Clancys.Splinter.Cell.Conviction-SKIDROW*. http://pre.scenedb.org/release/Tom.Clancys.Splinter.Cell.Conviction-SKIDROW.html, consulted on 25 May 2010.
[47] SceneDB. (27 April 2010). *The_Settlers_7-Razor1911*. http://pre.scenedb.org/release/The_Settlers_7-Razor1911.html, consulted on 25 May 2010.

[48] Ubisoft Forums. (March 2010). *Network problems - after login*. http://forums.ubi.com/eve/forums/a/tpc/f/6061083365/m/3871068648?r=7591020748#7591020748, consulted on 25 May 2010.
[49] Ubisoft Forums. (April 2010). *OSP & Server Downtime*. http://forums.ubi.com/eve/forums/a/tpc/f/5181026566/m/3371058458, consulted on 25 May 2010.
[50] Ubisoft Forums. (January 2010). *Ubisoft Online Services - DRM discussion*. http://forums.ubi.com/eve/forums/a/tpc/f/4811054957/m/6811098728/p/1, consulted on 25 May 2010.
[51] Totilo S. (18 February 2009). *DICE 2009: The Very Different Gaming World Gabe Newell Wants*. http://multiplayerblog.mtv.com/2009/02/18/dice-2009-the-very-different-gaming-world-gabe-newell-wants/, consulted on 25 May 2010.
[52] 2DBoy. (13 November 2008). *90%*. http://2dboy.com/2008/11/13/90/, consulted on 25 May 2010.
[53] Carroll R. (12 February 2008). *Casual Games and Piracy: The Truth*. http://www.gamasutra.com/php-bin/news_index.php?story=17350, consulted on 25 May 2010.
[54] Steam Forums. (March 2010). *Client update (522174 / 522175) out for non-Steam, soon on Steam as well*. http://forums.steampowered.com/forums/showthread.php?t=1191585, consulted on 25 May 2010.
[55] Hill C. (30 January 2007). *Digital piracy: Causes, consequences, and strategic responses*. http://www.ids-publishing.com/Common/Paper/Paper_84/Digital%20piracy.pdf, consulted on 25 May 2010.
[56] TorrentFreak. (4 December 2008). *Top 10 Most Pirated Games of 2008*. http://torrentfreak.com/top-10-most-pirated-games-of-2008-081204/, consulted on 25 May 2010.
[57] Orry J. (6 May 2009). *Spore sales over two million*. http://www.videogamer.com/wii/need_for_speed_undercover/news/spore_sales_over_two_million.html, consulted on 25 May 2010.
[58] Fahey M. (27 March 2009). *No DRM For The Sims 3*. http://kotaku.com/5186987/no-drm-for-the-sims-3, consulted on 25 May 2010.
[59] Ubisoft. (Date unknown). *Online Services Platform Q&A*. http://support.uk.ubi.com/online-services-platform/, consulted on 25 May 2010.
[60] Steam Forums. (May 2010). *List of Steam Games with DRM - Discussion, Details and Information*. http://forums.steampowered.com/forums/showthread.php?t=966005, consulted on 25 May 2010.
[61] Hyman P. (11 March 2009). *PC Game Piracy: Why Bother With DRM?*. http://www.gamasutra.com/view/feature/4020/pc_game_piracy_why_bother_with_.php, consulted on 25 May 2010.
[62] Stardock. (20 October 2008). *Customer Report 2008*. http://www.stardock.com/media/stardockcustomerreport-2008.pdf, consulted on 25 May 2010.
[63] Asay M. (19 September 2008). *EA seeks to remedy its 'Spore' DRM mistake*. http://news.cnet.com/8301-13505_3-10046288-16.html, consulted on 25 May 2010.
[64] GamePolitics. (6 January 2009). *Do Consumers Need Govt. Protection From DRM? It's on the Agenda at FTC Conference*. http://www.gamepolitics.com/2009/01/06/do-consumers-need-govt-protection-drm-it039s-agenda-ftc-conference, consulted on 25 May 2010.
[65] Sony DADC. (Date unknown). *SecuROM Disc Check*. http://www2.securom.com/fileadmin/user_upload/downloads/SecuROM_Disc.pdf, consulted on 25 May 2010.
