

Digital Rights Management  
-  
Promises, Problems and Alternative Solutions



by

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**“Digital Rights Management -  
Promises, Problems and Alternative Solutions”**

**Thesis for**

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## ABSTRACT OF THE REPORT:

This thesis presents the introduction of Digital Rights Management (DRM) systems used to protect copyrighted content, why these systems are emphasized and by whom. Legal and technical aspects of such methods are also introduced. Moreover, progress in anti-piracy techniques and reasons for the current situation with online piracy are explained. In addition to presenting an alternative model for digital entertainment business, a new distribution system based on direct subscription on downloadable media files is suggested. Positive and negative aspects of these options are discussed, indicating how copyright owners and distributors will approach these challenges.

## INDEX TERMS:

- Digital Rights Management - DRM
- Legal
- Intellectual Property Right - IPR
- Copyright
- Freedom of speech
- Digital Watermarking
- Watermark Attacks
- Piracy
- Business models
- Compensation
- New distribution model: Subscription



## PREFACE

This thesis is the final research paper to qualify for the degree of Master of Computer Science at the Faculty of Mathematics and Natural Sciences, Institute of Informatics, University of Oslo.

Most of my research was conducted during my stay at the Department of Computing, Division of Information and Communication Sciences, Macquarie University in Australia. This was because I was granted a one-semester scholarship to complete a part of my degree as an exchange student at Macquarie University. For this reason, this paper will be presented at both universities.

Working on a paper where I had defined the topic myself has been fun, though being responsible for the outline and framework of this was not the smartest approach in regard to workload. Being new to the subject, with limited possibilities of comprehensive feedback, neither ideas to investigate further nor the outcome of my research has been handed to me on a silver plate platter. Still, Digital Rights Management, its potential and problems has been a very interesting field of studies, and it has been a delight to put a lot of effort into a topic where I felt I have had so much to learn. Hopefully both my personal and professional outcome will prove useful for further research.

For anyone who would like a humoristic outline of the piracy conflict between internet users and content owners, I highly recommend the episode “Christian Hard Rock” from the animated TV series South Park (season 7, episode 9).

I would like to thank my supervisors Terje Knudsen and Huaxiong Wang for valuable insight, Hans Christian Nilsen and Bent Jostein Syversen for proofreading, and the guys in the Honours Room for making the studies from early morning to late night bearable.

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Front page picture by J. Alex Halderman.

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**Kristian Syversen**





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## **SUMMARY**

This report is the result of an investigation into the current situation for systems used to protect copyrighted material on the internet. As the motive with this paper is to bring light on positive as well as negative aspects of digital right management methods, the target audience is as much computer specialists as it is non-technical readers. Mainly it attempts to encourage more interest in the field of computer privacy, security and administration of digital restriction mechanisms. Hence, an in-depth introduction and presentation of technical as well as judicial means of such systems are given, and additionally an alternative compensation model by Professor William Fisher is presented. This suggestion and the current business models for producers and distributors of digital entertainment is used as the foundation to suggest a new distribution system for digital entertainment files, namely a subscription service.

While intellectual property rights and piracy are addressed in general, focus is on distribution of digital music and movies. One reason for this is that piracy of such digital content has been given the most attention in the media lately, in particular because online distributors of illegally copied audio recordings and films are attacked aggressively. Another reason is that efforts to prevent unlawful distribution of entertainment files involve both the technical industries in addition to the record labels and movie studios, as well as the content owners and the performers. Hence, a broader perspective can be applied when investigating potential solutions to the piracy problem than if only looking onto problems and solutions for the computer industries.

Of the most important indications from this research is that legal means cannot fully protect the current business models, neither will the technology industries likely be able to implement complete protection of digital content. Moreover, the reality and consequences of internet piracy apparently being a lesser problem for the content industries than their lobby groups report, politicians should arrange for less restraining systems to prevent the impact of digital piracy.

Better approaches to solve these problems are alternative business models and in particular the subscription model suggested in this paper.



## **INTRODUCTION**

### ***Background***

The initial reason for starting on this paper has been an interest in methods to handle problems with piracy on the internet, and the starting point came about after reading another one of the newspaper articles about the vast increase in internet downloads of copyrighted material. With piracy of software and digital entertainment there have been introduced numerous countermeasure schemes and anti-filesharing legislations to prevent data from being copied. Still, as soon as these schemes have been introduced, it is common that some computer talent breaks the copyright protection effort. Usually the contravention is done for some socialistic purpose or for economical gain by thus gaining access to closed formats, exposing security flaws or simply to get around restriction mechanisms in order to use the data in more convenient manners.

When reading news articles and technical magazines, it is sometimes easy to get the impression that internet is about to ruin the industries providing digital material, in particular the record, movie and software industries. Although one does not have to be all that critical to see this cannot be the case: Record labels have as much media coverage as they have always had, movie budgets frequently reach new peaks and software producers have some of the most well known brand names in the world.

With such disparity between the impression from the successful businesses of these industries and the elegy they tend to portrait in the media, it was interesting to investigate further in an attempt to reflect reality. Additionally, learning more about computer security and protection mechanisms has been an encouragement from the start.

### ***Research***

### **Method**

As this has been a one semester thesis, emphasis has been made on covering a wide range of different, relevant material, trying to keep a balance between broadening the search enough to find interesting former work on

the topic, and at the same time looking deep enough into the material to see the details useful to develop new ideas.

The topic of the thesis and research previously done in the field of digital rights management were unknown subjects at the start of the work, therefore the first weeks of the semester were used to examine sources, review relevant journals and investigating works of recognized scientists in the fields of computer security, intellectual property rights and digital rights management.

Initially going through most of the material available at Macquarie library, some journals proved to be more relevant than others. As the outline for the topic was under development, all seemingly interesting material covering any of the following topics was read:

- Digital Rights Management
- Intellectual Property Right
- Copyright
- Freedom of speech
- Piracy

Initially, there was a lot of reading of both appealing material, as well as numerous unappealing articles. Some journals like 'Communications of the ACM', 'Dr. Dobb's Journal' and 'IEEE Computer society - Security & Privacy Magazine' showed to have the most relevant articles. There were also some online magazines like 'D-lib' and 'DRM Watch' offering some valuable insight. Consequently, the initial part of the research was reading through years of issues.

After becoming more familiar with the status of current research, the next matter was to give a rough idea about the questions to answer with this paper. One of the topics drawing interest was how using computers to access and playback multimedia files, and how this influenced business models for the content providers. Thus, article search got more focused on the business aspect. Still the method was virtually the same: Looking up relevant material at the library and on the internet.

When having gathered sufficient articles and commentaries, there were a few discussions with the tutors before coming to a useful approach to the problem.



In addition to working on gathering material for the topics being presented and discussed in the paper, an alternative approach to distributing copyrighted material has also been investigated. As research on this field is new, data useful to improve existing models had to be found.

## **Problem**

Like described in the previous section, initially there was only a fairly unbound approach to the problem. Though, after investigating in relevant sources and reading special feature journals on digital rights management, it was becoming clear that in order to present consequences of limiting access to data and problems and potential with such restriction systems, the businesses of content providers was the issue to focus on. However, in order to present the existing and proposed business models for content distribution, some of the main limiting disciplines had to be introduced; respectively *technical* and *judicial* aspects of copyright protection.

Therefore the outline of the article had to be consequences of digital rights management, with and emphasize on what protection that can actually be provided. Additionally, there is a great desire to present reliable figures on internet piracy, and see whether these support the claims from the content providers or not. Conclusively, the results of these findings should compose the foundation for a presentation of alternative solutions to piracy problems for this industry.

One of the main points to be illustrated is that very little is ever as good as the producers claim, although also not as bad as what their competitors say. Like most real world situations, computer systems are commonly adequate to solve some problems, but they are never flawless like some software providers try to impose.

## **Restriction**

Texts and articles referred to in the paper are noted and included in the bibliography. Nonetheless, there are evidently other sources of information which have influenced the direction of this work, and the thinking pattern in general. Referencing only about one third of the sources reviewed throughout the research period, clearly other opinions not stated directly in this text are shining through.

This is one of the reasons why everything from newspaper articles to entire books which are read, if they were not rejected as irrelevant for the topic of

this thesis, are posted on a web-page supplementing this paper<sup>1</sup>. First of all this has been smart way to keep track of the material, additionally it makes it easy to look back at influential articles. This is particularly beneficial if further research is to be made. Having already linked more than 200 sources on the corresponding web-page, it should be plenty to choose from.

While having that many articles to refer from, in order to keep focus and coherent line of reasoning, many articles were deliberately not included in the thesis. Though, it must be emphasized that even though this was intentional, it was not done to escape different views or alternative interpretation of existing data. Some of the texts omitted are to the contrary backing up arguments presented, yet they were left out in order to keep the length of the text reasonable.

### **Literature review**

The first in-depth introduction to the topic came through the webpage “Trusted Computing Frequently Asked Questions” of Cambridge University Dr Ross Anderson. Here the new Trusted Computing (TC) scheme was analyzed with a critical perspective. Although written with a lot of insight and technical know-how, this FAQ should not be mistaken for an acknowledgment to the benefits of Trusted Computing and Digital Rights Management. It is a rather well analyzed objective yet critical approach, asserting some of the claims and prospects given by the industry supporting the new security scheme, and his presentation is an interesting text that discusses many of the main issues with Digital Rights Management at an introductory level. In addition to giving this introduction to the topic, Professor Anderson examines many of the potential scenarios that may come out of introducing this strict and radical security system proposed by the computer industry, and not least the business scenario from which may rise from this effort. Even though his skepticism to the impending scheme is deep, it is probably better to have input from someone without a capital interest in the issue. Moreover, one of the most inspiring aspects of his approach is that no matter how hard he has put his mind into his analysis, he is passionate in his writing.

Obviously, there are many other noteworthy papers and books, and some of the main sources of information have been:

- The book “Cyber Rights - Defending free speech in the digital age” by Mike Godwin for legal consulting

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<sup>1</sup> Extensive listing on complementary webpage, see Disclaimer for address

- “Techniques and Applications of Digital Watermarking and Content Protection” by Michael Arnold, Martin Schmucker and Stephen D. Wolthusen
- The encouraging study on online music downloads, “The Effect of File Sharing on Record Sales - An Empirical Analysis” by Felix Oberholzer and Keleman Strumpf

And of course the very important book “An Alternative Compensation System” by William Fisher, on which the subscription model is partially based, as well as articles by Andrew Orłowski on topics related to the work by Fisher.

### **Research outline**

The mission with this paper, in addition to be handed in as a final research report for the degree at University of Oslo, is to present this material in an easily understandable form, outlining some of the present technical and legal means of protecting digital contents. Although the degree of detail and thorough specialization is limited for such a short work on a comprehensive field of studies, some of the disseminated knowledge will be helpful for gaining insight in this area which is far too commonly veiled by propaganda.

While presented more in the style of an essay than a rigid and hard to grasp specialist phrasing type of text, hopefully this paper will be interesting and informative for both technically educated readers as well as people less used to computer language.

Initially the paper intends to present the history of copy protection and the progress into present digital management systems and trusted computing. Subsequently, the possibilities and limitations of technical as well as legal means to enforce rights management are explained. As digital watermarking is relevant for this paper, such systems will be described in detail. Then there is an important review of current business status, as consequences from piracy of digital entertainment may not really be what the industry claims. Thus, an alternate and possibly better compensation model for copyright owners of digital material is explained in detail, focusing on its potentially encouraging outcome. The line of argument is then brought further to demonstrate why the **subscription model** may be a more accomplishable and thus better alternative.

## **Ambition**

This paper should present some of the current problems with digital contents and the efforts done to amend these. While initially introducing current legal and technical limitations, the thesis will continue to demonstrate that the current situation is to some extent different from what the record, film, software and computer security industries try to present. Moreover, there are better alternatives to keep online piracy under control than to put in force problematic mechanisms which prevent access and limits handling of files. Instead of the content owners aggressively attacking behavior differing slightly from what they anticipate, this paper will demonstrate appealing alternatives that are beneficial for all parties involved.

## **Motivation**

While looking up further technical journals, forums, technical papers and other material proposing stronger control on distribution and use of digital content, as well as lots of those arguing against the same, some issues were frequently recurring: Piracy, Digital Rights Management (DRM), Fair Use, privacy and stronger legislation concerning distribution of copyrighted digital content. Directives like the American Digital Millennium Copyright Act (DMCA) and similar statutes passed in recent years were commonly raised, as well as questions regarding possible technical implementations. However, these issues seem to receive little attention among computer academics in Norway. Despite the significant impact they may soon have on computer science, it seemed to be a shortcoming of national, independent studies on the matter. If such retention is preserved, the already strong influence from the industry to push legal and technical progress in a direction which is at their benefit may come at an immense price for researchers, computer enthusiasts and unprofessional users.

## **Further research**

In this thesis most of the works is introduction to topics relevant for DRM systems like copyright protection, infringement of exclusive privilege and technical systems limiting the ability to manipulate digital content. There is also a comprehensive presentation of relevant, independent research of online piracy of various data, a broad presentation of alternative business models for the distribution of music and movies on the net by William Fisher, and finally a presentation of a new distribution model based on the current business scenario as well as these previous research efforts. While some of these parts are primarily presenting the outline of current research to show potential and limitations of some mechanisms applied to digital

rights management systems, the essential has been to show that although computer systems and legal means to protect digital productions are stronger and more restraining than ever, there is a limit to what they can gain. Despite what some system developers claim, there is no such thing as a totally secure or unbreakable method to protect data on the internet.

Future investigations into the topics presented should focus on income levels the record and movie industries must generate from subscription fees in order for this model to be profitable, as well as further analysis of independent piracy figures. Moreover, which parts of digital rights management systems that work, and why they work, should be examined, as well as aspects that are not very successful. The same approach should also be applied on government administered compensation and the subscription model.

There is also a need to study possible technical implementations of the model by Fisher and the subscription approach, in addition to potential for revenue growth if the business models are applied. Finally, there should be more research into consequences for development of Open Source computer system, both in case of a strict digital rights management paradigm and for the alternative content distribution models.

One perspective on the matter is the one of computer security. There are many definitions of a secure system, and for each problem DRM claims to solve, there are usually a refined technical investigation or study stating it does not.



## PROLOGUE

People who have been using internet from the time when it was barely known have witnessed significant changes. In the early years, the experience of using internet felt more or less like taking part in semi-anarchy society, governed by inadequate and outdated laws where the users, at best, behaved in a manner that they also wanted others to behave. Local networks administrators were the only ones limiting what you could do, resulting in very few restrictions for the users. Unfortunately, with freedom there also exist the opportunity to misuse it. Nowadays the situation has become completely different. It will in average only take roughly twenty minutes from the computer connected to the net until it is attacked by a malware of some kind<sup>2</sup>. Hence, there is now much restriction on how the internet can be used. Security measures are defined everywhere: On individual client computers, within the network systems used to connect and on the servers you link up to. User directives set limitations to what clients are allowed to carry out, and if somebody violates these regulations, there are legal means to deal with the infringement. In only a decade, internet has evolved from being a novelty for computer enthusiasts to a necessary part of business and everyday life throughout the world.

With the need for more secure transactions and a higher level of confidence in the system, additional levels of sophistication have gradually been added to nodes and links on the net. However, with the added complexity there comes the potential for even more errors and also the ability to misuse the tools that modern computer systems supply: Electronic transaction systems get defrauded, hobby programmers frequently unleash viruses, and software which regularly installs itself on your computer to hijack your modem or log your keyboard. On the less severe part of the scale there are enthusiasts 'ripping' audio CDs or smuggling cameras to screenings of the latest Hollywood movies in order to post the copy on the internet. According to the media it may seem that there are no limits on what these 'cyber-terrorists' can do and what downfall they will bring if not dealt with thoroughly. Hence the later years not yet successful attempts to adopt existing laws and passing new ones to cope with the problem internet seems to create for a large group of vendors and content providers.

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<sup>2</sup> According to an ongoing study conducted by the Internet Storm Center (a subdivision of the SANS Institute), it will in average take approximately 20 minutes from a computer is connected to the internet before its IP address is targeted by malware  
<<http://isc.sans.org/survivalhistory.php>>

The cliché is to bring forward an impression that the typical internet-user is a malevolent young man writing viruses, leeching off of Hollywood and occasionally making an appearance as a chat-room predator. If the nature of things continues to be that way, internet will prove to be the end of making movies, computer games, popular music, retail software, and may eradicate pretty much all other modern industry existing as well. Worst-case scenario the whole intricate network will become so infested that its use implodes on itself, in a logical sense.

After having become familiar with the computer industry, one learns to always read such information and especially news bulletins on the matter judiciously, as they may very well be highly influenced by someone using the circumstances to make a profit. Even if we live in the so-called 'information age', e.g. the recent admittances in regard to intelligence leading up to attacks on Iraq show that media is not always presenting all sides to a story.



# REPORT





## HISTORY

*“I say to you that the VCR is to the American film producer and the American public as the Boston strangler is to the woman home alone.”*

*- Jack Valenti [‘Home recording of copyrighted works’ (1982)]*

Digital Rights Management (DRM) and restrictions on how people are allowed to use digitalized data owned by others may be an issue of the digital age, but the problems such systems try to mend have existed since people made the founding attempts to live in societies. Various degrees of restriction have been carried out in all parts of the world, whether the mission has been to prevent banned religious transcripts from being published, or to control and possibly censor news to be broadcasted by media in totalitarian regimes. It can clearly be illustrated how important the flow of information is when looking back at the Norwegian illegal press during the World War II and seeing the praises it has received. The introduction of modern computer systems and the ability to represent information as bit messages may not change this fundamental issue much, although there is now slightly more emphasis on how to regulate the potentially limitless reproduction and how to compensate the rightful copyright owners when their work is redistributed.

In the modern digital world, most works can be reformatted into digital data that may easily be distributed between computers or across the internet. With increasing bandwidth and decreasing cost of copying equipment such as CD- and DVD-burners<sup>3</sup>, the possibility to spread digital content has more or less no limitations except time, cost and demand. Clearly, this opportunity can also be misused, hence the increasing problem with piracy and illegal use of copyrighted material. Copying music and film has evolved from being cassettes and video tapes of indeed various quality shared among friends, and the occasionally copy bought from the semi-professional at

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<sup>3</sup> Recordable Compact Discs (CDs) and Digital Versatile Discs (DVD) have an empty data spiral with a photosensitive layer, and data can be added to the disc by using laser to change the pattern of this layer. Thereby the disc appears like a normally molded CD or DVD. (Wikipedia)

street market, to becoming near-perfect copies easily downloadable by anyone with a sufficiently fast internet connection. But in essence, there is really nothing new with these problems. In the early eighties, the introduction of the Video Cassette Recorder (VCR) was predicted to be the black plague for the film makers. Instead, the movie industry continued to flourish. Not only because of the VCR, as the demand for entertainment has grown parallel to the increase in the consumer market. In modern household appliances have given people more leisure time, and a lot of that time is now being taken up by TV and film. The VCR has also rendered possible the option to re-sell films: First the movie is shown exclusively in cinemas. After this screening period is over, it is subsequently released on video so people can rent or buy it for personal viewings. By having the same movie available in multiple formats makes it reach a broader market, and those really enjoying the film on cinema are also inclined to purchase the video. In addition, films not assumed profitable for theater screenings can be released directly on VHS, in the recent years also on Digital Versatile Disc (DVD), allowing a broader range of films to be produced. Indeed, the VCR has made the variety of films produced greater than before as well as increasing the profit margin of the makers. Even without going to the cinema, a film can still be profitable. In other words resulting in a situation totally opposite of how it was foreseen.

At the time when private pirate copies were in the form of video or tape recording, the nature of the approach restricted the number of copies made and how widely they could be distributed. Mostly it meant circulating them within a small number of people, as very few bothered to bare the hassle of distributing more widely. First of all it was expensive, and it took a lot of time and work. Of course, there were exceptions like computer groups putting varnish on stamps before sending floppy discs by mail, making it possible to rub off the postmark and reusing the postage for later shipments. But this was merely the rare occasion, applicable only for small sized shipments. The perspective that has changed dramatically since the initial crusade against the VCR is clearly the change of distribution channels. With internet connections becoming more common, and the processing power in personal computers growing to be sufficient for real time processing of compressed audio & video, feasible for immediately tracking of encryption keys and versatile enough to function as a full-featured entertainment center. Connect this device to a social network like the internet and suddenly everything is accessible from you own house, most enforced data restrictions are evadable. When encoding music in the MP3 data format started becoming popular in the mid-1990's, many of the same arguments against it could easily have been cut and pasted right out of the VCR debate one and a half decade earlier (Home recording of copyrighted works, 1982).

Despite some debaters beliefs that an MP3 encoded version of a recording is simply a compression of the original track, it is actually a lower quality copy of the original music file<sup>4</sup> (Miller, 1999). Hence making MP3's of a CD is very comparable to making a copy on video of a film: It is a derivative, and how its characteristics differ from the original will mostly depend on the tools used when making it. Patents for the ISO standard defining the MP3 format is actually owned by Fraunhofer Institute and Thomson Multimedia (Bouvine, 2002). Even so, the compression method has become popular and nowadays MP3 is the most common format for compressed digital audio recordings. Therefore, most pirated music files are found as MP3s, which enables a song with reasonably good audio quality to take up only approximately 1/10 the size of the same file in an uncompressed audio CD wav-format. This means that music can be downloaded at the size of approximately 1 MB data pr minute recorded, averaging common songs to less than 5 MB. Something that's feasible even with only a modem and lots of patience. Or simply upgrade to ISDN and you are cruising!

When it comes to copy prevention mechanisms it is most relevant to look back on efforts with audio recordings, as this business was the industry that pioneered such technology. In the late 1960's there were attempts to mix an inaudible signal with the recording that would distort the signal at the magnetic reproducing head of a tape recorder, thereby ruining any attempts to copy. However, as the sound from the vinyl had quite a lot of noise embedded, the distortion signal was lost in the process (Neset, 2001). In the late 1980's, before CD burners were common property, the Digital Audio Tape (DAT) recorders introduced the first opportunity to make a perfect copy of digital music. As most DAT systems actually sample audio at even higher rates than on a normal music CD, and many of them feature optical input and output, it meant that the digital data could be transferred from a CD without any reduction of the signal. For this reason the Audio Home Recording Act was passed in the USA, enforcing a 'Serial Copy Management System' to be built into all DAT recorders. By adding 'copy' information when recording data on a device it should be impossible to make new duplicates of the first copy (Zittrain, 2003). But as this was an implanted electronic signal, there was also made devices that removed this data and enabled an unlimited number of copy generations (Neset, 2001).

Similar efforts have been made to movie players in form of Macrovision, which scrambles the output from the VCR and DVD and thereby produces

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<sup>4</sup> Tracks on a CD are stored solely as digital data that describe the contents, and for this reason it can be viewed upon and treated as any other 'file'.

viewable images. At the same time the signal is made useless for recording on another machine. For DVD there is also the Content Scramble System (CSS) encryption, protecting the digital contents by making the data on the disc unreadable without the decryption aids found in commercial DVD players. There are, of course, mechanical arrangements that remove the Macrovision electrical pulses, and the commotion from publishing the 'DeCSS' algorithm to decrypt CSS made advocates of programming as free speech embracing the case. Maybe no surprise after Hollywood studios sued the firm CopyLeft for producing a T-shirt depicting the code<sup>5</sup>. Even cryptography researchers were attacked, leaving the feeling that the "aggressive misuse of copyright law is an intolerable affront to the right of computer scientists" (Touretzky, 2001). Eventually the circumstances lead to an amendment of the American DMCA (the "Digital Media Consumers' Rights Act", 2003), restoring fair use and allowing users to go around protection mechanisms as long as the effort does not violate copyright of any works. According to the revised text, reverse engineering for ensuring interoperability between computer programs and compatibility between data formats is legal to carry out. Obviously, there is a fine line between format tweaking and violation of protection mechanisms, but that will in case be for a court to draw.

There has also been a wide range of other more or less sophisticated copy protection efforts on bundles for music, text, software, film and all other media that can be distributed as digital copies and for the devices they are used on. So far they all seem to have been somewhat futile. One example is the discovery of how to circumvent the 'MediaMax CD3' compact disc copy protection mechanism provided by SunnComm Technologies Inc. simply by disabling the 'autorun' feature for the computer CD-ROM. The report by Princeton PhD student J. Alex Halderman revealing this (Halderman, 2003) was unsurprisingly target for a prompt retort from SunComm, with insinuations of legal actions to claim compensation for damage (SunnComm, 2003).

Many of these copy prevention systems have rather resulted in customer outrage than being those successes the record industry hoped for, as products embedding them often fail to function as expected. It is easy to understand the frustration when e.g. some CDs do not play from CD-ROMs or players with anti-skip memory like Discmans and in-car stereos<sup>6</sup>. When people buy a CD they expect it to function in all players. Some even

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<sup>5</sup> PC World article on the lawsuit:

<<http://www.pcworld.com/news/article/0,aid,18360,00.asp>>

<sup>6</sup> See e.g. extensive comments on this problem made by the Electronic Frontier Foundation:

<[http://www.eff.org/IP/DMCA/copyrightoffice/20030514\\_copyprotected\\_cds.php](http://www.eff.org/IP/DMCA/copyrightoffice/20030514_copyprotected_cds.php)>

challenge the copy protected audio CDs formats for abuse of the 'CompactDisc' trademark label, as they do not comply with the specifications of the 'Red Book'<sup>7</sup>. Other restricted products may only allow the contents to run on a very limited set of platforms, or set special limits to what data that can be used on a particular platform. This often results in the products or contents not having the portability customers may expect, or competing vendors are being prevented from supplying their products to certain platforms.

Most endeavors seem simply to end with the customers losing faith in affected products being so full of discouraging flaws that they end up rather buying from vendors providing the functionality users actually want. Some recent products have been fairly successful, despite their DRM controls. This was the situation in a recent court case between French music retailer VirginMega and Apple, where the FairPlay copy protection mechanisms prevented VirginMega from providing music for Apple iPod players (Smith, 2004d). The case was eventually won by Apple, as the copy protection was found not to violate competition laws (Smith, 2004a). Ironically, Apple has at the same time had its own battle against another content vendor, RealNetworks. The entry of Apple into the online music retail is a great success and their pay-per-download music store iTunes started off by selling songs equivalent to a turnover at more than \$100 million a year. Additional sales of iPods and Macs have in total been worth about \$1.5 billion for the third quarter of 2004 alone (Erickson, 2004). On top of that, the increasing popularity of proprietary Apple formats for e.g. music files, users of other systems are likely to migrate and as a result creating an even bigger market. In order to gain access to this huge market, RealNetworks was able to reverse engineer the FairPlay system (Smith, 2004c) in their Harmony software, enabling files from RealNetworks subscription service, RealOne, to be converted into the format used on Apple iPods. Thereby RealNetworks became the first competitor offering legitimate music downloads for Apples iPod player, although Apple is looking into the legitimacy of the action (Smith, 2004b). Being so important for their business, Apple cannot allow competitors to steal their customers, though it is yet to be seen if they can do anything about it (Erickson, 2004).

With very much money involved, fights over digital copyright and its lock-in and lockout mechanisms has a potential to turn out very unpleasant. And if the big corporations are allowed to lead the way, it may result in even "further eroding of the right to reverse engineer" (Erickson, 2004) with

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<sup>7</sup> The technical specification for audio CDs is found in the red edition from the 'Rainbow books' series, which is a set of manuals defining the standards of different compact disc formats. Hence, the Audio CD standard is often referred to as the 'Red Book'.

directives even more limiting than those currently existing. Next generations pioneering software engineers “may find their development efforts put them at risk of criminal and civil penalties if the tools they develop are inadequately protective of copyright interest” (Godwin, 2003, p 234).



## TRUSTED COMPUTING

*"It was one of those pictures which are so contrived that the eyes follow you about when you move. BIG BROTHER IS WATCHING YOU, the caption beneath it ran."*

*- George Orwell – "1984"*

In general Trusted Computing (TC)<sup>8</sup> is the effort to provide a more secure and presumably more trustworthy computing base on which transactions requiring a high level of trust can be performed, though what characteristics and minimum requirements such a platform must meet in order to be 'secure' is still being debated. This is for good reason, as 'secure' and 'trusted' are very loose and easily adaptable terms. Going into such a discussion about the philosophy regarding computer safety measures would be far too detailed for this section. Still, some of the same issues are implicitly raised when enlightening the basis of trusted computing. Most importantly is seeing that security is not something you attach to a system. Security does not come in an attachable box, as a device that can be plugged into a currently existing system or as an application to execute. As Seth Schoen at the Electronic Frontier Foundation puts it in his article "Trusted Computing: Promise and Risk": "Changes to the design of PC hardware are one useful tool among many for improving security. While hardware changes aren't a prerequisite for increased security, they're undeniably helpful." (Schoen, 2003) Vendors and private user tend to rely more on computerized information, hence it is obvious that computer security and the possibility to make relatively secure transactions from one platform to another becomes increasingly more paramount. As stated, there is no single fix to make a previously insecure platform trustworthy, but Microsoft and the Trusted Computing Group (TCG) emphasizes that the next generation hardware will provide the necessary platform where tasks requiring a high security level can run in a isolated protected operating state (Cram, 2003).

For the industry providing contents it may seem much better to have single-purpose platforms on which the tools and entertainment they provide can

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<sup>8</sup> Also commonly referred to as *Trustworthy Computing*

easily be controlled, rather than a multi-purpose computer that can be programmed to perform the tasks a user wants. On the other hand, the versatility of such systems is one of the key success factors. With the introduction of strict DRM systems, flexibility of personal computers is bound to be sacrificed. In basic terms, a computer is a machine that moves “bits around from hard drives to RAM to screen and back again, with 100 percent accuracy” and embed DRM features into all parts to limit the core functionality simply degrades it into a special purpose electrical appliance (Godwin, 2003). In a worst case scenario, which is still highly probable bearing in mind earlier compatibility problems and lack of intractability even between systems from the same or collaborating application makers, users “may not longer be able, for example, to move music or video files around easily from one of their computers to another [computer or other platform]... the digital videos they shot in 1999 may be unplayable on their desktop and laptop computers – or even other devices – in 2009” (Godwin, 2003). Such limitations will most likely make customers resist DRM platforms, causing the vision fail. Then again, it is possible that restrictions are introduced in imperceptible and individually tolerable portions, or enforced by law. Either way, as a result customers may in the end be rendered no choice and thus dictated by available hardware.

An extremely rigid DRM architecture, which it indeed has to for any chance of success, will ultimately shift personal computers supervision from users to the hardware producers, application makers and not least whoever controls the authentication data needed to operate in a secure mode. This happens because it will in essence be remotely controlled whether the computer is set in a ‘secure’ or ‘insecure’ state<sup>9</sup>, and what kind of contents it will be allowed to run. Therefore the “Trusted Computing” platform approach has unsurprisingly created quite a controversy. Even if many of the proposed features of DRM enabled systems are requested by the industry as well as computer user, and most aspects of the platform suggested by the TCG are still being revisited, some essential innovative concepts have lead to skepticism rather than enthusiasm. Concerns of the German Bundesregierung were published in a ‘criteria and preference catalog’<sup>10</sup> early March 2004. One of the amendments suggested was to

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<sup>9</sup> The ‘state’ of the computer applies to multiple logical security and/or privilege levels, as different security measures will be in effect dependent on type of application running on the platform or transaction that is to be made etc. Possible logical segmentations and security states will not be discussed in detail within this paper.

<sup>10</sup> A copy of the position paper “*Kriterien- und Präferenzkatalog der Bundesregierung zu den Sicherheitsinitiativen TCG und NGSCB im Bereich Trusted Computing*” (March 2004) by the German Bundesregierung can be found at: <<http://www.ccc.de/~andy/CCC/TCG-BRD-Stellung.pdf>>

formalize a fair policy for licenses. This means that the companies in the TCG consortium should not take advantage of the position they will have in the market to demand unfair licenses, which applies for both **type** of license and its **cost**. Common necessities like e.g. software drivers should be available for free, with permission to alter and redistribute them. A special emphasis was made to the effort from open-source communities, insisting on a cost free membership with access to details on how the security modules function (adapting a ‘non-discriminating information policy’) being offered to **all** developers. Furthermore it was pointed out that the safety measures are required to work equally well on all hardware platforms, regardless of which system is run. It should even operate flawlessly on less than average capacity hardware, and importantly work together with non-DRM computer systems and equipment. Similarly, Ross Anderson is skeptical to whether or not this will be the case if the industry is given too much liberty when developing these systems (Anderson, 2003).

## ***Initiators***

The Trusted Computing Group (TCG) is an industry standards consortium, consisting of computer hardware, software and contents providers like AMD, Hewlett-Packard, IBM, Intel Corporation, Microsoft, Sony Corporation and Sun Microsystems, with a “stake in enhancing the security of the computing environment across multiple platforms and devices”.<sup>11</sup> In addition to the promoters, there are various other contributors and adopters from the IT industry. Initially, this consortium specified a Trusted Platform Module (TPM) to be integrated in the hardware platform, making it a robust interface for containing data necessary to establish the security state of the machine. (Arnold et al., 2003) In order to do this, the module hardware should provide:

1. Asymmetric key functions
2. Secure storage and reporting of values from the ‘Platform Control Registers’ needed to attest a secure platform configuration
3. An Endorsement key to authenticate that identity keys were generated in a TPM
4. Initialization and management functions  
(TCG, 2004b)

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<sup>11</sup> From Trusted Computing Group homepage:  
<<https://www.trustedcomputinggroup.org/home>>

In essence such an architecture should facilitate a tamper-proof system where a key can be validated in hardware, i.e. without disclosing data in readable memory, and this facilitates the platform to verify the validity of encryption for data as well as allowing applications to check the security state of a platform (TCG, 2004a). This can in turn be used to assess whether or not a platform should be authorized to e.g. execute a specific file, as the owner of that file may require the platform to be running in a secure state or have a certain configuration.

### ***Criticism***

Even though such platforms will enable more secure data transactions between them, the TCG specification have been criticized amongst other by Ross Anderson for granting too much control to the application developers. To the contrary of TCG, he has a very different view upon their specification for the next generation of secure PCs, and upon the whole *Trusted Computing* scheme. As he sees trusted computing it “provides a computing platform on which you can’t tamper with the application software, and where these applications can communicate securely with their authors and with each other” (Anderson, 2003). This is made possible, as the applications can requirements to the state of a platform that must be met before a user is allowed to run files with that program. In practice this removes the control of the platform from the owner and puts it in the hands of application designers and authentication brokers.

He also shows a convincing argument why a trusted platform is actually one that can break your privacy and security, because by its nature it is a component that will break the policy it was put to enforce if the system fails. One example he uses is that by trusting a doctor with your personal medical records, you will put him or her in a position where you can be harmed if the confidentiality is breached, or the physician is careless and loses the information, it will be difficult to provide you with the proper treatment should you have an accident or trauma (Anderson, 2003). Transferring this trust onto a remote administrator not only makes the situation unclear, especially for the owner of the computer, but it also leaves a lot of the critical policy choices up to those governing the system. Initially this may look like a substantial improvement, as there will be professionals supervising and controlling the state of the system. Just think of all the times it is learned that security is breached because of neglect or user error when handling a complex system. Leaving protective efforts in the hands of system designers or authentication key brokers can lead to other

fundamental policy problems. As an example, maybe some additional supervisors should preside over the security administrators. In the Wikipedia entry on 'Digital Rights Management' it is discussed whether "DRM schemes would enforce additional restrictions to be imposed solely at the discretion of the copyright holder". One must also keep in mind that "the 'rights' that the content owner chooses to grant are not necessarily the same as the actual legal rights of the content consumer"! With profit as one of the main influencing powers, it is unlikely that security measures which are more beneficial for the end user will be given greater value those that are beneficial for the service providers.

There are other features of DRM facilitated computers as well, making them more appealing to content providers and potentially legislators. Theoretically it is possible to censor material on a remote computer, as "digital objects created using TC systems remain under the control of their creators, rather than under the control of the person who owns the machine on which they happen to be stored (as at present). Given such possibilities, we can expect TC to be used to suppress everything from pornography to writings that criticize political leaders." (Anderson, 2003) One problem is the tremendous invasion of privacy just by enabling such features. Another is to prevent abuse from happening when it becomes technically achievable. If the possibility is present, there is bound to be some level of exploitation. "Most opponents [of TC] have little faith that the courts or legislatures will be able to limit such manipulation to only that which is legally permitted." (Wikipedia)

If the proposed arrangement necessary provides more security is hard to say. Perhaps it will be possible to prevent users from running unlicensed software and illegally view or manipulate multimedia files. At the same time it will also be possible for software vendors to restrict entirely legal activities and impede competitive efforts. In the end, security for one is insecurity for another, and within such a rigid framework this 'insecurity' is most likely at the detriment of the end user.



## LEGAL

*“Sometimes called the best legislation money can buy, the DMCA, along with digital rights management software, seek to maintain existing business models. But at the terrible price of restricting the lawful fair use of content.”*

- Sandy Ressler (Ressler, 2003)

The term Intellectual Property Rights (IPRs) classifies rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields. Some examples of IPRs are trademarks, patents, industrial designs and copyrights. What gives value to e.g. a trademark or a work protected by copyright is that a person or a company has the exclusive right to control, use, or exploit it, or at least use it in a certain way. That exclusive right is protected by the rules of intellectual property law. On the other hand, the public also has the right to exploit a copyright protected work, design or similar, as long as they do not infringe the exclusive rights of the right holder (Caenegem, 2001, p 1-2).

In the chapter “The battles over Copyright on the Net (and Other Intellectual Property Encounters)” of his book “*Cyber Rights*” (2003), American lawyer Mike Godwin debates on how the internet has and will continue to influence the management of copyrights and other intellectual property rights. Although the book was originally written in mid-1990s, many of the points discussed are still relevant today. One particular comment in this chapter eloquently described some of the current issues:

*“I had no idea then that the law of intellectual property, its economics, and the social and political forces it brings into play would turn out to be so central in deciding the free speech issues raised by the Net. Maybe I should have seen it coming.”*  
(Godwin, 2003, p 185)

As he is an American lawyer, it is obvious the examples and some of the arguments from his book are most applicable in the U.S. Nevertheless, many of the issues raised are relevant in the rest of the world as well as they will influence throughout cyberspace. There are many examples showing how laws and regulations passed in America pioneered changes in Europe and the rest of the world, especially when it comes to rules giving business privilege or limitations. The U.S. music and film industry is successful throughout the world, and their production of information technology is also among the leading. So it was anticipated that the first real efforts to raise important questions about relevant cyber-behavior were made there. With these questions raised, it was in no way astonishing that those powerful businesses were strongly trying to influence how to deal with the issues.

The successful lobbying effort by U.S. industries is already affecting other continents. The European Union (EU) sees the same trend, where especially the music and film industry influences politicians. There are also examples where new laws are proposed and old amended, simply to tag along with the United States. Even Norway, having had one of the most liberal legislations in the world supporting the right of individuals to make personal copies of copyrighted works, may toughen up legislation to bring it nearer that of the EU. While it used to be legal making copies for personal purposes and even lending these out (which even meant downloading from the net was legal, as this could be considered a personal copy), file downloading and format converting will become illegal if the amendments passes (Steen, 2004).

If the most rigorous and safeguarding copyright propositions are passed, then every kind of work will be protected by some kind of exclusive rights. A likely scenario is that anyone obtaining facts from a reference book or encyclopedia, whether being for a scientific paper or a fictional work, will violate the copyright unless a specific permission is obtained from every source. With the willingness to use the legal system shown by the music and film industry in regard to illegal copies of songs and feature movies, even to prevent small scale exploitation for personal use, there is a risk that this scenario will escalate and be used as widely as possible when the legal tools are in place.

Of course, such a situation is something that will have a dangerous effect on the education system, academic research, media and all other information contributors. So far such institutions and non-profit writers have in most countries been protected by the precept that works accessible to the public



can be copied freely for fair use<sup>12</sup>. Given a stronger regime of copyright protection, already put forward and also adapted in many specific areas previously protected by more liberal regulations, it is easy to see many of the practices of today will become criminalized. On top of that, while trying to attain stronger copyright protection, many initiators also suggest increasing the penalties for violators. As an example, in the mid 90's Bruce Lehman, head of U.S. Patent and Trademark Office at that time, proposed imprisonment, "as next generation of 'infringers' won't be deterred by huge fines (which, since they may just be individuals using the internet, they may be unable to pay anyway), which is why he backs scary jail sentences to protect these companies' interests" (Godwin, 2003, p 191). Hence, it will not only be possible for the content owner to prevent others from using the material by means of legal force, but the threat of even being sentenced to jail or at least having to fight a jeopardous legal battle will scare many into paying royalties for materiel which they earlier where entitled to use for free.

When the understanding of how copyrighted material is to be treated simultaneously falls into more restrictive frames, liberties previously taken for granted are done away with. In his response to a European Commission document on 'Management of copyright and related rights' (Anderson, 2004), Ross Anderson addresses the problems with legislation overruling code of conduct for folk music performers. While street musicians play tunes composed by others and school bands copy sheet music without paying royalties, this is a conduct generally endorsed by composers. Lately copyright guardians like the UK Copyright Licensing Agency have threatened to take legal actions against such infringement. Fair use does no longer apply for non-profit groups, and alternatively they will either have spend all their money to buy separate sheet or book copies, pay huge royalties in accordance to intricate schemes or only play music old enough to no longer be copyrighted. Similarly, composers face the problem that they either have to place their compositions in the public domain or risk that no community bands can afford to play their songs. Matters are made worse by central agencies collecting royalties, as no discrimination is made to where the money comes from and "social norms may no longer be relied on" (Anderson, 2004). Even if composers approve their works to be used without requiring compensation, the action may be defined as illegal and stopped by the collector agents.