[66] StarForce. (14 April 2009). *StarForce announces release of the new protection version - StarForce 5.7*. http://www.star-force.com/press_room/news/index.php?news=2402&SHOWALL_2=1, consulted on 25 May 2010.
[67] StarForce. (Date unknown). *Protection of software*. http://www.star-force.com/solutions/products/fl_disc/rescopy/, consulted on 25 May 2010.
[68] StarForce. (12 August 2005). *"Prove it!" and receive $10 000 from StarForce!*. http://www.star-force.com/press_room/promotion/index.php?promotion=1911, consulted 25 May 2010.
[69] Hudson J. (16 June 2008). *EA to PC Gamers: "Install 3 times? Buy another copy"*. http://www.simprograms.com/ea-to-pc-gamers-install-3-times-buy-another-copy/, consulted on 25 May 2010.
[70] Amazon. (Date unknown). *Amazon.com: Customer Reviews: Spore*. http://www.amazon.com/review/product/B000FKBCX4/ref=dp_top_cm_cr_acr_img?_encoding=UTF8&showViewpoints=1, consulted on 25 May 2010.
[71] Pigna K. (21 November 2009). *Stardock Estimates Steam has 70 Percent of Digital Market Share*. http://www.1up.com/do/newsStory?cId=3177041, consulted on 25 May 2010.
[72] Games For Windows. (2010). *Games For Windows*. http://www.microsoft.com/games/en-US/index.aspx, consulted on 25 May 2010.
[73] Games For Windows. (2010). *Game Catalog*. http://www.microsoft.com/games/en-US/games/pages/catalog1.aspx, consulted on 25 May 2010.
[74] Steam. (2010). *STEAMWORKS – PUBLISHING SERVICES*. http://www.steampowered.com/steamworks/publishingservices.php, consulted on 25 May 2010.
[75] Stardock. (25 March 2009). *Stardock throws GOO on DRM*. http://www.stardock.com/products/MyColors/press.asp?d=3,2009&id=1214, consulted on 25 May 2010.
[76] Steam. (2010). *STEAMWORKS*. http://www.steampowered.com/steamworks/, consulted on 25 May 2010.
[77] Stardock. (17 March 2010). *Impulse::Reactor FAQ*. http://frogboy.impulsedriven.net/article/378254/ImpulseReactor_FAQ, consulted on 25 May 2010.
[78] The Pirate Bay. (21 September 2007). *Steam Crack Pack [Installer+Patch+GCF+NCF]*. http://thepiratebay.org/torrent/3813985/Steam_Crack_Pack_[Installer_Patch_GCF_NCF], consulted on 25 May 2010.
[79] Zelfden Van E. (14 January 2009). *Valve: Pirates Are Just Underserved Customers*.

http://www.gamedaily.com/articles/news/valve-pirates-are-just-underserved-customers/, consulted on 25 May 2010.
[80] Meadows C. (29 March 2010). *Valve's Steam is game DRM done right—is there an equivalent for e-book DRM?*. http://www.teleread.com/2010/03/29/valves-steam-is-game-drm-done-rightis-there-an-equivalent-for-e-book-drm/, consulted on 25 May 2010.
[81] Masnick M. (13 January 2009). *Friendly DRM Is An Oxymoron*. http://www.techdirt.com/articles/20090109/1812353351.shtml, consulted on 25 May 2010.
[82] Zenke M. (1 June 2009). *In Defense of DRM (And the Importance of Steam)*. http://www.gamerswithjobs.com/node/43005, consulted on 25 May 2010.
[83] Kingsley A. (24 March 2009). *Steam "makes DRM obsolete" ... with more DRM!*. http://www.zdnet.com/blog/hardware/steam-makes-drm-obsolete-with-more-drm/4023, consulted on 25 May 2010.
[84] Steam Forums. (March 2010). *What is wrong with steam DRM?*. http://forums.steampowered.com/forums/showthread.php?t=1200988, consulted on 25 May 2010.
[85] Center for democracy & technology. (September 2006). *Evaluating DRM – Building a Marketplace for the Convergent World*. http://www.cdt.org/copyright/20060907drm.pdf, consulted on 25 May 2010.