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<sup>12</sup> "Fair Use Rules of Thumb":  
<<http://www.utsystem.edu/ogc/intellectualproperty/copyypol2.htm>>

“In a free society, we do not require that every citizen have the same economic resources, but we have long depended on the principle that every citizen has at least something like the same access to basic informational resources, such as public libraries – resources that provide each citizen with an ability to educate himself about the world, to use the facts of the world, which no one owns or should own, to better his situation [...] The greatest interest at stake is not that of the copyright holders [...] We should regard our nation’s investment in the knowledge of its citizens, and in their ability to participate knowledgeably in an open society, as the highest and most precious intellectual property we can ever protect.” (Godwin, 2003, p 192)

In 1881 Justice O. W. Holmes, who was an American lawyer and law philosopher, published the book “The Common Law, where he declares the belief that “The life of the law has not been logic: It has been experience.” (Reilly, 1996) Or, as lawyer/writer John Reilly put it in 1996: “The common law is not a fixed body of doctrines and the syllogisms derived from them, but an organic structure that has grown up in response to ‘the felt necessities of the time.’ The way to evaluate a law, in other words, is to measure the degree of subjective satisfaction it gives the community.” (Reilly, 1996)

With respect to the recent history of what possibilities digital media and internet has given to the use, abuse and distribution of protected contents, the same aspect of the legal philosophy (as well as the quote by Holmes) is advocated by Godwin: “The appropriate strategy is to wait and see what problems emerge ... Once we understand the *actual*, not *perceived* risks, we can legislate accordingly and with full regard for the competing interests at stake.” (Godwin, 2003, p 192) Therefore it may be just as important to withhold those legal modifications that support the interests of big corporations and, and reflect on what would be beneficial for the online community in general. One example used to describe ‘the copyright cage’ is the fact that Girl Scouts who are singing around a campfire actually are infringing copyright and thereby breaking the law unless they pay royalties! “We live today under two copyright regimes: The law on the one hand and the reality as experienced by the public on the other.” (Zittrain, 2003) And adapting these laws to the cyber-age seems only to make matters worse. The *fair use* doctrine is more frequently being challenged, at the same time as the DMCA has set stricter rules to what falls under infringement of copyright. Even encyclopedias and lexica are developed more into restricted brand names than being made freely available. By limiting what is regulated as common assets, “we might soon enter a world in which all facts, and all collections of facts, are presumptively *owned*.” (Godwin, 2003, p 192) If

business is allowed to keep manipulating politicians into pushing new, restrictive laws at the current steady pace, intellectual rights, freedom of speech and individual entitlements may soon suffer badly.

The Russian researcher Dmitry Skylarov was July 2001 arrested in Las Vegas while attending a conference, and became the first person prosecuted in America for violating the DMCA. The reason for this was that Skylarov wrote a program that circumvented the copyright protection mechanisms in Adobe eBooks. Lawyers from ElcomSoft, the company for which he had produced the code, tried to argue that the DMCA was unconstitutional, but attempts to challenge the law itself were rejected by the court. Instead the case ended December 2002 with the acquittal of Skylarov and ElcomSoft on the basis that they had not deliberately broken the law, and not recognized the infringement of the American DMCA when selling the resulting program on the internet (Bowman, 2002).

For observers of the case, a major issue was also the lack of legislation in Russia to prohibit code that evades digital copyright protection, and it was wrong to prosecute the infringer in the U.S. for something that was not a crime in his native country. The program was developed in Russia and marketed on the internet, and “applying U.S. laws to global commerce – and our criminal laws to foreign nationals based solely on their internet activities – is highly questionable if for no other reason than other countries might apply the same logic to our own citizens” (Grosso, 2002). Another issue was arresting a researcher for analyzing a copyright protection mechanism, as looking into processes like these is rather investigating an *idea* in contrast to tampering with a physical product. Many argued that he had only executed his right to free speech when publishing results on how the system could be altered.

Starting with the very nature of internet, it seems unbeneficial to set the strictest possible regulations to what the term ‘copyright’ embraces. When something is published on the internet, it has to be done with the implicit perception that this material is in the public domain. In Norway, there is a legal interest to keep as much information freely available to the public. This is in the interest of the general public and it ensures freedom of speech as intended in the constitution (Syversen, 2003, p 6-7). As there are few distinct rules for digital content, inadequate conventional laws have to be applied to modern activities. Therefore, one may argue that a reproduction of copyrighted material in either the cache, the memory or on the screen of a computer is indeed a copy and should be protected (Syversen, 2003, p 26). However, as such duplicates are volatile and necessary for the convenience

of most internet browsing and media streaming<sup>13</sup> purposes, it would make no sense to attack these techniques for facilitating infringement of copyright.

Generally there are few or no limitations to what a viewer *can* do with this available on the internet. Once published, the material is in most cases accessible in an open format to anyone. For that reason, all viewers are in a position where they *can* violate the copyright if they would want to. Or they can establish links, directly or indirectly, to this accessible content. What is actually done has as much to do with good manners as with legal restrictions and approaches. Internet is global and the ability to control data is restricted by varying local regulations as much as by the power or willingness to pursue possible infringements at the terms of local laws. Publishers must in essence accept that data is linked, cached and copies stored locally on personal computers in ways commonly convenient for users (Syversen, 2003, p 61). In many circumstances it would actually seem as good an approach to relax the control of data as it is to modify current directives into shielding data exclusively. It would probably serve the public better to allow free manipulation of all available data, instead of choking progress with disputes and money matters controlled by institutions refusing to change their current business models. However, it is very unlikely for such a suggestion to be embraced, as big-scale copyright owners usually set the terms for both technical and judicial progress.

Copyright and patent laws were originally enacted to endorse research, culture and independent businesses, protecting developers from being run over by others leeching of their ideas and producing the same at lower cost. Now “even legislators are starting to admit that the patent system is not serving its original purpose” (Swaine, 2001) and many criticize the directives for being molded into tools supporting only big corporations profiting from strong exclusive rights and away from those it was intended to protect. “The primary problem with [e.g.] the DMCA is its supporters fail, or perhaps refuse, to understand that the old means of doing business no longer apply in the digital age. Moreover, attempts to maintain those old means impermissibly infringe on our fundamental freedoms, as well as upon generally accepted notions of fair play and international comity.” (Grosso, 2002) Others accuse the emerging paradigm with full-scale DRM systems as the spear point for even mending existing business models into positions where content owners have absolute control on how customers may use

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<sup>13</sup> There are techniques to keep only the minimum necessary amount of data in a buffer on the computing platform used when streaming data, but still it is common to upload a temporary copy of the entire file. Either way, there exists software that enables the streamed data sequence to be captured and subsequently reproduced locally.

their products. If system policies are remotely controlled, like in the DRM model suggested by the TCG, even stricter policies than the current protection mechanisms may be applied. CDs and DVDs may retail at a low price, but they will only play for a certain number of times, movies can only be viewed on one or a small number of machines, books can only be read once and news articles are only accessible from specific platforms. Digital music is non-transferable. (Anderson, 2003) The possibilities are endless, and examples of numerous similar situations can by now also be found with current technology. Those who have ever brought their laptop when traveling abroad and tried using it to watch a DVD movie have probably experienced a similar situation: As a DVD-ROM by law should be fitted with a zone control mechanism, you may not be able to play a perfectly legal copy. Or there is a policy determining that the zone configuration can only be changed a given number of times, ending with the player refusing to play movies when you get back home. So if one likes watching movies, but does not want to purchase a new player for every zone, this situation renders no choice but to hack the hardware, risking to breach the terms of the warranty, or using fishy software to circumvent the zone guard altogether.



## TECHNICAL

*"Unlike actual law, Internet software has no capacity to punish. It doesn't affect people who aren't online (and only a tiny minority of the world population is). And if you don't like the Internet's system, you can always flip off the modem."*

*- David Pogue<sup>14</sup>*

The most common ways of protection digital material is either by hiding information or by restricting access to the data, therefore these methods are commonly used to enforce DRM. There are numerous ways of hiding data from a user in modern computer systems. Examples are to create a hidden partition or storing the information in the file overhead, as data file systems usually function in the manner that the operating system allocates storage space in clusters, leaving an empty space when the file does not match up with the allocated clusters. Even if the file itself does not use this space, it is possible to store data on such parts of the disc. As the operating system regards them as used, these disc sections do not show up in the file directory. Other means are to hide information in the overhead of media header files and TCP/IP packets (Craver et al., 2000, p 55-56). Although this data is difficult to detect, it resides 'in the clear' and can be obtained by those who succeed in targeting and filtering the right segments. Consequently, hiding information in the header files is not a good approach when it comes to music and film files, as it will simply be for infringers to replace this section or overwrite any critical data in the overhead space with nonsense data to get rid of any means of copyright protection.

If data in a file should be made inaccessible for everyone not authorized to access it, cryptography can be used to protect this information. However, considering the complex nature of such schemes, their algorithms and possible implementations, going into details about specific methods would be far out of the scope for this paper. In very general terms, encrypting is making data unreadable, usually by means of mathematically altering the

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<sup>14</sup> From the text "Don't Just Chat, Do Something.", New York Times 30 January 2000, reviewing the book "Code: And Other Laws of Cyberspace" by Lawrence Lessig

contents, unless you know the decryption algorithm and possessing the secret key which was used to encrypt it. For the protection of digital content, the encryption and decryption methods have to be balanced between security and usability. Initially, the encryption must be strong enough to prevent unauthorized access of the encrypted data. Secondly, the system must facilitate effective decryption to ensure that the usability and consequently the value of the data are not diminished by posing too much inconvenience for the user. This is especially important in terms of easy access, response time and consumption of computing resources in such systems.

Another method of protecting exclusive digital data and is by use of watermark embedding, which makes it possible to trace back the legal owner of a work and subsequently track the traitors if copyright has been violated. In general, such systems are classified with regard basic functionality (Arnold et al., 2003):

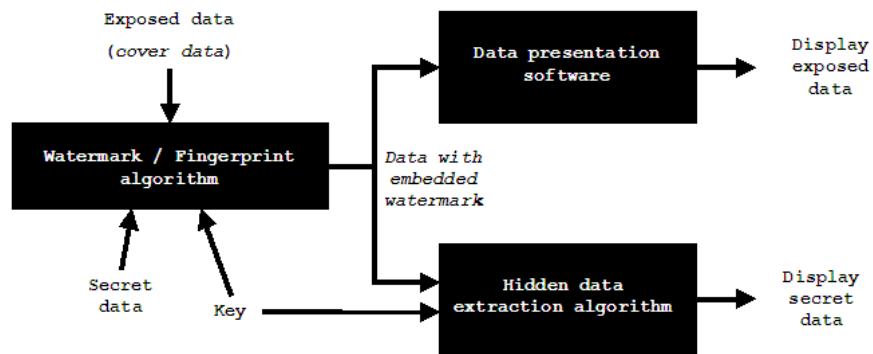
1. **Copy protection mechanisms** make sure reproduction of data is not achievable.
  - a. *Analog physical media* allows the files to be reproduced on designated platforms, but the resulting signal should not be reproducible.
  - b. *Analog ephemeral data* where the transmitted signal should only be usable on designated platforms.
  - c. *Digital physical media* requires additional elements to facilitate reproduction of the data.
  - d. *Digital ephemeral data* where platforms used to reproduce the data do not allow copying.
2. **Usage monitoring** for feedback to the copyright owner of the work.
3. **Distribution tracing** to keep track where the data originated, if it is moved or copied.
4. **Usage control** so data is only reproduced in accordance with the requests of the copyright owner.

These functionalities can be facilitated through data processing and physical means, and the scheme most relevant for this paper will be “a digital watermark uniquely identifying the end user of a creation is embedded in the creation’s carrier signal as the payload” (Arnold et al., 2003). This means that a digital ‘fingerprint’ for the owner can be embedded before shipping a file to a customer. In the same way the identification of the



customer using the file can also be embedded, if the system contains such features. The latter is most relevant in pay-per-use business model scenarios, but can also to some extent be used to trace back violators, should this be necessary. As copyright information embedding is most relevant for this paper, in particular for digital media files, a few methods and approaches will be presented to demonstrate the applicability and limitations of such systems, and give some insight to the technical features of this variety of DRM.

In general a watermarking or fingerprinting system functions like shown in this illustration:



Watermarking of file

Necessary data to set rules regarding rights management for computer files will usually be contained by the file itself. If this content has to be hidden, some form of *steganography* – the art of hiding information within information – may be used. To be practically useful, watermarking systems should at least fulfill four requirements: The watermark insertion should be *imperceptible*, meaning that it should be almost impossible to distinguish the watermarked file from the original. To facilitate that a file still contains the watermark even if it is corrupted parts are missing from it, *redundancy* should be ensured by spreading the watermark data amongst the whole set of cover data. The system must also be *robust* to modifications and adjustments of the cover file, as it is common to e.g. compress, decompress, re-scale, split, re-assemble and add additional features to music and film

files. Finally, the watermarking should make use of either a public or a private *key* to prevent the watermark from being read, altered or removed by unauthorized users. (Kutter and Hartung, 2000) On the other hand it is important to minimize the amounts of data that are added with a watermark, as more additional information will influence on performance and appearance of the cover file. These reasons make digital steganography a complex discipline requiring a great deal of balance between what will be beneficial and what is strictly necessary.

Historically it has been common to use such ciphers in text or images to hide secret messages and most of the research originates from those scenarios. While the human ear is more sensible to minor errors in music than in visual references like images and text, a number of successful methods for hiding secrets in sound have been developed. Some of these include:

- **Least Significant Bit (LSB) coding:** The LSB of the carrier signal is replaced with the bit pattern of the watermark. As this method is not at all robust and requires exact synchronization to detect the watermark, it is considered useless (Arnold et al., 2003).
- **Phase coding / Phase modulation:** Data is represented by a phase shift in the carrier signal. This exploits the fact that the ear is less sensible to phase factors than to noise or irregularities in sound (Craver et al., 2000, p 61-62).
- **Echo hiding:**  $c(t) = f(t) + \alpha f(t - \Delta t)$   
The carried signal  $c(t)$  has an inaudible echo  $f(t - \Delta t)$  added to the transmission  $f(t)$ , and by choosing between short ( $\Delta t_s$ ) and long ( $\Delta t_l$ ) delay a digital signal is sent (Craver et al., 2000, p 62).
- **Spread-spectrum:** The watermark is distributed as ‘noise’ across the carrier signal, it jamming the code. In simplistic terms, the watermark will then reside as peaks in the carrier wave. Additionally, a key is embedded to help hide the watermark (Arnold et al., 2003, p 30 and 102).
- **Patchwork technique:** Pseudo-random statistical data is embedded in a file, and the watermark can be extracted using numerical indexes for the distribution of watermark data.

The watermark can also be inserted into a compressed audio bit-stream. This is commonly done by using a specific key when changing the scaling factors of frames making up the audio bit pattern, or by altering values of

the audio sample values (Arnold et al., 2003, p 99-100). Such methods alter the digital data itself and have the advantage of being quick to compute for data inserting and extraction. But as the audio that it samples is not taken into consideration, there are vulnerable changes in the audio features and can often be easily attacked that way.

For a compressed video stream the easiest way to watermark a file seems to be by integrating the watermark and the compression encoders. Then the fingerprint-data can be kept at a level lower than an audible threshold, masked within the visual spectrum. The data can be spread over a large set of frames, the watermark can be recovered from both the compressed and the uncompressed data stream and using the same scaling values as when embedding it to the original file. On the other hand, it will be necessary with a new method for every new film compression technology. (Arnold et al., 2003)

As the output from an audio or video source is commonly analog, recovery of the digital watermark should at best also be possible from this signal. Preferably even if only a small part of the original recording is available, and still if it has been degraded in quality. (Arnold et al., 2003) Though, these are additional requirements that make already intricate digital watermarking systems even more difficult to construct. Since both the carrier and the watermark data can be configured and manipulated in a number of ways, there are numerous tactics to use when attacking such systems:

- Signal diminishment or enhancement (sharpening, blurring, modification of color and gamma correction in images and film, or changing the sampling frequency of sound)
- Add, reduce and expand distortion signals
- Filtering (linear and non-linear)
- Compression where some of the original information is eradicated
- Transformation of the file (rotate, invert, scale, shear, frame rate, encoding frequency)
- Data reduction (e.g. cropping the file, removing or changing the original into a set of clips, histogram modification by altering the frequency of certain features)
- Data composition and 'Frame dropping' (logo insertion, adding scenes, altering the frame frequency for films etc)
- Transcoding (e.g. converting a GIF image to JPG)

- Digital-to-Analog or Analog-to-Digital conversion (additionally, the quality usually declines over time when the data residing as analog signals on e.g. a magnetic tape)
- Multiple watermarking (putting a new watermark over the original one)
- Collision attack (either by adding a new signal marked using a known key and then removing both watermarks using this new key, or by finding an alternate input that produces the correct result)
- Statistical averaging (usually done by reviewing many files with the same watermark do see if there are similarities in the data)
- Mosaic attack (dividing a file into a set of smaller parts that have to be joined in order to be viewed)
- Protocol attack (a counterfeit watermark is subtracted from a watermarked file, leaving an 'original' where the initial watermark is destroyed and it seems the original actually belonged to the con artist)
- Oracle attacks (signal levels for decision threshold of a watermark / encryption decoder is analyzed, disclosing the decryption algorithm)
  - Though this attack could made considerably more difficult by randomizing the detection process or making the decoder tamper-proof.

*Sources: (Kutter and Hartung, 2000), (Craver et al., 2000) and (Arnold et al., 2003)*

For an ideal system, attempts to change or remove embedded information should leave the cover data unusable if successful. Files damaged through tampering must show this clearly, leaving the act evident to novice users as well as professionals. In the same way, 'invisible' data must remain so, even to attackers using advanced methods and with substantial funding (Craver et al., 2000). Neither of these prerequisites are straightforward to facilitate. Digital watermarking protects files in the way "that they provide a deterrence mechanism or evidence of breach of copyright or other contractual obligations after the fact" (Arnold et al., 2003). Even if they can be used together with authentication systems to ensure that a file is permitted to playback by the copyright owner, before the user is allowed to run a file on a platform, this only works for "copy protection in conjunction with specially equipped devices for playback and recording" (Arnold et al., 2003). The way computers and most other playback devices are constructed now, there is little stopping the user from making use of a file even if an

expected watermark is incorrect, tampered with or even missing. In essence, digital watermarking and fingerprinting will only function properly to track down the source of infringement **after** copyright is breached. To actually prevent files from running on a system, stronger protection mechanisms have to be adopted.

### ***DRM technology dilemma***

On one hand, transactions are more secure and data integrity is protected on more levels. This is valuable for business where confidential data have to be transferred and contained, as improvements will affect the safety measures for future systems regardless of intended use. Efforts to protect data influence software, hardware, business scenarios and how computing systems are allowed to function. Content providers are very much trying to introduce stronger means to protect their digital material. On the other hand, if the mechanisms become too restrictive, which is likely to be how most users experience such systems, they will potentially limit the usefulness of devices and especially general-purpose personal computers immensely.

Content providers collaborate with system implementers to define specs of relevant DRM methods, and quite frequently this seems to come at the cost of flexibility for the users of such systems. Therefore the effort of protecting data may actually lead to loss of data and revenue for customers of protected material. As “it may be desirable to retain archival copies of unencrypted data for the eventuality of catastrophic failure on the part of the DRM (e.g., loss of all decryption keys – such an event can occur through failures or as part of a deliberate denial-of-service attack that triggers tamper response functionality in the desired locations)” (Arnold et al., 2003, p 250), too strong a protection may eventually make this impossible.

The vast variety in possible attacks illustrates the difficult challenges faced when implementing such systems. Even if many protection efforts have proven to be fairly successful in the past, it is apparent that attackers with necessary resources have huge advantages over those trying to prevent copyright infringement: Simple attacks often prove to be all the more successful than complicated protection efforts, as errors easily happen in the algorithm or implementation when building the systems. More critical are potential attack tactics that fail to be addressed. Aggressors are often as ingenious and creative as the defense designers, and they are quite often equally or better funded. And not to be forgotten are people who find cracking such algorithms an intellectual and enjoyable challenge, without

really profiting from it. It would be fair to say that “even when designed under realistic expectations, watermarks offer robustness against non-experts, but may still be vulnerable to attacks by experts.” (Kutter and Hartung, 2000, p 118) There will never be ‘unbreakable systems’. Additionally, copyrighted material may be distributed from servers located in countries lacking copyright laws or the willingness to enforce these, making the task of protecting data even more difficult.

## STATE OF AFFAIRS

*“There are three kinds of lies: Lies, damned lies, and statistics.”*

*- Benjamin Disraeli (British prime minister in 1868, 1874-80)<sup>15</sup>*

For many generations, production companies have regulated most aspects of how their records or movies, just to name a couple of examples, are put on the market. A simplified illustration is how they initially decide which products, i.e. artists and films, to invest in: Record companies manage songwriters, which songs to record, what producers to use and how much time & money allowed to spend during the making. Equivalently the movie industry organizes screenwriters, choose which stories to go through with, hires producers, cast actors and manage budget. At least if one sees it in a bit wider perspective. Usually they control the marketing and distribution, with movies even to the extent that the world is divided into different release ‘zones’ to ensure that video release of a film in one part of the world does not affect the marketing for the cinema screening of the same movie another place. However, “internet is bringing new key players and business models into the music industry” (Lam and Tan, 2001), and the product bundles this industry in particular has relied on for a long time is being revolutionized. Although many of the same changes are also apparent when it comes to trading music, films, books and computer software (including computer and console games), and these businesses has experienced some dramatic changes.

Recent decades songs have mainly been sold as either collections in the form of records (LP, cassette, CD or equivalent), or in form of broadcast licenses to radio and TV stations. Nowadays when recordings can be stored digitally, it has become common to purchase individual songs rather than full-length albums. And of course, complemented by the ever-returning pirate distribution, where the same data is illegally made available without compensating the owner. It is still being assessed on which level

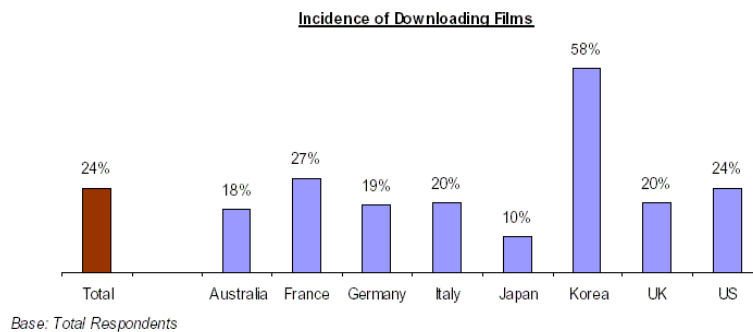
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<sup>15</sup> The quote was later immortalized by British World War II prime minister Winston Churchill and American author Mark Twain

unauthorized distribution of copyrighted content is impacting the commerce, but figures presented vary very much dependent on which organization displaying them. Further examples will illustrate this.

## **Piracy**

According to a recent study conducted by the Motion Picture Association of America (MPAA) in conjunction with Online Testing Exchange (MTX), about 24% of internet users throughout the world have downloaded one or more pirated full-length movies. This particular analysis had approximately 3600 internet users from eight countries examined, from whom the substantial majority of “approximately 80% of sample” were broadband users (MPAA, 2004):

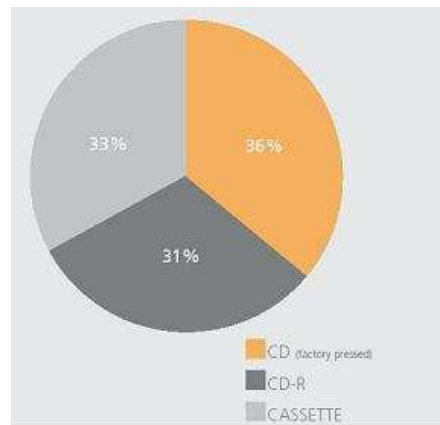


### **Piracy figures medio 2004 – Film Download**

Figures from this analysis show that almost a quarter of users in these countries have downloaded or keep downloading movies frequently. While this is mainly users with a high bandwidth, the quantity of downloaded movies is probably not representative for internet users in general. But they do reflect current trends. Unsurprisingly, the study also indicates a correlation between the download activity and the decline of cinema visits and DVD / video purchases amongst downloaders.



Similarly an annual study conducted by the International Federation of the Phonographic Industry (IFPI) points out Korea as an area with large scale internet piracy, which has resulted in the music market almost halving from what it used at the turn of the century. The region lacks good intellectual property copyright laws and has failed to control the emerging use of broadband for sharing music. The problem of private music piracy is evident, as the number of “unauthorized peer-to-peer (P2P) filesharing sites may be as high as 500” and “the prevalence of unauthorized streaming sites ... accounts for about 55% of the marked segment” (IFPI, 2004, p 13). Both of the most popular P2P site and the most popular streaming site in Korea are estimated to have over 10 million members each.

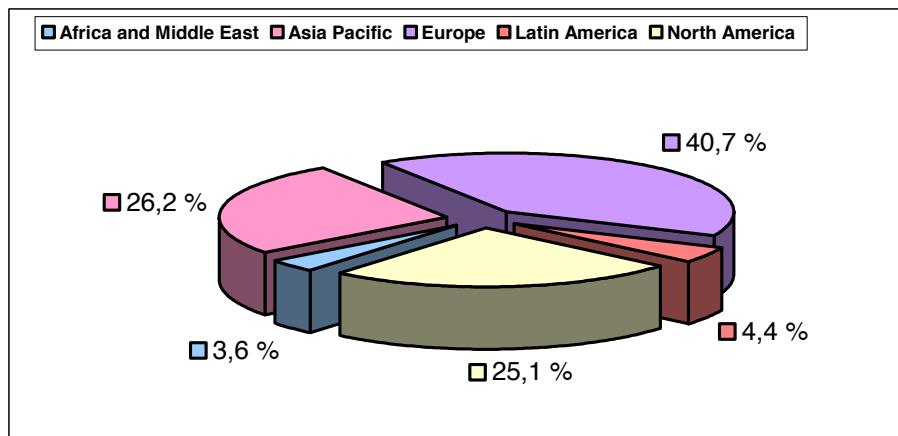


**Composition of pirates 2003**

This diagram from the study shows that out of the total of printed music pirate copies, the cassettes format, burned CDs and factory printed CDs constitutes roughly 1/3 of the marked each. The IFPI report also points out that “commercial piracy, contrary to what commentators mistakenly think, is just as important a problem for the music industry today as internet piracy” (IFPI, 2004, p 1). Pirated records are estimated to generate about US\$4.5 billion in sales throughout the world, with estimations of more than every third record CD sold being an unlicensed copy. Additionally a substantial numbers of pirate recordings are sold as cassettes, Minidisks,

music DVDs and other less common formats. In total it is estimated that “piracy amounts to “40% of all music products sold worldwide” (IFPI, 2004, p 2).

Like IFPI, the Business Software Alliance (BSA) conducts annual studies to measure the impact from use of pirated software. Their results indicate that the last decade, on a worldwide basis something between one third and half of all the installed software has been a pirated copy (BSA, 2002). Last year 36% of computer programs in use were illegal, and the countries with the worst piracy rates are China and Vietnam at 92%. Parallel to the legitimate software industry worth about US\$80 billion, BSA estimate that almost US\$30 billion worth of illegal copies are distributed. Losses are according to their latest research spread as follows (BSA, 2004):



**Regional software piracy losses 2003**

On the other hand: What do these numbers really say? MPAA function as the “voice and advocate of the American motion picture, home video and television industries”<sup>16</sup>, IFPI “represents the recording industry worldwide”<sup>17</sup> while BSA “is the voice of the world's commercial software industry before governments and in the international marketplace”<sup>18</sup>. It is

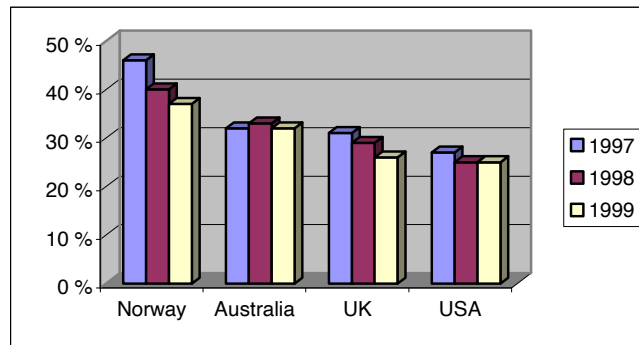
<sup>16</sup> Quote from MPAA web page: <<http://www.mpaa.org/about/>>

<sup>17</sup> Quote from IFPI web page: <<http://www.ifpi.org/site-content/about/mission.html>>

<sup>18</sup> Quote from BSA web page: <<http://www.bsa.org/usa/about/>>

obvious that investigations carried out by the industries themselves or their partners will come up with results supporting their cause. There would be little point in presenting the findings otherwise. Often, studies seem to be conducted with the basis of proving that piracy and downloading of films, music and software is the primary problem for the industries. Data signaling the bad ill-natured behavior of pirates and the devastating effects of piracy are highlighted and emphasized, anything indicating differently seems simply to be avoided and not analyzed further. That is, the question seems so to be answered beforehand and statistical data is simply gathered to prove the assumption. Consequently, one should read such findings with a healthy degree of skepticism.

The study “Digital music and online sharing: software piracy 2.0?” from 2003 examined the distinctions and resemblances between software and music piracy made an analysis of how “consumers' music purchasing behavior is affected by free music” (Bhattacharjee et al., 2003), and their result was quite remarkable. Most importantly, and differentiating a great deal from what usually emerge in the media, was how it came out quite clearly that “digitized music can serve a useful marketing function, and that demand for music depends critically on price, distribution mechanisms, technology, and the type of music” (Bhattacharjee et al., 2003). Another study from 2000 explored the “key link in the piracy-income equation: The software pricing mechanism” (Gopal and Sanders, 2000). An important problem when selling legal software licenses is that they are (mainly) priced at American levels, “which are significantly higher than individuals in most countries can afford” (Gopal and Sanders, 2000). When many governments hesitate to put in force the laws preventing this kind of activity, it becomes much better business to sell illegal versions of the programs. Still, not all piracy issues can be explained as a result of inability to purchase original, expensive goods. A subsequent study in 2004 (Shin et al., 2004) analyzed the social and cultural impact on piracy rates, as many industrialized countries repost vastly more piracy than what the consumer economy should indicate. Some figures extracted from the ‘Report on Global Software Piracy 2000’ by the Software and Information Industry Association (SIIA, 2000) exemplifies this:



Software Piracy Rates 1997-99

Importantly, these countries were chosen for convenience of being most relevant, and do **not** represent peak cases. To the contrary, they rather reflect regular figures for rich countries. The study states that average piracy rate was 36% Western Europe and 49% for Asia/Pacific over the same time period, and although figures from BSA differ slightly they are similar enough to back up these claims (BSA, 2002). Additionally, their statistics from 1994 to 2003 show that rates have been quite stable, or only slightly decreasing, for these regions and on a worldwide scale<sup>19</sup>. “These observations are contrary to the attitude that global piracy is a poor-man's disease that is exclusively curable through economic elixirs.” (Shin et al., 2004) In addition to finding a consistent link between averaged Gross Domestic product (“*GDP per capita*”) and piracy rates for a country, there was also an important coherence between national collectivism and distribution of pirated software within a country:

<sup>19</sup> See both studies previously referred to in the text and additionally their publication webpage <<http://www.bsa.org/usa/research>> for further reports.

Country	Piracy Rate	GDP per Capita	Collectivism	Country	Piracy Rate	GDP per Capita	Collectivism
Argentina	62%	\$8,100	54	Korea	50%	\$12,086	82
Australia	32%	\$23,554	10	Malaysia	71%	\$4,526	74
Austria	36%	\$31,550	45	Mexico	56%	\$3,613	70
Belgium	36%	\$29,687	25	Netherlands	44%	\$30,135	20
Brazil	58%	\$4,479	62	New Zealand	31%	\$17,210	21
Canada	41%	\$21,754	20	Nigeria	67%	\$250	80
Chile	51%	\$5,121	77	Norway	37%	\$37,142	31
Colombia	58%	\$2,261	87	Pakistan	83%	\$508	86
Costa Rica	71%	\$3,994	85	Panama	66%	\$3,246	89
Denmark	29%	\$37,308	26	Peru	63%	\$2,346	84
Ecuador	71%	\$1,419	92	Philippines	70%	\$1,138	68
El Salvador	83%	\$1,752	81	Portugal	47%	\$12,309	73
Finland	30%	\$30,355	37	Saudi Arabia	64%	\$6,718	62
France	39%	\$28,959	29	Singapore	51%	\$26,460	80
Germany	27%	\$31,721	33	South Africa	47%	\$3,904	35
Greece	71%	\$12,652	65	Spain	53%	\$16,989	49
Guatemala	80%	\$1,545	94	Sweden	35%	\$29,866	29
Hong Kong	56%	\$22,185	75	Switzerland	33%	\$45,496	32
India	61%	\$450	52	Thailand	81%	\$2,717	80
Indonesia	85%	\$962	86	Turkey	74%	\$2,965	63
Ireland	51%	\$25,158	30	United Kingdom	26%	\$21,069	11
Israel	44%	\$16,438	46	United States	25%	\$30,845	9
Italy	44%	\$20,174	24	Uruguay	70%	\$6,208	64
Japan	31%	\$42,318	54	Venezuela	60%	\$3,213	88
Kenya	67%	\$337	73				

Piracy Figures: GDP per capita & Collectivism<sup>20</sup>

This explains why countries where people are collective, yet financially capable of purchasing legal software, have frequent piracy, while with other less joint communities fewer people will be inclined to pirate software, even if the economy is worse. Software is just another resource “that can be shared and in effect used to increase the overall welfare of the group”, because the “behavior is right if it provides an excess of benefits over harmful effects” (Shin et al., 2004).

The 2003 comparison of software and music piracy (Bhattacharjee et al., 2003) did show that distributing pirated audio has “similarities as well as uniqueness compared to software piracy”. Statistics are comparable when it comes to demographic data like age, gender and background, but as music consumers are generally younger than those who buy business software, “the demographic effect is likely to translate to a larger drain on the bottom line for the music industry than for the software industry”. On the other hand, sharing music files on the internet promotes artists at a low cost, and is great for those not supported by big corporation budgets. Therefore “many consumers download music to sample and subsequently purchase a

<sup>20</sup> Collectivism, in general, is a term used to describe an emphasis on the group, as opposed to the individual (Wikipedia), i.e. a focus on interest of the group rather than personal gain. *The national collectivism scale in the table ranges from 0 (lowest) to 100 (highest).*

CD if they like the music, hence it provides an effective advertising channel”.

Similar results were achieved in March 2004 by Felix Oberholzer and Keleman Strumpf from the University of North Carolina at Chapel Hill (Oberholzer and Strumpf, 2004). They conducted a comprehensive study to determine what kind of file sharing had which impact on record sales. In order to obtain a representative set of data, they started by setting up a range of test-criteria like:

- Bandwidth for test-servers (T3 transmission speed)
- P2P network to use for test (OpenNap with minimum 25 000 simultaneous users sharing over 10 million files)
- Reliable data for weekly album sales (Nielsen SoundScan was chosen, as this tracks sales from more than 14 000 in the U.S. and is used for the Billboard music chart)
- Analyzed downloads had to be in a common audio format (e.g. MP3, OGG, WAV, AIF, WMA)
- A broad selection in music samples (500 albums from eight different genres were chosen from a selection of almost 1500 albums appearing on U.S. charts July-December 2002)

As their “goal was to measure the effort of file sharing on sales” (Oberholzer and Strumpf, 2004, p 13), a basic model for **observed sales** ( $S$ ) of an album was set up:

$$S_i = X_i\beta + \gamma D_i + \mu_i$$

This is a linear regression model<sup>21</sup> where  $i$  is an index referring to an individual album, the dependent variable  $X_i$  is a vector of album characteristics and the other dependent variable is the number of downloads  $D_i$ . To find the relationships between these factors and the sales, i.e. the influence on the sales for a given album ( $S_i$ ), the value of the coefficient

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<sup>21</sup> The ‘linear regression’ method is used to estimate the expected value ( $S$  in this model) when this is dependent on other conditional values ( $X$  and  $D$  in this model), i.e. the output from observed data (according to test-criteria) can be approximated through the resulting mathematical model.

vectors  $\beta$  and  $\gamma$  should be established (with  $\mu$  being the mean number of sales).

Some characteristics that influence both the sales and the number of times the equivalent files are shared will be difficult to observe. Therefore, in order to “control the album-specific time-invariants”, the model is altered slightly to approximate the fixed effect:

$$S_{it} = X_i \beta + \gamma D_{it} + \sum_s \omega_s t^s + v_i + \mu_{it}$$

With this time series model, sales over time ( $S_{it}$ ) is observed. Here  $\omega$  is the time dependent coefficient vector with  $t$  indicating the time in weeks, and  $v_i$  is the album fixed effect (i.e. the initial value). And by summarizing this time trend, a flexible time effect is for the sales is introduced in the model.

On top of this, not being able to observe  $\mu_{it}$  may introduce a level of uncertainty, as it will be critical in cases where album sale rise and fall may vary by season and from album to album. Hence the number of downloads over time,  $D_{it}$ , is fine-tuned by introducing valid measurement mechanisms (“instruments”)  $Z_{it}$  that have an effect on file sharing but without being linked to the “second stage errors”  $\mu_i$  or  $\mu_{it}$ :

$$D_{it} = Z_{it} \delta + X_i \beta_2 + \sum_s \omega_{2s} t^s + v_{2i} + \mu_{2it}$$

Instruments defining coefficient  $Z_{it}$  can be:

1. Permanent album-specific factors (e.g. track lengths, which influences the file size of compressed versions of the songs)
2. Conditions varying over time, but being similar for all albums (e.g. bandwidth, network traffic and changes in the user groups)
3. Feature that changes over time and from album to album (e.g. that availability depends on which songs are being popular to share at the time)

From the report it seems that the major second stage error ( $\mu_i / \mu_{it}$ ) were non-stationary attention like “additional radio play or media exposure, [which] can have persistent effects and continue to affect sales or downloads weeks after their occurrence” (Oberholzer and Strumpf, 2004).

After tracking the P2P networks for 17 weeks they had registered more than 1.75 million downloads, most of which being music files. In addition to logging what songs and albums P2P users looked for and which files were being downloaded, the data was also compared to album sales and influential factors like advertisement, radio and TV play frequency, concerts and other ways of getting additional attention. Other aspects like user location and download rate were also examined. In fact, for this particular sample the average user was only connected two days, making 17 downloads. Although there are some large-scale users (the maximal number of observed downloads for one user was 5000 songs during the period), the low average is “indicating large turnover in the user-base” (Oberholzer and Strumpf, 2004, p 11) and it seems numerous users only access the networks on the odd occasion.

While album promotion through radio, TV, concerts and other media coverage has a boosting effect on both sales and downloads, it is observed that “while file sharing significantly reduces the financial cost of obtaining music, it has an ambiguous theoretical effect on record sales” (Oberholzer and Strumpf, 2004, p 2). Many of those using file sharing networks to get pirate copies also use the same channels to browse collections of others with a similar taste. Community-building and discussing songs and artists may be just as important as accessing albums for free. This sampling may increase the motivation to spend money on new music, even if much is available for free. Early 2002 there was already a study by the Jupiter Research institute indicating that out of frequent file sharers a significantly larger percentage spent more money on buying music than less money, compared to what they did before starting to download on the internet. At the same time another study by the IFPI claimed downloaders spent less on music than they used to. (Borland, 2002) Again it is back to the problem with trusting the numbers presented, but at least independent research has the advantage of actually being ‘independent’. Oberholzer and Strumpf claim that out of 159 file sharers responding to an online survey they conducted along with parts of the 17 week study, 65% online availability made them not buy an album. But 85% also said free online sampling made them purchase one or more albums. Actually, “file trading led the average user to purchase an additional 8 albums” (Oberholzer and Strumpf, 2004, p 4). And although this number may be overstated, it indicates a significant increase on the total revenue.



## ***Effect***

It seems that most downloaded albums would not have been bought if file sharing did not exist, and being less concentrated around hit songs and albums than sales the findings are “inconsistent with the argument that file sharing is reducing sales of commercial important albums” (Oberholzer and Strumpf, 2004, p 23). Although influenced by the same hypes and media exposure (like radio playtime and heavy rotation on TV) as conventional sales, download seems to span wider across the available selection and is not trailing the peaks and ‘lows’ of hit lists. Popularity can be traced to both record sales and downloads, but generally the top selling albums make out a larger portion of the retail than on the file sharing networks. In fact, the statistical data seem to indicate “high selling albums actually benefit from the file sharing” (Oberholzer and Strumpf, 2004, p 3). Despite what the record industry claims, the analysis concluded that “file sharing has no statistically significant effect on purchase of the average album in [the] sample” and “estimates are of rather modest size when compared to the drastic reduction in sales in the music industry” (Oberholzer and Strumpf, 2004, p 24).

Another appealing fact being pointed out that is that despite continuous lament from the RIAA since people started to swap songs on P2P networks, music revenue was actually rising during the first years of file sharing. If consulting U.S. sales statistics provided by the RIAA, it shows clearly how there was a steady rise in both CD shipment<sup>22</sup> and total figures for the record industry from the mid 90s until 2000 (RIAA, 2004). At that time Napster, the supremely largest network in 2000, was not expanding anymore. It rather faced the verge of extinction, months away from being torn down by the RIAA and its partners.

Without going too deep into speculations to why record industry sales have dropped, it seems to be a complex course of events leading to the current situation. The number of shipped units dropped, retail price of CDs has dropped and the American economy was crippled, particularly noticeable in the aftermaths of the 11 September 2001 terror (Ziemann, 2002). The situation is also possibly influenced by e.g. movies and interactive entertainment stealing portion of the large music market. And even if computer games and DVDs in particular have been haunted by the same piracy as CDs, though to a lesser degree, both of these formats have had a steady growth of revenue during the decrease of the CD market.

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<sup>22</sup> Selling two to three times (dependent on year) more CDs sold than other formats in total, making CDs the indicating product

By blaming piracy for being the key setback in the music market today, focus is drawn away from the more important issues. “Downloads have an effect on sales which is statistically indistinguishable from zero, despite rather precise estimates. Moreover, these estimates are of moderate economic significance and are **inconsistent** with claims that file sharing is the primary reason for the recent decline in music sales.” (Oberholzer and Strumpf, 2004) Quite often the large record labels rely on a set of few, highly promoted superstars generating massive sales, and the profits from these sales are used to invest in new talent. The study showed that for these artists, file sharing seems to have a positive effect on sales, which shows that neither superstars nor newcomers invested in by the record label should suffer from online distribution of pirated music (Oberholzer and Strumpf, 2004). Obviously, the economy of those selling fewer albums will more easily be influenced by piracy, but the study does not at all show that such an influence is necessarily negative.

The Pew Internet & American Life Project is a non-profit, non-partisan organization that has been studying other different aspects of internet use over the recent years, to produce statistics on various online trends, activities and which social influence the net has. In one of their recent surveys musicians and songwriters were asked about their opinions on how music file impacts their profession. From the results, it may seem that the industry and performer it is founded to support deviate on some of the fundamental issues. The fact is that only 5% say “free downloading has exclusively hurt their career” and as many as 35% say “it has helped” (Rainie and Madden, 2004b). One third of the professional musicians even responded that “file sharing poses ‘no threat at all’”, while the remaining two thirds were divided 50-50 on saying it poses a “minor” or “major” threat. But more interesting is the situation that out of the 83% respondents who had offered music for free downloading on the internet, 35% reported their career (in form of sales, concert attendance and time on the radio). Only negligible 5% claimed free downloads were hurting business. Ultimately, “60% of those in the sample say they do not think the Record Industry Association of America’s suits against online music swappers will benefit musicians and songwriters” (Rainie and Madden, 2004b).

Through the Pew Internet & American Life Project similarities for the music file downloaders have been found to be *gender, age, internet experience* and *household income levels*:

- While men download more music than women, the rate has been increasing and decreasing at similar rates for both sexes over the recent years (Rainie and Madden, 2004a).
- In the peak period (mid 2001 to early 2003), more than half of American internet users between the age of 18 and 29 downloaded music (Graziano and Rainie, 2001). Even if this number has been halved within late 2003, mostly due to the RIAA lawsuits (Rainie and Madden, 2004c), young users were still responsible for more downloads than the rest of the age groups in total (Rainie and Madden, 2004a).
- Newcomers often start downloading at the foundation of their internet learning curve, and are commonly as frequent downloaders as more experienced users (Graziano and Rainie, 2001). But still there are indications to download frequency increases with internet experience (Rainie and Madden, 2004a).
- The lower income, the more frequently internet users are inclined to download music. But this may also be connected with low age and lower education levels for frequent downloaders, as these factors will affect the income level as well (Rainie and Madden, 2004a).

One of their most recent surveys including data from comScore Media Metrix implies a drop in use of P2P software. Still 18% of internet users in America still download music regularly, despite 38% claiming they have reduced their downloads due to RIAA efforts to have file sharers prosecuted. Even though the P2P systems which RIAA attack are becoming less widespread, there was an increase in users reporting that they downloaded music or video files. Additionally, the same growth was reflected in the number of users saying they let others download music, films, pictures or computer games from them (Rainie and Madden, 2004c). This increase seems to mainly come from users changing to other file sharing venues like email or online chat and instant message systems. Some users also seem to avoid the most popular P2P applications like Kazaa and WinMX, switching over to less known and therefore less likely targeted programs like BitTorrent and eMule. Though the latter situation applies only to an insignificant quantity of the users, and does not make a real impact on the overall situation.

Reality may be less hostile than the American industry wishes internet users and not least predominant politicians to think. As the Pew Internet Project polls are done solely in the USA, the results do not seem entirely representative for the rest of the world. Even if Americans are some of the

most regular music file downloaders. Data collected from 81,500 internet users by IT Innovations & Concepts, Inc indicate that throughout the world<sup>23</sup> slightly less than 5% of internet users had used a P2P platform to download music in 2003. That is quite a small proportion, and a great deal less than one could expect from all the attention this problem gets. Online music piracy figures were also compared to recorded software and movie piracy, involving “economical and statistical data for ~ 90 significant countries” (ITIC, 2004). Moreover, regardless of characteristics analyzed, the study concluded “that **only** a computer with an internet connection were common to each infringer.” To the contrary of what many other researchers claim to have found, there were no other unequivocal consistencies found in this report as test data ranked dissimilarly depending on which context like e.g. unemployment, poverty, literacy and amount of downloads it was evaluated against.

Additionally, the ITIC study found that average value of downloaded goods was approximately US\$42 per downloader with an estimated loss for the industry of more than US\$34 billion (only software and music, pirate movie files were omitted for this calculation). However, this figure is only a very rough estimate, as there was made no differentiation between types of files most frequently downloaded for each country. It is something which may have a significant impact if it differs a lot for countries with a high or low download frequency. Nor was the potential positive impact from music and software sampling that later leads to purchase of the product investigated. Most users would probably only buy a small fraction of what they download if it was not available for “free”, the actual loss may be debatable.

## ***Indications***

First of all it has to be pointed out that while enquiries in different geographical and social incomparable parts of the world necessarily will indicate different trends, the main problem shines through as the results mainly depend on how the data is interpreted. Some investigations will “prove” that illegal file sharing is bringing down the industries. Others show to the contrary that online sampling is one of the better advertisement channels and “undoubtedly” enhances business. Regardless of who gathers the data, in which ways the figures are examined and how the data is presented, three criteria seem to stand out as essential:

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<sup>23</sup> Internet users from approximately 90 countries were selected as sample basis

- Price
- Availability
- Quality of service

All will have significant impact when it comes to influence piracy for digitalized media (film, books, music and such), software as well as bundled versions (physical editions) of these products, and seem to be notably more crucial when fighting infringement of copyright than any content protection mechanisms. While introducing excessive DRM management schemes and may seem beneficial for the computing industry (especially to those profiting from providing modules to assemble such systems), “it is apparent that focusing purely on enforcing intellectual property rights will have limited success. In the fight against piracy, the legislative and educational weapons may win a few battles, but the overall war against piracy cannot be won without addressing the current draconian pricing policies.” (Gopal and Sanders, 2000) While this statement was made in respect to the problem with software piracy, the same mechanisms will have the same kind of impact on piracy of other products as well. When applying the results of the initial software piracy study on the newer problem with illegal copying of music, the same researchers concluded that “price of music and available bandwidth are found to have significant effects on piracy. The price impact becomes more pronounced as technology improves” (Bhattacharjee et al., 2003). Although the affected industries are fighting file sharing on the internet with all means they find suitable, it seems that most independent researchers and observers find this warfare be a symptom of corporations simply not accepting the fact their old business models need extensive overhauls. Even Keith Jopling, head of market research at the International Federation for the Phonographic Industry, recently “said he believed that new [legal] download services such as *Napster*, *iTunes* and *Rhapsody* had fuelled a resurgence of interest in music” (Waters, 2004). After some years of declining music sales, the trend seems to have been brought around this year. The increase in CD sales has been particularly good in the United States, and from sales figures for the first three quarters of 2004 many believe that online download services enhance the popularity of music products in general. And this trend is subsequently leading to an additional rise in sales of other long-established products.

DRM in any form, whether it is in form of technical implementation or legislations supporting the requests from the industry, business problems such efforts aim to improve are very much the same as faced many times before. The difficulties have been tackled by the same industries now setting an almost unjust focus on the issues, as well as by other branches.

Ironically, from previous struggles it may seem that the businesses came out most successful when the initial battle concluded against them. In light of history it is easy to suggest the apparently easiest approach: “Just let the whole thing blow over...” Still, for many it may be difficult to envision the potential profit of the future, when turmoil has settled and they are yet again controlling their own business. Instead, the focus is entirely on the opportunity to make money on forcing customers into restrained behavior rather than adapting business in the direction of what consumers embrace. While actors try to control the commerce as they see it beneficial, there are strong indications this effort may strangle growth of newer business patterns where even more money can be made. Downloading almost unlimited amounts of digital entertainment, legally or illegally, is exceptionally popular amongst internet users. Despite this, the principal rule of business – “The customer is always right!” – does not seem to apply for the music, film and partially computer industry as well.

Many people who frequently download pirate copies of music, films, software and games do it simply because it is available. It is a matter of availability, and in reality most of what they download would not have been collected if they had to pay for it in the first place. For others it can simply be about getting hold of ‘lost’ productions, i.e. those CDs and movies that are out of print and difficult to get hold of. Another important aspect with copying files or converting them into portable formats is the ability to listen to music from a computer or a portable device. To quote a comment in Communications of the ACM: “I’ve copied all my CDs to my computer and often listen to music from the computer. I have been buying more CDs than I have in years. It is the convenience of converting and copying CDs into MP3s that has increased my buying of CDs.” (Ressler, 2003) Even if piracy may lead to lower sales, although research indicates it does not, it is important that especially the music and film industries realize that this kind of customer behavior does not exclusively mean lost revenues and bankruptcy. It may also prove to be an important sales channel in the future. Though free music is a nice carrot if you just want to sample, nothing you download can beat a printed album. Despite the fact that near-perfect copies of songs can be downloaded for free, many will prefer to still buy the album. Which shows it is a lot of value for the customers in what comes with the music. The same line of reasoning applies to videos and full-feature DVDs with additional features, computer games with thorough user manuals and software that will actually upgrade properly.

## EMERGING BUSINESS MODEL

*"My son, ask for thyself another kingdom. For that which I leave is too small for thee."*

*- King Philip of Macedonia, 339 BC, to his son, Alexander*

Being a bit conservative is usually a safe approach, as the likelihood of total failure is almost absent, as. It may be foolish to start gambling while the marked situation is still being established and the business is operating in unknown territory. For many digital contents providers, making money seems to be about keeping things the way they used to be, and dominate in marked areas where their business has already grown strong. Still, a lot of what is seen in cases regarding online distribution of multimedia, especially when it comes to music and film, cannot be viewed upon as anything other than desperate attempts to maintain marked dominance in a outdated business scenario (Orlowski, 2004b).

“It is interesting to examine a somewhat analogous situation that arose in the 1400s with the invention of the printing press. The church had nearly complete control over the Bible—handwritten copies were kept chained in the church—as well as its interpretation for the masses. The publication of the Gutenberg Bible took that content, translated it into a lay language (an open standard, relative to Latin, if you will), and made it available for reading and interpretation by the public. Surely the church must have resisted this loss of control of content. But looking back from our time, would anyone think to argue that any church should control the distribution of the Bible? We all know that it is available free for the taking in hotels while remaining a best-seller, and see no contradiction there. Can such a happy confluence of free distribution and profitable sale be conceivable for the music industry?” (Easley et al., 2003)

The same question is examined by Stanford professor William (Terry) Fisher<sup>24</sup> in his book “Promises to Keep: Technology, Law and the Future of Entertainment”, and his answer is: Yes, it can. The book presents results from research conducted over more than three years, examining business profiles and distribution models for record companies and the influence from online exploitation of their products.

In order to explain the ‘Alternative Compensation Model’ model Fisher presented in chapter six of the book, it is necessary to look into distribution of public goods. These are characterized by being:

- *Non-rivalrous*:  
Enjoyment of them by one person does not prevent enjoyment of them by other persons

**And**

- *Non-excludable*:  
Once they have been made available to one person, it is impossible or at least difficult to prevent other people from gaining access to them

(Fisher, 2004, p 1)

As these services are important, governments have commonly adopted the some of the following approaches to ensure they are provided:

1. The government produce the goods or services themselves (e.g. most military forces)
2. Private companies can be paid to supply the goods or services (e.g. private companies are hired to provide regional and national public transportation)
3. Research and development is encouraged through e.g. scholarships, and rewards are given to those making their results publicly available (e.g. science awards and competitions for inventors)
4. Suppliers of public goods or services can be granted monopoly rights, protecting them from further competition (e.g. patent and copyright laws)
5. Companies providing public goods or services are allowed to keep secret the techniques they use to create it (e.g. laws against industry

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<sup>24</sup> The authors full name is William W. Fisher III, but he is often referred to as Terry Fisher even in official press releases



espionage or using other unacceptable methods to reproduce the inventions)

(Fisher, 2004, p 1-2)

For entertainment, most of the business models these industries have relied on derive from the fourth alternative, where the artist and the production company are granted exclusive rights to the story or composition and the realization of it. Examples of this are the copyright of a script and the movie made from it, or a song itself and one specific recording. Advantages of such a model is that even if a company only profits from certain productions, these will likely generate enough earnings that some of it can be channeled back into the progression of new talent even if only a handful of them are likely to succeed. The drawback is on the other hand that customers have to pay for access, and the price of such products can often be kept unnaturally high. Additionally, there may be imposed rigorous restrictions to how these purchases can be used. Access-management mechanism do at times become access-denial systems while fair use and fair dealings are being suppressed. As internet makes it more difficult for artists and record labels to and put their copyrights into effect under existing laws, further limitations have been added and this is making current business models draw nearer the fifth alternative (Fisher, 2004). This has the downside that direct and indirect access and reproduction becomes even more expensive.

### ***An alternative approach***

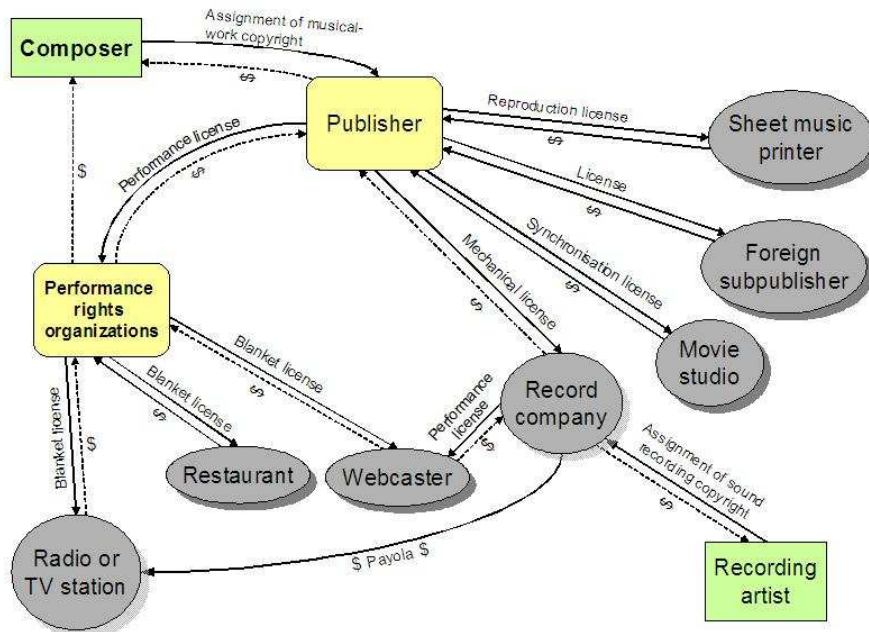
Instead of adapting to a world with restrictions on how material is allowed to be enjoyed, William Fisher suggests a radical change: As an alternative to governments giving legal protections against users access to entertainment, there should rather be established a reward system for those producers who place their material in the public domain. This adopts the third policy, granting free access for the public while the creators are rewarded through general funding for their efforts. The argument is that even if the users pay only a little bit compared to how valuable they find a service, the providers will make good profits (Fisher, 2004, p 1). Contrasting the current situation, entertainment could be legally accessible for free, and consumers would have right to use more products for less money at the same time as the content owners could make their business even more profitable.

The main line of reasoning is the prospect that all can benefit from it; the social value will be greater, digital recordings can be used much more conveniently, the burden on the justice system<sup>25</sup> and litigation costs should drop, artists may benefit from being less dependent on record companies and movie studios, distribution costs are almost guaranteed to decrease and entertainment will potentially become more diverse. “Schoolteachers, civil-rights activists, and university-based research scientists, for example, all confer on society gains that vastly exceed their incomes.” (Fisher, 2004, p 8) Hopefully the same would happen to those making recorded entertainment if the compensation becomes more socially fair. Instead of the situation today, where a minority of artists bring in most of the total profit, the earnings can be distributed more evenly and as a result more artists will be able to present their talent. Even if some performers will suffer, art enthusiasts overall will benefit immensely.

This model derived from one similar in the work of Professor Fisher (Fisher, 2004 - Figure 6.2, p 10) illustrates the most likely changes in revenue flow for the music industry if the sales is supplemented by free flow of digital music:

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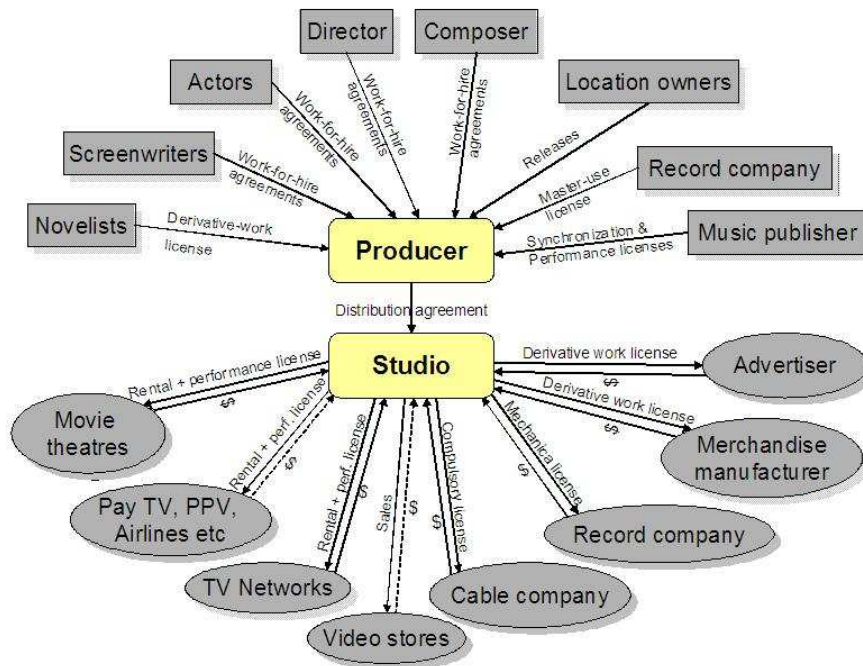
<sup>25</sup> Norwegian IT expert Gisle Hannemyr is critical to how the entertainment industry skips investigation queues and undermine normal police procedures by using private investigators: <<http://www.nrk.no/nyheter/okonomi/3934773.html>>



**Fisher: Changes in revenue flow – Music**

Dotted lines indicate an observable reduction in the flow of money, while solid lines denote little or no change at all. Basically this shows that sales of music bundles like CDs is likely to go down, as more people may utilize the increased availability of online music. Additionally, audience may substitute music broadcasts like radio and web-streaming with permanent downloads.

Fisher also illustrated in a similar way how the paradigm shift is likely to influence the film industry (Fisher, 2004 - Figure 6.3, p 13):



Fisher: Changes in revenue flow - Movies

This business is likely to be even less affected than the music industry, also in terms of magnitude. One possible reason for this is that for the time being, satisfactorily fast broadband connections are not yet widespread, and most internet users do not seem satisfied with long loading time and relatively low quality for the films. Compared to how music is enjoyed, another reason may also be with the way films are screened: There is a major difference in terms of both film and sound quality, as well as surrounding facilities, between going to the cinema or watching a digital reproduction of the movie at home. The same production will award distinctly different experiences.

### Compensation

In order to set a reasonable compensation level, Fisher uses year 2000 (the last year of the continuous growth in revenue for the record industry) to estimate losses from decreasing revenue through these channels and

approximate the value this will amount to for the music and film industries. A cautious assumption that the record companies may lose approximately 20% of their gross returns and the movie studios about 5% of theirs “produces an aggregate figure of \$1.736 billion” (Fisher, 2004, p 11-14). Another calculation using the same rationale was carried out by Andrew Orlovski as well, ending up with a compensation of “\$1.677 billion to keep the RIAA and the MPAA happy” (Orlovski, 2004a)<sup>26</sup>. To accomplish this in America, one of the following alternatives could be carried through:

- Pay \$2.4 billion extra in taxes each year (which adds up to roughly \$27 per household)
- Sales tax on recording and playback devices, including blank discs (but this alternative may have some unfortunate side effects when it comes to customer behavior)
- Taxation of the distribution channels like P2P networks (then again, they make most of their profits on advertisement and it would seem better to rather introduce taxes on advertised products)
- An additional fee on internet connections (less than \$6 a month per subscriber should be enough to cover the entire compensation cost)

As internet users are the ones most likely to take advantage of this new system, the last alternative seem by far to be the fairer option. And considering a DSL subscription to be about \$50+ a month, an increase of roughly 10% should be a reasonable disbursement for unlimited music and films.

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<sup>26</sup> This article is a presentation of the work by Professor Fisher.



## REFINEMENT

*"We all knew from day one this mumbo jumbo wouldn't fly"*

*- 'Fidel Castro'*

*(Castro about communism, in 'The Simpsons' episode "The Trouble with Trillions")*

Piracy is an old phenomenon and, as already concluded, the only issue about it that has changed in the recent years is its distribution channels. And those will continue to change, in particular because of the immense unfolding of wireless computer and high-bandwidth mobile phone networks. Internet has been around for quite a few years, and despite depressing prophecies from the affected industries it may seem that the net revenue is rather on the incline than decreasing (RIAA, 2004). The smart approach by those making money selling digital content is probably not the one where they try to tie down any opposition by brute force and legal empowerment. Rather adapting to the current behavior of customers and offering better products and services at competitive prices. Meaning that online file sharing communities and P2P systems could be treated as business competitors instead of attacked like enemies. While file sharing is usually free to use, most of the networks are inconvenient and involve a lot of effort from the user. Although this does not take into account that broadband connections are still relatively expensive, unless you are transferring large amounts of data. Additionally, access to any kind of free digital entertainment will usually require a lot of patience as there are many users queuing to copy from the same sources and no guarantee for files not being corrupt. Problems many would be thrilled to avoid if there were better alternatives at a reasonable cost. Because humans, and in particular computer users it seems, are lazy and convenience is reasonable to pay for.

For those appreciating freedom to do what they want with their music and films, little could be better than a business scenario where unrestricted downloading and sharing of such data was legal, convenient and new material was conveniently available at a low cost. At the same time the artists and organizations providing the necessary marketing and distribution infrastructure would be fairly compensated, and this situation is obtainable through the model Professor Fisher advocates.

Digitalized entertainment being shared freely with the blessing of the copyright owners seems a smart approach to a state of affairs inevitably being established. People can access almost unlimited amounts of data at the same time as the copyright holders presumably make even more money than from selling restricted access to their works. Ultimately an almost perfect win-win situation, it seems. Compared to the present situation it clearly set out, convenient, fair and even has the potential of increased profits for the content industries. His ideas may function well for a major scale domestic market like the U.S. But as mentioned, there will be problems with cross-border leakage and foreign lechers exploiting the system. Unless there is a calculation of the compensation at an international level, the efforts of setting up the system is flawed. To show examples, European customers will most certainly want American music and vice versa, in the same way Australians want Asian films and Brits want French music (Fisher, 2004). File transfers from across borders is especially important for small countries, as they will have very little content to contribute with. For them there is no point in limitless downloads of digital music if only domestic artists can be downloaded. If the money to balance the lost revenue of the entertainment industries is raised at a national level, there is very little chance America is willing to subsidize users from the rest of the world. Attempts could be made to limit access to national IP numbers, but prohibited file trading would most certainly take place via unofficial channels. The situation could end up becoming much the same hunt for music and movie pirates as the situation is today. In the same manner there would surely be ISPs offering domestic addresses to foreign customers, a practice which would probably be more difficult to render illegal. There is little point in adopting this business model unless the situation for retailers and customers of digital content is in reality improved.

More problems can be added to this puzzle, as chances are governments in some of partaking countries will try to pose further taxes on e.g. downloading or use of the available material, in addition to the registration fees and levies on the playback devices. Unrestricted, free distribution of material is a key factor to the chances for success. Therefore, imposing costs that in reality taxes the foreign content without any compensation to the owners will in all probably make copyright owners less willing to publicize their material. And again, America and its music and film industry is financially supporting those making significantly smaller contributions. Although it is obvious that the flow of data will be imbalanced, U.S. music and movie production being substantial and very popular, unmistakable exploitation will not go down without a fight.



Despite the fact that the system Fisher puts forward has the advantages of more entertainment made accessible at less cost, customers will be free to handle their music and films as they like, income for artists will be more stable and that it will put a stop to the extensive illegal activity, there are also some significant flaws to it. First of all, establishing a functional recompense system seems extremely complicated. The fact that Fisher uses more than **ten** times as many pages discussing compensation models than he did actually presenting and promoting the models themselves, should serve as a strong indication to how difficult it will be to carry out this alternative.

The suggestion is to set up a government agency that raises the revenue now being generated through sales and licenses, similar to the role copyright offices have now. Such a system is likely to be burdened by high cost and consequently high registration fees and unless an international supervision agency is established, one has to deal with lack of compensation for files transferred across borders. Setting up this system to conquer the problem of internet piracy in the first place, seems paramount to solve this challenge.

Any compensation method has to ensure that “each artist’s share of the pot [is] proportional to the total value that, during a given year, consumers derived from his or her creations” (Fisher, 2004, p 23). The current business model is based on customers buying the entertainment they like. With everything free to everyone, a new way of quantifying popularity must be established. Using the proposed system, it would be fair to expect the rate of sampling, where the user downloads a track and subsequently deletes it for not being to his or her taste, will escalate. Furthermore, some of the files that are kept will be played a lot more frequently than others. These are some of the challenges to measuring how popular individual productions are. Both rating by use of random user polls or watermark surveillance seem easy to manipulate. Additionally the latter method, which seems far better for correct feedback, is burdened by the numerous ways of attacking this technical implementation. Fisher compares the potential of such tracking to be barcode catalogue systems and purchase bonus cards used in the grocery industry to analyze sales of different products and customer habits (Fisher, 2004, p 4). However, there are fundamental differences in registering the sales of physical products and keeping track of playback when files can be copied in unlimited numbers and used on devices that may never be in contact with a calculation server. The results from probing a set of users, i.e. monitoring the actions of each individual closely, will be very dependent on what kind of users there are in the test group. Extracting valuable data becomes even more intricate for derived works, composite productions and spin-off merchandise. The suggestions Fisher comes up with seem only to barely scratch the surface of this puzzle.

Another significant problem with this model, and this is perhaps the reason that it most likely will never become more than an elegant proposal, is that it forces control out of the hands of those industries currently making a huge profit and into the hands the ones habitually trading files on the internet, i.e. the same ones who are willing to spend time and effort into getting the recordings for free rather than paying for the product the industry is promoting. Despite a change could be advantageous for both all parties, the content providers are not likely willing to offer their products at the terms of their adversaries. Bearing in mind the proposed alternative is very much about making their material available more or less for 'free' and compensation model actually channels money away from the record labels and movie studios.

There is a set of arguments to imply that this proposed future will not happen:

1. The industry is not likely to give up control over their successful products, even if their business models are becoming outdated and control of their material is increasingly difficult to accomplish as new technology emerges.
2. Instead of adapting to the market, the industries may as well try to force it into their preferred business model. So far this approach has proven to be quite successful, at least in the short term.
3. Politicians seem more than willing to comply with the requests from the industries.
4. Even if argued that revenue is guaranteed at current levels, the record and film industries would probably not want to settle for these numbers when there is a potential for increased revenue through conventional sales if piracy is constrained.
5. Technical companies are developing DRM systems necessary for transaction of other types of data, claiming the same technology will provide the means to protecting the existing business models of the entertainment industries

Of course, politicians could implement such a compensation model, but as long as RIAA and MPAA have stronger influence on the legislative bodies than the other way around (Fisher, 2004, p 40)<sup>27</sup> this is not likely to happen.

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<sup>27</sup> Although this one case is only an example, relevant laws passed recent years can be reviewed to recognize that this is an ongoing trend.

Record labels and movie studios have for years been dependent on business models where they have had strong control over their productions. One can assume they do not want to suddenly be bypassed and have their revenue determined by some bureaucrats, in a scheme that could eventually pull the plug on their market. Despite strong indications from independent researchers that online file sharing may be more beneficial for sales than it is actually hurting the content industries (Oberholzer and Strumpf, 2004), their representatives seem to persistently rule out this possibility (Vance, 2004).

In other words, there are many factors and partakers encouraging to retaining the situation like it is now and has for years. Unless politicians enforce a new business model, there are little prospects of this radical change. Albeit this may seem somewhat apathetic and very little innovative, which it of course is, the point is that in order to adjust for such a fundamentally different business model, the most prominent participants have to lead this process. Without an industry accepting a socialistic business model, it stands little chance of success.



## **SUBSCRIPTION MODEL**

*“Consumers are meant to **ignore** higher sales of cheap CDs, a sour overall economy for the last three years, lawsuits against consumers, a price-fixing scandal, a Harvard study that shows no line between file-trading and lower sales and **believe** that piracy is driving a slowdown in overall music sales. Makes perfect sense. No wonder the RIAA is agonizing over increased recent revenue.”*

*- Ashlee Vance (Vance, 2004)*

An alternative arrangement for distribution of digital entertainment that is more likely to be successful is a **subscription model**. Although subscription based broadcasting of entertainment is a familiar content distribution channel, the business model is very much the same as in the retail of physical products like CDs and DVDs. As an example, subscribing to pay-per-view television grants access to channels, on which the networks decide what is broadcasted at a given time. In that way these services are not much different from free television, except that by paying subscription fees one avoids the advertisements. If you decide to keep any of the programs or movies you watch, this is generally accepted as fair use, as long as the recordings are not re-distributed. For subscription to digital broadcasting services, this works in similar manners. ‘Rhapsody’, one of the more popular online digital music services, charges US\$9.95 per month in subscription fees, granting the subscriber access to all of their more than 800’000 tracks. In addition they have more than 60 advertisement-free online radio channels and even offer the facilities for the user to set up play lists with favorite tracks from the collection of songs.

The major difference between analog and digital subscription services is that the latter is protected by stronger legislation, and if users want to make a copy of the music or movies they stream, this usually comes at an additional cost. For Rhapsody, the price for burning a CD is 79 cents per track. In addition to the broadcasting, what this service in reality provides is convenient access to a large selection of digital music, just like a record store. The only difference is that the selection is a lot more flexible. This

way the subscription services currently work in much the same fashion as the business model for physical sales, except that the customers produce the actual hard copy themselves.

If someone wants to pirate this content, the situation is exactly the same as with digitalized music and films distributed in physical bundles. Therefore a new distribution system should make this less convenient and additionally less beneficial. One alternative is to set up a subscription model in a manner that discourages illegal reproduction and rather beat pirates at their own game, instead of conducting pursuits which in the longer run are most likely futile. By taking on some of the general ideas from the taxation model Fisher promotes and combining those with the current online distribution mechanisms, it is feasible to establish a system that is beneficial for consumers by providing more entertainment legally available at lower cost and at the same time grants appropriate compensation for the content owners. Even better, by offering online access to their recording and movie catalogues the industries could establish more direct marketing and distribution of their products. Thereby the revenue would potentially increase, as more sales would be generated through channels where the distribution costs are low.

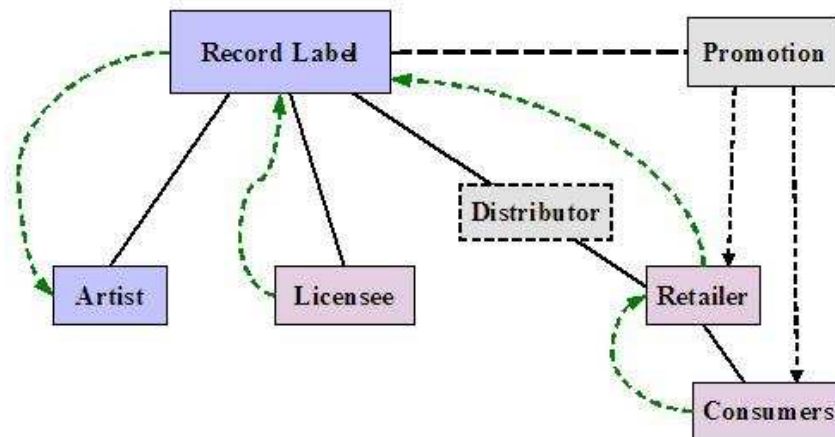
The better approach seems to be that the copyright owners set up the subscription service. This way, the content owners decide themselves in what ways distribution of the content should be controlled. That is, if they choose to impose any restrictions on the files subscribers can download. Furthermore, once the necessary infrastructure is set up and the product catalogue is made accessible to customers, e.g. on a web page, operating expenses would be very low.

To give an idea about the subscription based business model, a general overview of the alternative business approaches to retail of music will be demonstrated. Only the core entities have been included, and most real cases will, of course, alter from these examples.

As a guideline to the illustrations:

- Solid black lines indicate formal, necessary business relationship
- Green dotted lines show significant payments
- Dotted black lines indicate an informal business association or an optional role (i.e. outsourced tasks)

## *Present situation*



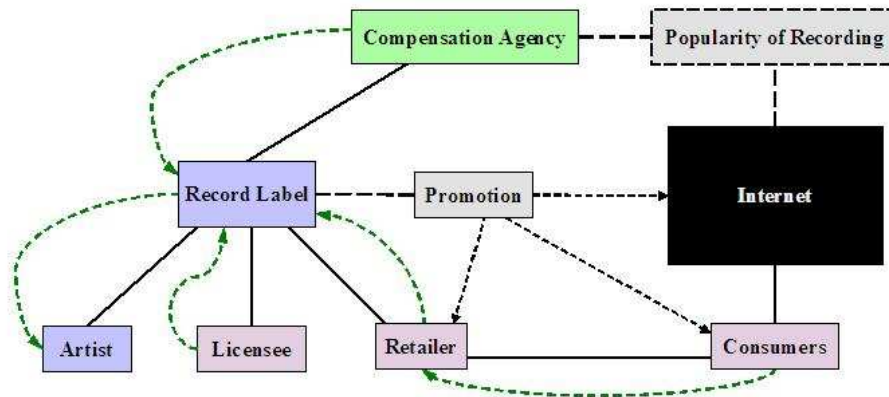
**Present Business Model**

A record company commits to a contract with an artist, stating it will provide financial support for recording and production of an album, and additionally promote it when the album is finished. After the music is recorded and the CDs are printed, retailers buy the finished product from the record label, or more commonly their distributor, which in turn pays the artist a percentage according to the contract of the income from record sales. Additionally, the record label can allow licensees like radio stations and television networks to play songs by this artist, and for each time they do a fee is paid to the record label. Again, a percentage of this income is forwarded to the artist.

In this model, retailers can also sell digitalized versions of the song on internet. The main difference from selling physical copies being the way the record label is compensated, which is more similar to the management of playback licenses.

For independent artists, the business scenario is the same except that the artists themselves have to carry out the tasks of the record label.

### *Alternative compensation model*



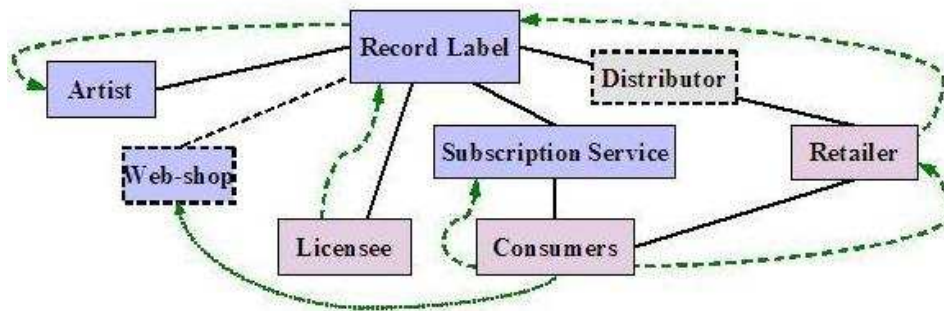
#### **Government Administrated Compensation Model**

With the governmentally administrated compensation model, much the same situation applies. The artist and the label commit to a contract, and the label manages retail and playback license revenues as well as promoting the artist. In addition, a government agency measures the popularity of each individual recording, and corresponding returns from taxation are re-distributed back to the record label. As with all other income, a percentage of this is forwarded to the artist.

However, if an artist chooses to register a recording directly with the agency instead of signing with a record label, the compensation is paid directly to the artist.



## Subscription model



Subscription Model

Like in the previous models, the relation between the artist and the label is the same, as well as between the label and conventional sales channels. What is unique in this approach is that a large share of the distribution is carried out directly from the label to the customers via a subscription service. Additionally, a parallel web-shop for physical bundles like CDs and DVDs could be run, as the record label will have to establish infrastructure for the subscription service anyway. Though, this addition is not central for the distribution model.

In general this model could allow customers to gain access to large quantities of digital entertainment at low costs. In the study of similarities and unique characteristics of online music sharing and software piracy “Digital music and online sharing: software piracy 2.0?” it was found that “users with high-bandwidth connections (via cable modem or DSL service) indicated they were willing to pay over \$10 per month for an online music service, while those with slower connections (56Kbps modem or less) were willing to pay about \$5.” (Bhattacharjee et al., 2003) Although this seems to be very similar to existing subscriptions services, by using the calculating of required compensation by Professor Fisher the record labels and movie studios could vastly extent the impact of their service. Instead of focusing on how to protect it contents from pirates, the entertainment industries should exploit their opportunity to offer a better and more convenient product at low enough costs to make their legal alternative competitive.

Alike the government administered compensation, a subscription system controlled by the content owners would be able to provide freely available digitalized entertainment, conveniently and at low costs for the users. The main difference between the two business approaches would be the way proprietors were compensated for allowing the public to access their works.

The obvious way of generating income seems simply to be by requiring a small subscription fee to be paid for access to downloadable files, and by providing a service that is significantly better than current alternatives. As an alternative the revenue could be raised from advertisements on the subscription service webpage or bundled with the downloadable files. Instead of blocking the content, value is raised by adding features people will pay for, such as better quality of the recordings, exclusive material, special information and features to search for and download files conveniently (Karp, 2003). As an example of a successful approach, the internet pornographic industry makes use of subscription models to distribute their content. Rather than fighting piracy, they flood all available channels, e.g. P2P networks, with advertisements and samples, as well as posting free sample products on their websites (Buckman, 2003). This is low cost promotion, and has proven valuable even for a product that is not appreciated by most people. Even if the promotion methods make massive amounts of their product easily available for free, customers still find that access to material which is well arranged and frequently updated, and not least less burdened with annoying ads, is worth paying for.

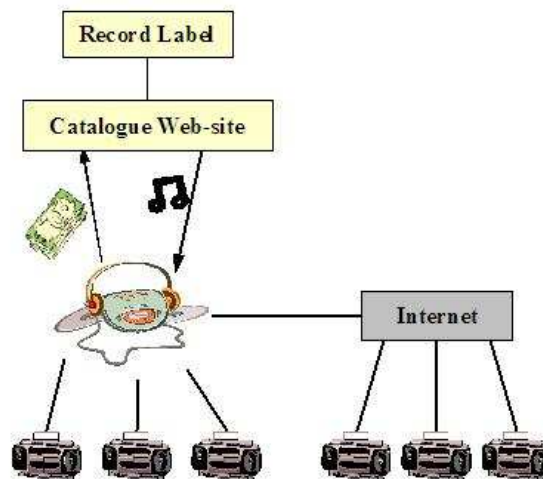
Far too many content providers simply see internet as a problem and responds to it by putting a lock on their material, trying to prevent access to it. Few view it as an opportunity. Despite **very** few people inclined to pay for pornographic material compared to those willing to pay for music and films, it is still an expanding business. For pornographers, very little money is to be made in other parts of business than continuous production, owning the rights and distribution. To the contrary, there are countless bi-products for film and especially the music industry: Proper bundling of contents (CDs, DVDs), music scores, rights to shows a production like a theater play or a musical, audio-biographies, broadcasting on radio and television, direct distribution channels online (streaming and downloading), playback devices, clothing and concerts, to name some.

Some of these business approaches should be adopted by in subscription services provided by the music and film industry, as would be both beneficial for users as well as content providers. There are alternative ways of arranging such services, and profiting from increased distribution of their

products should be a lot better than ongoing war against people occasionally sharing files.

### ***Alternative subscription systems***

#### **Free use**

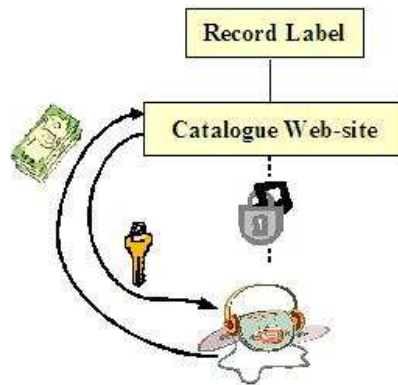


**Free use of download**

There are different alternative business models when carrying through the subscription model and the most radical one is a service which sets no limitations to how the user handles the downloads as long as payment is made to access the service. The file can be transferred to any to as many devices of which ever type the user wants. As long as files are made available in a standardized format, the key marketing point with such a model is that this will be easy and convenient for the users. Thus, this approach is likely to gain popularity quickly.

Obviously, if the industry adapts such a model, the piracy issue will still maintain because downloaded files are unrestricted and can easily be re-distributed through unauthorized channels. However, if the service is superior to that of the unauthorized channels, the assortment is excellent, and users are only required to pay a small subscription fee, this alternative will likely be the most appealing service. Value that comes in addition to the main downloads, like information about the artist, communities and relevant linking to similar products, would also make the service more appealing. In turn, this means that many users would migrate from the poorer piracy networks to the legit subscription services. Revenue lost because of piracy could also partially be promoting merchandise related to the main product on the heavy trafficked subscription sites. Seeing that many people still prefer bundled music on e.g. CD or DVD, this can also function as an indirect distribution channel for such items. If a web-shop is running parallel to the download site for subscribers, increased popularity for the unlimited and unrestricted downloads is likely to be reflected in increased sales of those products as well.

### **DRM enforced by software**

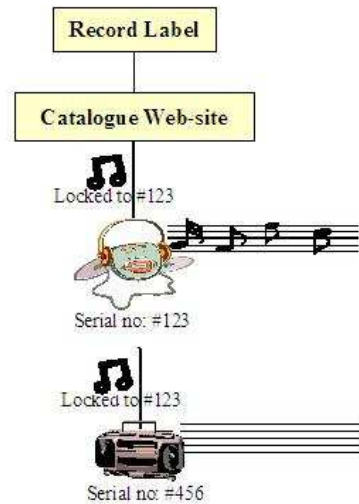


**Use of download limited by software**

If the content owners require some protection of how the downloads are handled, one alternative is to distribute the files as encrypted, so that a secret key is required to unlock. As only the subscriber has access to this key, only this user will be able to playback the downloaded media.

Another alternative is to lock songs into a specific file format, making redistribution less convenient. Then again, this may lead to a potentially harmful fight amongst providers to having the most popular format. In turn, only a few devices will support each format and customers may only obtain their music and films from a single or very few providers. With such limitations the system may prove to be less popular and consequently less successful. Still, if the user does not want to download pirates or make illegal copies of streamed media, the other option is pay-per-song download retailers like iTunes and MSN Music. This is because most subscription services also adopt this retail model if a subscriber wants to make a copy for playback on another platform there is an additional for each song. Hence, the approach outlined in this alternative for a new subscription model will from a user's point of view still be better than current services, even if downloads are hampered by in-transferability. Though, in reality the copy prevention mechanisms will not be more secure than any other means of security by obscurity, and will likely have little impact on piracy.

## DRM by tying the downloads to a specific devices



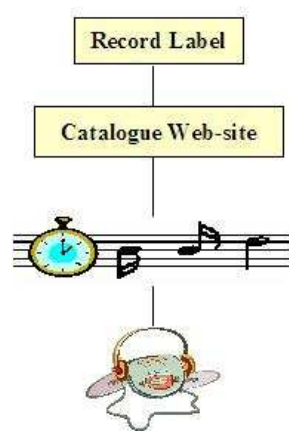
### Download licensed to a single platform

A different method to protect downloaded files is by authorizing only one player or a predefined set of devices to playback the file. This could be facilitated by granting a subscription license based on e.g. the serial number of the player on which the subscriber is going to access the files. However, this will require standardized playback devices, because they must be able to authenticate themselves by serial number or another means of identification before playback of a downloaded file is allowed. An alternative to this method is to provide a specific playback device for each subscriber, and lock down downloads to this piece of hardware, although this comes at a higher cost for the service provider and consequently higher subscription fees.

Tying the license to the player is more secure, assuming the encryption of the file is not breached, as alternating hardware generally costs more and requires more skill than circumventing software protection mechanisms and conducting such efforts is done at the risks of destroying an expensive unit. All the same, the security depends mostly on how the security mechanism is installed in the player. E.g. some computer game consoles have a chip to

authenticate original discs while rejecting copies. By replacing that by an artificial one, it is possible to alter the console so it can run illegal pirate games. Still this is a too big and risky effort for most users and they simply do not bother to carry it through.

### **DRM by lifespan of the downloaded file**



#### **Download valid for a limited time period**

The alternative of protecting downloads to be reviewed is by making downloadable files valid for a specific time period only. The main reason for using time-stamps is that it opens for some new business approaches:

- Subscriptions for digitalized entertainment could function in a fashion more similar to a rental, with different prices for a day, a week, a month or even permanent purchases if desired.
- A sales pattern similar to normal retail can be adopted more easily, with diverse price approaches made for new hit list songs, old songs and classics.
- As well as offering bundles of music at discount prices, although this is already common for retail of physical goods

Even subscription for a method could be offered at a very low fee, as the default timestamp of a file could be of such short duration that it would function more similar to streaming of data than actually obtaining a file. While each download would be at lower returns for the provider, the number of transactions for which the subscribers had to pay an additional fee should be gainfully high.

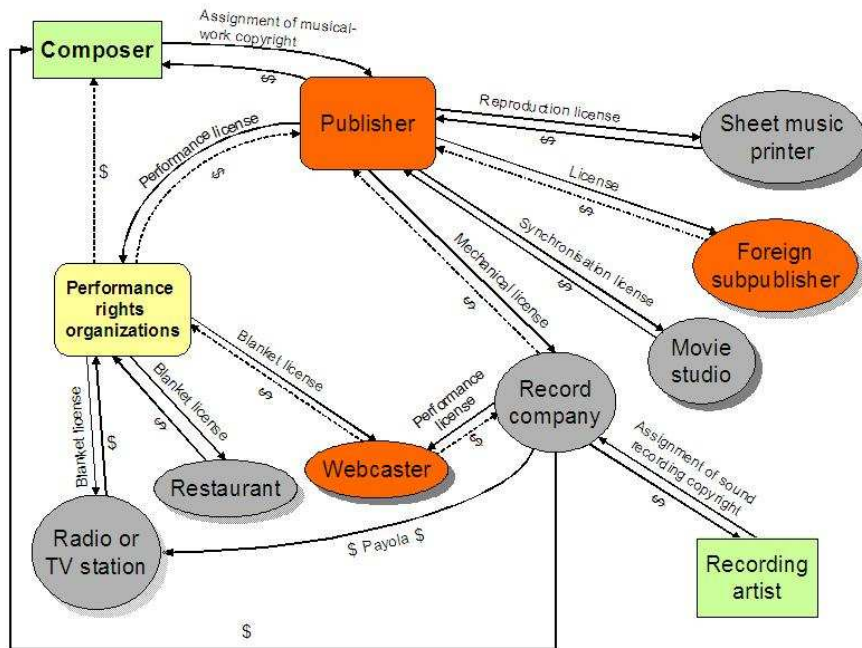
This approach approves the fact that many people only listen to presently popular music or a certain set of favorite songs. By offering such a pay-as-you-listen service, most casual users should find this service attractive. If music collectors should also be embraced, downloading permanent versions should also be made convenient in a way similar to online music download services today.

Although this model has some positive features, there are drawbacks as well: If the state of a time-stamp is the only information needed to be manipulated by a potential pirate, this scheme seems easy to circumvent. It also seems like a file can be re-distributed for free within the valid time period unless some other means of protection is applied. Additionally, the model appears complex and the way differentiated prices is management may be confusing. It also introduces the concept of rather renting music instead of owning it, which may be difficult for the customers to accept.

### ***Consequences***

With the subscription model these will be two general options to raise revenue to cover the loss from potentially less sales: A subscription fee or by advertisement. For both of these options it seems likely that either alternative should generate enough revenue to compensate for a potential loss in sales, although the financial validity of this claim is not investigated thoroughly.





**Music revenue for Subscription Model**

Compared to the model suggested by Professor Fisher, the subscription model will influence some of the same revenue flows. People will buy sheet music and the printer will still have to pay the publisher for license to reproduce the works. Movie studios will pay for using music in their films, restaurants would still broadcast their CDs and people will certainly not quit listening to the radio or watch TV. Although Fisher has a different view on the latter, as he believes radio and TV stations may be inclined to broadcast less music.

However, publishers will most likely lose parts of their income, as the record labels will have their own publishing and distribution channel with the online subscription service. Even if the general interest in music rises when customers get better access to available recordings, it is likely that more customers will transfer from purchasing CD over to downloading the music. And as the labels will distribute their recordings on the internet themselves, it is likely that web-casters will become less popular and thereby generate lesser fees. The composers and the artists will on the other hand get more money in total, as the increased revenue from the subscription service should exceed the loss in conventional sales by far.

For movies, on the other hand, the two distribution models will have the same affect on the revenue flows. Although there is a chance that free downloads will make cinemas less profitable, as people get better home entertainment systems, though this is unlikely to happen before the quality of the downloadable files draw near the quality of current DVDs. One can assume the same line of reasoning also applies to the alternative compensation model.

## FUTURE

*The threat to the music industry is not MP3s, but the arrival of a consumer distribution channel that is not controlled by the music industry.”*

*- Jeremy Silver (vice president of new media, EMI) in 1999*

Top range portable devices are not only able to playback good quality sound, but in a similar way they display still pictures and films. Nowadays many of these may be considered too expensive high-tech novelties, but in the near future large capacity discs, music players, movie systems, broadband mobile networks, wireless internet and other kinds of elaborate technology may be embedded in almost any portable techno-gadget. The next generation of sophisticated articles will come at prices making them as commonplace as portable phones and music players have been for some years. People will be sending songs and movie clips as frequently as they are sending text messages today. A scenario that is certainly not many years ahead, as sending ring tones, pictures and small sound clips is already done with multi media messages on the mobile phone networks. Even streaming live images with handheld videophones will become feasible. Necessary means are already common in some modern mobile phones, only hindered by mobile telephone network companies not having the ability to offer necessary bandwidth at reasonable prices yet.

Just imagine how important it will be to control the development of such functionalities! By that not necessarily suggesting investments in hardware research, but emphasizing how valuable it will be to control the flow of information on such devices. When portable multimedia players become as ordinary as cell phones are today, as well as the phones developed into more or less comprehensive media centers, imagine what a powerful business tool it will be to provide content to such portable sources of entertainment. Supposing the devices will be versatile much like modern computers and easily adaptable to suit individual users, the potential range of content is only limited by the imagination of service providers. As people generally are lazy and happy with what is provided for them, at least as long as the

quality of the content is adequate, those controlling the salable entertainment have a major head start in the competition.

The present attempts to stop leakage of data may be semi-successful for a period of time, while the media has to be downloaded onto a computer before copied to a portable player. Having a leading role in the development of the new DRM enabled platform, Microsoft is already exploring methods on how Windows users can be prevented from re-distributing downloaded files (Anderson, 2003). And as Windows is by far the most commonly used platform, restraining these users will have a major impact for the time being. The same goes for Apple, looking after their iTunes online music retailing service. Only the UNIX / Linux minority may pose a joker. However, if the DRM scheme suggested by TCG becomes the dominant policy, hardware will control the state of individual machines. Consequently, it does not really matter which operating system the computer uses. Unless the computer is properly validated and authorized to process the data, DRM-limited files will not execute. On top of that, "IBM and HP have apparently started work on a TC-enhanced version of GNU/linux" (Anderson, 2003). So as far as personal computers go, DRM may be adequate to limit and maybe even stop the illegal flow of copyrighted content. Certainly a deprivation for end users, but this scheme seems to inevitably being taken on anyway.

Everybody connected to the internet today have a physical internet Protocol (IP) address that is unique for every node connected, making the machine illicitly if downloading copyrighted contents is traceable. With the right tools and the necessary legislation it is straightforward to obtain the network address and hunt down the delinquent by doing a simple cross referencing at the Internet Service Provider (ISP). Of course, some action to conceal or divert the actual machine is possible, but most users do not have the expertise to achieve this. Despite everything, eventually there will be no need for a computer to access songs, films and other material restricted by copyright. As increased storage space becomes cheap and wireless communications are being integrated into an increasingly broader selection of handheld devices, larger amounts of data can be exchanged at progressively faster rates. Already, top model Personal Digital Assistants (PDAs) come with unit-to-unit wireless communication in form of Infrared<sup>28</sup> and Bluetooth<sup>29</sup> signals, or both. And for many of the most expensive models, additional wireless LAN is built-in. Even the Playstation

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<sup>28</sup> Current IrDA standard has a theoretical max transmission rate of approximately 4 Mbps

<sup>29</sup> Current Bluetooth standard has a theoretical max transmission rate of approx. 1 Mbps

Portable (PSP) handheld gaming console to be launched early 2005<sup>30</sup> will feature built in ATRAC3 audio (audio format comparable to MP3 in quality and file size) and MPEG4 movie playback, IEEE 802.11b (Wi-Fi) wireless LAN, Infrared communication (IrDA), a Memory Stick PRO DUO reader for easy swapping of contents and a USB2.0 socket (Marchant, 2004). Taken into consideration that this is a Sony product, it will most likely have some sort of DRM management system, limiting how media files can be distributed<sup>31</sup>. Still, all previous experience indicate that the next portable amusement center may be built by a company not controlling nor making money on content the device can play back. In order for manufacturers to come up with an attractive product, they will probably facilitate all functionality a potential buyer would want, i.e. with little or no restrictions on how content is swapped between users as well as barely limitations to what content the user can playback.

Technology reporter Andrew Orlovski claimed at the music convention 'In The City' September 2004 that "the technology people have failed to tackle the issue" (Orlovski, 2004b). As he points out, when the electronic appliances used to store and distribute music have become so cheap and small that they can be carried around and used anywhere, there is little chance preventing users from sharing files if they want to. No profitable device will have control mechanisms to stop a group of friends from sharing the contents of their music players. Consequently, the same applies complete strangers in any public place (Orlovski, 2004b, p 2-3). Today most mobile phones ship with built in wireless communication of some kind. Even if data transmission using these means is still a bit slow, it is only a matter of time before somebody comes up with a new improved version of the standard that has sufficient range and bandwidth. Or maybe power consumption of WLAN transmissions will get low enough to be useful in more of the low-power hand held devices produced. The 802.11g standard can already facilitate a theoretical transmission rate of 54 Mbps, boosted up to 108 Mbps in some systems (equaling the common transmission rate of wired Ethernet), and is currently being built in as a standard feature in most laptop computers and some PDAs. And like the latter, most tiny cell phones are shipped with either built in flash memory or smart card readers. Storage, which is expensive today, but it will be cheap next year. Lately an extensive range of portable hard disk based media players that can store as much data as normal computer drives have been put on the market. With wireless communication being built into most other computer systems and fixed digital media players, the technology is only a

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<sup>30</sup> According to press announcements it will be released in Japan before Christmas, then gradually introduced to other markets early 2005

<sup>31</sup> See Appendix: "Sony DRM case"

small step away from being integrated into almost every pocket-size entertainment system. This will embody anonymous P2P network traffic between independent, individual nodes anywhere and at any time. Such communication does not entail any additional cost for the user, and will be very conveniently compared to the necessity for fixed access points nowadays. The only real way to prevent illegal use within restrictions given by current legislation is having the police confiscate and check media players. If files with without or with wrong DRM identification are discovered an instant fine can be issued<sup>32</sup>. Or “copyright watchmen” patrolling the streets with radio scanners could be introduced, oppressing every case of file sharing they discover. The content owners may hope such a presence can prevent people from misusing their devices, but history has repeatedly shown that totalitarianism never survives.

Even if regulating how the digital music flows may raise profits for a foreseeable time, at least obstruct customers who prefer the pirate alternatives, the efforts are most likely futile in the end. People will still be given the offer to record from the radio or television, and when appliance become adequately sophisticated, little effort will be required to save the broadcast from many channels simultaneously, sort out the appealing parts and transfer them to whichever device is handy. Consequently there will be no more reason to download from the net (Orlowski, 2004b).

Focusing too much on how to prevent access can slow down progress into a future where the really big money is, as the best way to ensure growth seem not to be by limiting how people can enjoy the services provided; it is by expanding the market. Releasing the restrictions of contents by allowing users to expand their relationship to music, the record labels and movie studios will make customers become more interested in their products. An effect that in turn will reimburse sales and probably by far exceed the profit previously made from ownership of the recordings.

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<sup>32</sup> Real-time checking against authentication databases is already done from police vehicles, and computers for that purpose are like all other kinds of electronic equipment becoming smaller and smaller.

## DISCUSSION

*"Try and be nice to people, avoid eating fat, read a good book every now and then, get some walking in and try and live together in peace and harmony with people of all creeds and nations."*

*- Monty Python – "The Meaning of Life"*

A joint action to introduce the alternative compensation model, making digital entertainment available at no cost and getting the right owners their money from some sort of taxation scheme, would probably be the best solution to the problem with piracy of music and film in general. Instead of being the main illegal distribution channel, internet could become the most effective and not least the cheapest way of advertising. It would have great chances of success if only the industry was willing to see it this way, and act accordingly. However, there are apparent problems: If implemented, some companies are bound to try avoiding redistribution of their material by offering product samples through the normal channels while only selling the full-scale product in a way that makes it difficult to copy. Methods to facilitate this will exist, at least making it possible to raise the level of entry high enough that most people pay the extra price, which will be to repeat the current situation with only slightly altered roles. There will always be opportunities to make difficulties for the customers and gaining an extra profit in the process, regardless of the distribution and compensation models the industry relies on. Not to mention all the quarrels and legal battles that are bound to come out of disagreements to compensation levels. Having already pointed out how many alternatives there are to manipulating watermark methods, which will be relied on to establish playback frequencies and compensation ratios, another dilemma is how to ensure that the government agencies appointed to carry out this task are satisfactorily independent. In the way the model is presented, these mediators have ultimate control to gather, control and keep information about the popularity of individual files. The industries providing material will probably not be happy with the situation unless they can control the agencies and their bookkeeping. On the other hand, having agencies guided by the industry is in particular a situation to avoid.

As problems like these occur, the subscription model seems to be a more feasible distribution method. It entails the same positive features, while the control of the content distributed will be entirely at the hands of the corporations owning rights to it. Additionally, circulation of more entertainment is likely to have a positive effect on sales of related products. If you watch a film at the cinema and you find it really good, chances are you will buy the DVD when released. When there is a song on the radio you like, the CD from that artist tend to be the one buy the next time you go to the record store. The same line of reasoning says that if you legally download tracks from the internet and find artists you like, you will buy products related to these artists later. Moreover, you will visit their webpage, attend their concerts and, if the best place to find their other available recordings is a subscription site run by the record label of the artist, you will probably pay for access to that service as well. On top of this, if information is available about similar artists, sampling those could be only a convenient download away.

However, this business model will most likely be opposed by content distributors, other online retailers and probably record stores as well, as the direct subscription service should attract vast numbers of customers if assumptions about the model are correct. Should the record labels and film studios decide to run an additional web-store, customers who subscribe are likely to make direct purchases instead of at their old shop and these retailers will probably lose revenue. Nevertheless, content providers should review the problems associated with their current business models against the advantages of the alternative. As Professor Fisher put it, although arguing for the supremacy of the government administered compensation system, any system from which the artist and the copyright owners gain revenue merely from their products being spread should be better than the existing situation:

“Let skeptical musicians and filmmakers continue to use technological self-help measures to restrict access to their creations--and let them continue to call upon the aid of the legal system to protect those measures from hackers. If the new regime is as efficient as we have argued, the skeptics will soon discover that it is simpler, cheaper, and more profitable”.  
(Fisher, 2004, p 43)



Such a potentially massive expansion in awareness about their products should be encouraged by the record industry, as the impending increase in revenue is directly linked to it.

Another issue is that by legalizing free sharing of digital entertainment, other businesses will harvest from it. Internet service providers are almost guaranteed to increase their traffic and customer mass, and with that there is likely to be a parallel need for expansion of infrastructure. Hardware manufacturers will have to produce more devices for playback and communication. The music and film industries will unlikely accept that others benefit from their products if their revenue remains at current levels. However, in contrast they would probably consent to a distribution system like the subscription model, which decreased their distribution costs while at the same time generating massive promotion of their artists and productions.

As this paper mainly presents already established matters influencing DRM and the digital world, as well as presenting a new distribution model for online material based on the government administered compensation model by William Fisher, further research is essential to establish the cost to operate and price to access such a subscription service (Rosenblatt, 2003b). Additionally, investigation should be made into possible technologies and suitable alternative topologies to expand such subscription services. Results for these efforts should be measured against the positive impact of accessible contents, and emphasize should be shown to ways of making the industry abandon rigid restrictions on online content to the benefit of expanded business. If assumptions are correct, the system should be significantly cheaper to establish and maintain than a bureaucratic, although slightly more advantageous for the copyright owners at the cost of other participants.



## CONCLUSION

*“You can make life awkward for users, but I’m not going to bet that it’s enough to protect your business. Technology succeeds when it gives people something they didn’t have before. If you take stuff away from people, the chances are it won’t succeed.”*

- Andrew Orlovski (Orlovski, 2004b)

### ***Beyond music and movies***

Many customers of digital tools and entertainment can be easily reached through the internet, if appropriate mechanisms are available. One alternative is to establish a web-store and selling the same products in the same formats as done through conventional stores, another is to actually distribute the end product. For example, the media can be streamed from a server to the client or downloaded as complete files. Although a setback with streaming is that it requires a fast and permanently stable internet connection, which is not always available. Additionally, there can be problems to control the ways the data streamed is used. On the other hand, a movie file may be of a size exceeding well over 1GB, depending on length, picture quality and encoding mechanism used. Having to obtain such quantities of data can be just as inconvenient for the user, and not being able to watch it before the entire download is completed will often render this alternative unattractive. In general, it has also been very easy to make copies that can easily be redistributed to new nodes for free. Most media streams can be copied into shareable formats<sup>33</sup> and copy protection for downloaded files, if any, is circumvented.

This example indicates some of the major problems with the existing distribution models: Services are commonly as inconvenient as obtaining the same material through illegal channels, nevertheless they are relatively expensive to use. Current business models for conventional retail of

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<sup>33</sup> See e.g. <<http://all-streaming-media.com/record-video-stream/all-streaming-video-recording-software.htm>> for information about stream-capturing software and how it may be used

physical goods are adopted for distribution of digital media. Though, unlike most physical products, it is possible for user to make perfect digital reproductions which can be distributed online. To the contrary of goods there is also very little cost to making a digital copy. Thereby the frequent piracy, and as discussed in this paper, there are two general approaches that can be used to reduce this problem:

1. Create better protection mechanisms for media that is to be delivered online, not only restraining who can use the files but also in which ways the data can be accessed.

**Or:**

2. Establish an alternative way of compensating right owners and allow the market to be literally overflowed with digital reproductions of such material.

The first alternative is what the content industries almost frantically try to impose to the market at the moment. Although the 'pay per download' model seems to be having a bit of success when it comes to music, as some consumers are willing to pay one tenth, or even less, the cost of a CD to download a song. Nevertheless, most of the retailers have different rules regarding how many copies you can make of each downloaded song, how many devices you can transfer it to simultaneously and other limitations that users quite often find bothersome. Initially, the situation with shops not having a common set of rules is untidy and inconvenient for customers, secondly filling up your computer or portable device this way will be **very** expensive. Furthermore, the necessary rigorous protection mechanisms are not in place and piracy downloads continues to be the main competitor of such services.

Given this, there are strong arguments shown in this text to why the second alternative will be a better and more successful model. Nevertheless, there are some unfortunate limitations and drawbacks with such an approach.

Even if an alternate compensation model or subscription model was introduced for the distribution of digitalized music and film, where many of the same characteristics are applicable to books and other types of cultural contents that are distributed digitally (Sobel, 2003, p 4), it is unlikely the software market would pursue the same changes. First of all, in the recent years most of modern computer applications have been distributed using the following methods:

- The initial software is free and the customer pays for support

- The software license is contained on a physical product (usually a CD or DVD for modern programs) that can only be used on a single platform at once
- As a license for use on one computer or as a license for use within e.g. a company

On occasions software is also retailed as variants of these alternatives.

It is highly unlikely that there will ever be a situation where most consumers are willing to pay additional costs to have available more tools than they need, and taking into account the success of popular software tools and the business model of this industry, there seems to be little advantage in adapting a more socialistic approach to distributing licenses.

Therefore, neither the government administered distribution system nor a subscription model offering free downloads would suit the software industry very well. Most software vendors are strong promoters of keeping their current business scheme where applications are licensed on a pay-per-use basis. On the contrary, many technologists strongly promote the idea that it will be possible to stop **all** leakage, given proper technical and jurisdictional tools. Necessary legislation to support this is being enforced, at least in most western countries, and if a perfectly secure computer platform is ever introduced this may some day be true. The Trusted Computing Group claims it will be able to offer such an architecture (TCG, 2004b), however others are doubtful. E.g. Andrew Orłowski points out rather sarcastically that such claims have come from the computer industry before:

“Windows Longhorn with Palladium [NGSCB<sup>34</sup>], its part of the deal [Trusted Computing], was originally supposed to ship this year. The version that ships in 2006 won't have everything that Microsoft promised you in it. And do you really want to bet your business it won't leak? That the CD manufacturers have got it leak proof? And the BIOS people, too?” (Orłowski, 2004b)

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<sup>34</sup>NGSCB (formerly named *Palladium*): The 'Next-Generation Secure Computing Base' from Microsoft, providing strong process isolation, sealed storage, secure path to and from user, and attestation, protecting the privacy of computer owners and users.  
<<http://www.microsoft.com/resources/ngscb/archive.msp>>

Still, even if the DRM scheme is flawless and the hardware tamperproof, there are vulnerabilities like disabling the protection mechanism or building a compatible system without such features (Arnold et al., 2003, p 249). Besides, the architecture currently advocated by TCG seems to only work satisfactory when the majority of computer users perform their transactions on a DRM enabled platform. Maybe it will not be embraced by customers like they hope. Then again, computer users may perhaps have no choice, due to both legal issues and the fact that AMD and Intel dominate the PC mainframe marked in the same way Microsoft Windows dominate the market for operating systems. Still, nobody will know for sure if it really works until enough users are running a DRM supporting platform. Despite theoretical models showing it (TCG, 2004a), computer history has so far shown that anything can and will be circumvented if it is worth the investment.

“While tamper resistance can be achieved to some extent even in consumer devices, the cost of such measures limits the strength of mechanism that can be obtained. Given the major source of losses for publishers of audio and video material is organized crime, which can be assumed to have adequate financial resources, this limits the reliance that can be placed on tamper resistance.” (Arnold et al., 2003, p 9)

Its potential failure is a strong incentive for the music and film industry not to place all hope on DRM solving neither current problems nor those evolving in the future.

For e-books the situation is much the same, in addition to being a potentially less successful product if freely available: Most people read books only once or very few times, maybe with the exception of a handful of favorite titles. The most important value being the story, there is not much additional content that can be added. Of course there are some exceptions, as accompanying merchandise or events may enhance the salability of the manuscript and vice versa. Still, most of the extra-features joining other products like music and films, this be extra features, insight information, background notes or alternate versions, comes with a book either as a natural part of the publication, it is available for free or has simply been neglected as a valuable attribute. In fact, the most beneficial ‘addition’ to a book is the printing and binding itself, and for the imminent future paper copies of books will continue to have the substantial portion of the market.

## ***Abuse of DRM***

One problem with setting stricter limitations and more complex protection mechanisms is that it can be abused to benefit criminals as well. Already there are online file sharers successfully using DRM to avoid piracy detection software (Rosenblatt, 2003a). This is likely only the beginning of infringers adapting DRM mechanisms to suit their illegal purpose. The ability to limit documents to specific platforms, having to obtain decrypted authorization from a remote server or deleting content within material already being published make perfect tools if someone wants hide their tracks and get a head to the police.

In a study to find an economic model for censorship resistance, Cambridge professors George Danezis and Ross Anderson discuss some aspects that are very applicable to the fight against piracy on the internet. The fact that censorship or suppression comes at a financial cost, regardless of the target, means that defensive action taken by the object of attack and this obviously will diminish potential success for prosecutors. When it comes to illegal sharing of files in form of e.g. P2P networks “a censor is targeting a set of individual nodes, and the success or not of his attack on a particular node depends only on the defense budget of that node.” (Danezis and Anderson, 2004) None of the alternative distribution models will stop the problem with piracy of copyrighted products entirely, although they will make the problem less significant. At least the alternative compensation model Fisher promotes should reduce the problem of owners not being compensated to a minimum, and a subscription model would even potentially increase the sales and revenue of content owners. Nevertheless, it will be impossible to eliminate method piracy at all levels since some of the imposed protection mechanisms will be broken, no matter how rigid are. It is simply a matter of cost and effort, and if money can be made on creations made by other sufficient motivation will be there. Even by approaching the problem the other way around, making currently pirate-able products freely available, manipulating compensation balance will become one of the adaptations. Regardless of how unrestricted the use of data should become, privileges will still at some degree be abused. This will happens regardless of business models chosen.

Therefore, making music and films freely available or not is one of the key elements, but it is not the vital factor. People have been able to record from the radio and TV for many years, more effortless for every new generation of equipment. Still those broadcasting systems seem to become increasingly popular. Hence, means of inhibiting reproduction are more about making the practice inconvenient than it is about total copy prevention. Even the

strongest DRM system will allow playback that can be recorded as an analog signal and redistributed that way. In the end, what people are willing to pay for is convenience. If the alternative is paying US\$10 for a high quality DVD rather than spending hours downloading the same film as a apparently downgraded version which you do not even know if going to work, or if it actually is the film it passes off as being, the option should be clear. At least this applies for most people, and those not willing to spend money on the legal item would probably not buy the item if it had not been available for free online in the first place.

### ***The better alternative is not likely to be chosen***

Quite often one will see what lies ahead by looking back. By reasoning in a historical manner like at the beginning of this paper, it is difficult to anticipate DRM to provide the final perfect set of tools, stopping data from flowing freely around the internet and onto playback devices of every kind. The likelihood of it failing partially or in full like many other copyright protection scheme seems probable, either because there will be too much to gain from circumventing these mechanisms or simply for the reason that most customers will actively avoid equipment infested with too strong DRM regulations.

While there are benefits TC can bring into the currently imperfect world of computer transactions and system security, there is little doubt there should be made more emphasis to the potential problems this structure can include. Rather than letting the manufacturers and content providers dictate the terms of development efforts, there should be arranged more independent research into the matter before the industry is allowed to implement a paradigm that indisputably seem to mainly be to the convenience of an already rich minority. There are, as shown, unfortunate effects from DRM and better alternatives for the digital content businesses. In particular, a too rigid TC paradigm seems very unfavorable for freeware communities and small businesses unable to bare the potentially huge costs if having to change DRM controlled business systems (Anderson, 2003). Unfortunately, the industry is successful in presenting their point of view and manipulating politicians into the same single-tracked reasoning. Consequently, alternative approaches seem to be neglected instead of being investigated independently and thoroughly.

As this paper has shown, there are many good arguments to why the content providers should explore alternative distribution models. This is in



particular true for the music and film industries, shown in the extensive work by William Fisher and proposed as an even financially better and easier controlled alternative with the subscription model. Unfortunately, this change of attitude seems less probable the more accepted restricting DRM systems becomes. The copyright owners are not likely to give up the products they now spend the most time sheltering, especially not when the trend is rise in sales (Vance, 2004). Thus, from the point of view of the industry, the DRM seems to have the desired effect. This provides a situation which in turn makes it alluring not to look further ahead.

Additionally, there is a lot of money to gain by frightening normally law-abiding people from downloading pirate music, films and also software. Maybe even more economically attractive than from stopping the large-scale pirate business done by professionals. In many regions with a high pirate rate, people spend are likely to spend less money on digital entertainment products, thereby making infringers in western, high-income countries more profitable targets.

If the RIAA and MPAA succeed in bringing even common, small-scale infringers to court, most other internet users may be unwilling to take the risk of prosecution for downloading a song or movie. After all, most CDs and DVDs retail at US\$20 or less, and having an original is a lot better than a lower-quality copy. In countries where most people have a low income, most will not purchase much full-priced entertainment anyway. Moreover, for computer programs and games there are plenty of free alternatives.

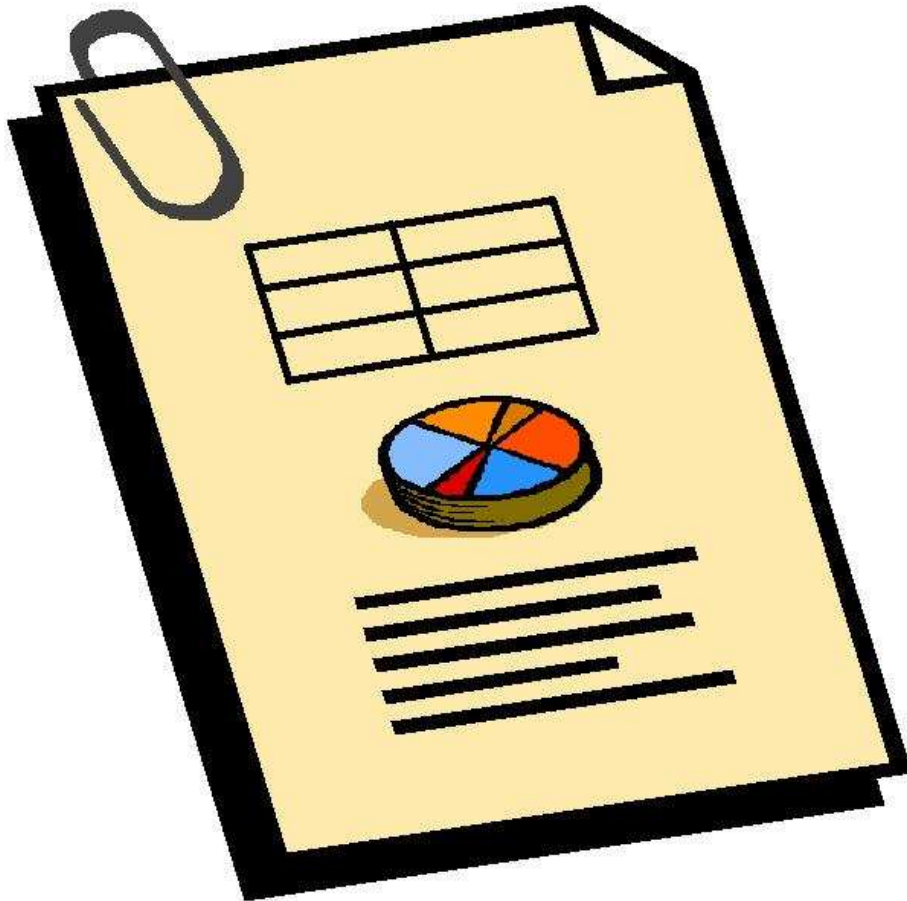
The history has proven that audio and video cassette recorders made music and film more accessible, thereby taking part to facilitate a huge market growth. In the same way digital entertainment may become the next revenue booster, if only the suppliers of this content can avoid making such systems too inconvenient for their customers. Additionally, the industries must enthusiastically approach a distribution model that takes advantage of customers favored ways of obtaining and enjoying digital entertainment.

Still it is reasonable to ask if the copyright owners are really willing to explore a better business model.

Not likely, as long as they can dictate politicians, thus getting laws and sentencing framework passed that effectively allows them to take out legal action against filesharers and restrain potential agitators for years to come.



# APPENDIX





## ABBREVIATIONS AND SPECIAL TERMS

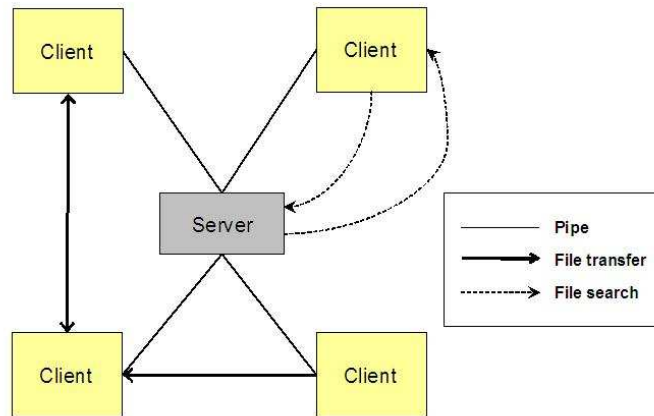
<b>DMCA</b>	“Digital Millennium Copyright Act” – A controversial United States copyright law which criminalizes production and dissemination of technology that can circumvent measures taken to protect copyright, not merely infringement of copyright itself, and heightens the penalties for copyright infringement (*)
<b>DRM</b>	“Digital Rights Management” (or “Digital Restriction Management”) – An umbrella term for arrangements which allows a vendor of content in electronic form to restrict the usage of the material (*)
<b>EUCD</b>	A Copyright Directive which is the European Union’s implementation of the WIPO Copyright Treaty, to harmonize certain aspects of copyright and related rights in the EU information society (*) <i>(This directive is an European equal to the DMCA)</i>
<b>Fair Use / Fair Dealing</b>	A doctrine which provides for limitations and exceptions to copyright protection, i.e. the copyright holder has no rights to control that use and no license or permission is required (*) <i>See also e.g. “Fair Use Rules of Thumb”:</i> < <a href="http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm">http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm</a> >
<b>IPR</b>	“Intellectual Property Rights” (or “Intellectual Rights”) are legal entitlement which allows its holder to control the use of certain intangible ideas and expressions, e.g. patents, copyrights, trademarks and trade secrets (*)
<b>P2P</b>	A peer-to-peer (abbreviated <i>P2P</i> ) computer network is any network that does not rely on dedicated servers for communication but instead mostly uses direct connections between clients (peers) (*) <i>P2P network topographies are included in the appendix</i>

<b>TC</b>	“Trusted Computing” (or “Trustworthy Computing”) – A computer platform that can be trusted as to its hardware/software configuration. This is a requirement to see this computer as a trusted client (*)
<b>WIPO Copyright Treaty</b>	Treaty by the “World Intellectual Property Organization” to provide additional protections for copyright deemed necessary in the modern information era: <ul style="list-style-type: none"><li>• Computer programs are protected as literary works</li><li>• Protects arrangements and selections of material in databases</li><li>• Provides authors of works with control over their rental and distribution</li><li>• Prohibits circumvention of technological measures for the protection of works</li><li>• Prohibits unauthorized modification of rights management information contained in works</li></ul> (*)

(\*) Definitions taken from Wikipedia, ‘the free encyclopedia’  
<<http://en.wikipedia.org/>>

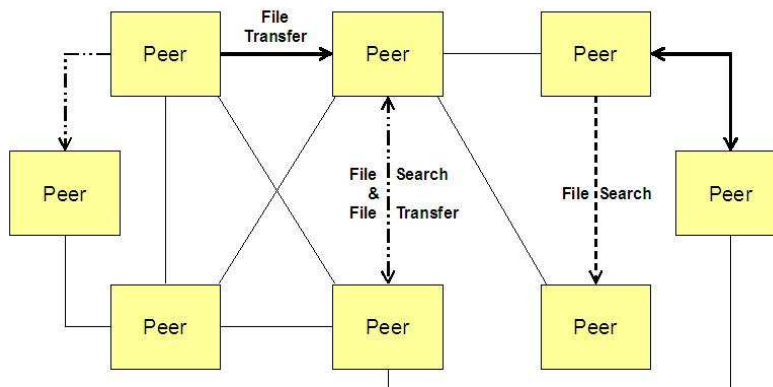
## P2P - TOPOLOGIES

### Centralized



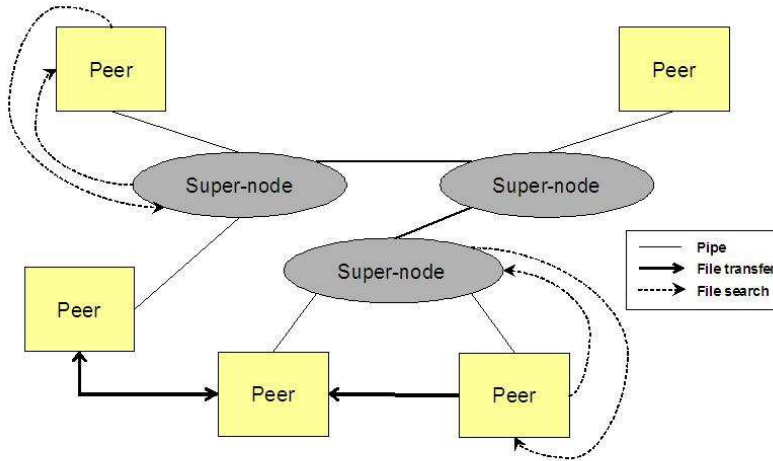
Each client (peer) connects to a server to search for files  
 To download files a direct link is established between the two (or more) clients

### Decentralized



Not all nodes (peers) will be interconnected at a given time

### Hybrid



*Each node (peer) connects to a super-node  
Not all nodes / super-nodes will be interconnected*



## OPINION OF A LAYMAN

*Late 2003 and early 2004 there was a debate going on between readers in the computer magazine Dr Dobb's Journal, and in particular the entry from Derek Snider expressed some aspects of the piracy issue:*

“I don't think... [they] ... realize that the only face of piracy that hurts the industry is professional piracy rings that pirate for profit (places that sell burned CD-ROMs of pirated software for cash), and the odd computer sort that bundles pirated ware onto a system to make a sale.

Even then, the software industry suffers little. Microsoft products are pirated far more than any other, and you could hardly say that Bill Gates is going hungry.

You see, the same thing goes for sharing software as for sharing music (I prefer sharing to piracy referring to individuals versus people who pirate for profits – pirates profit from their ill gotten gains). Sharing actually benefits the industry. It's like free advertising. It makes more people familiar with the software, and it's like an investment – the people may depend on sharing software when they can't afford to buy it themselves, but sooner or later they will pay for the new version.

It's the same with music. Jobless teenagers may not be able to afford to buy all the CDs of their favorite bands, but you can bet that they'll be buying the entire collection when they get their first job.

Surely there's a part of the population that never pays for software if they can help it... but most likely they wouldn't pay for it even if they couldn't get a copy from a friend, or a warez site. The point is that good software will give a good name to a company. If people are pirating (or sharing) your software, then you're doing something right. It's a good sign...

Piracy also keeps abandonware alive<sup>35</sup>. Many products are discontinued, and sometimes the company is long gone, but if an old

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<sup>35</sup> **COMMENT:**

Often there is a failure to realize, or being willing to investigate money in, customers who want to keep their old hardware running. E.g. Nintendo forced legal actions against companies selling replicas of their old gaming consoles, despite Nintendo stopped selling them year ago: <<http://www.itavisen.no/showArticle.php?articleId=1304765>> (Norwegian) For many producers cult-status seems to have no room in the market. But it would probably be a shockingly surprise if e.g. Ford started suing someone for making replicas of the old Mustang. Or if they forced legal actions against those companies supplying parts to keep

product was exceptional it may be still floating around in classic warez circles, and certainly shared among friends.

Without this, these old products would be lost for good. A rare few companies sometimes give away ancient products for free, or release source code (like ID Software), but this is far from widespread.

[...] sharing – software, music, movies, books, whatever – benefits companies far more than it hurts them. Microsoft is a perfect example. [...] Going after individuals will end up hurting the industry because it will give them a bad name, and people will end up choosing companies with a more lenient hand (and/or free open-source software).”

(Snider, 2004)

*Some sections have been left out from the original entry:*

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the old originals running. As a matter of fact, there are laws protecting those manufacturing third-party spare parts to automobiles (as long as the parts fulfill all security requirements).

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\* **Remark:** *If not all URL's work as they should, this is due to errors in the way EndNote formats and handles hyperlinks!*