

Is The Answer To the Machine Really in the Machine

Technical measures for copyright protection and the social dynamics of filesharing communities

Nicklas Lundblad,

Ph D Student at The Swedish Research Institute for Information technology

nicklas@acm.org

+46 8 555 100 00

+46 70 638 60 60

Abstract

E-commerce and content distribution models rely on working copyright protection. The recently introduced legal protection of technical measures is theoretically interesting in that it uses legislation to protect a certain form of architecture. This seemingly double protection is also highly paradoxical, since the technical measures were invented in part to deal with law being unable to protect content on the Internet.

We use file sharing networks, where most piracy is found, to test hypotheses about this legislation. It is found that the number of circumventions and cracks is low relative to the number of copies – implying that few people actually circumvent copyright protection. While this may seem to strengthen the usefulness of trying to stop such circumvention, we will argue that the relatively low number is not due to a cost constraint, but to the low actual demand for cracks, as opposed to copies and that current legislation will fail.

Is the Answer Really in the Machine?

Technical measures for copyright protection and the social dynamics of filesharing communities

Abstract

It has been surmised that technical measures will be an important part of copyright protection and thus e-commerce with intellectual property rights in the future. So important, in fact, that it has been decided in the recently ratified WIPO-treaty of 1996 to legally protect these measures. These protections are highly controversial and have already been subject to many public debates in both the Sklyarov-case and the case of research scientist Edward Felten.

The protection of technical measures is theoretically interesting in that it uses legislation to protect a certain form of architectural regulation. This seemingly double protection is also highly paradoxical, since the technical measures were, historically, invented at least in part to deal with the fact that law was unable to protect content on the Internet.

In this paper the proposed and decided legislation is analysed from a law and economics perspective and a central hypothesis is presented: the new forms of protection will fail to become relevant in the filesharing context because of the social patterns of behaviour that the filesharing and piracy communities exhibit.

One basic hypothesis are tested:

That the number of circumventions and cracks is low relative to the number of copies – implying that few people actually circumvent copyright protection. While this may seem to strengthen the usefulness of trying to stop such circumvention, we will argue that the relatively low number is not due to a cost constraint, but to the low actual demand for cracked copies – in contrast to the demand for copies. This market consists of a weak demand for cracks and a strong demand for copies.

Introduction

Architecture regulates. This is one of the basic premises in the work of American legal scholar Lawrence Lessig. In his seminal book *Code and other Laws of Cyberspace*, Lessig argues that architectural design will become a, if not preferred, at least popular, method of regulating the emerging global communication networks.¹

Few laws have resulted in so much public vehemence and debate as the protection of technical measures protecting copyright.

The case of Dmitry Sklyarov, a young Russian programmer that was arrested in the US after having shown how one could circumvent the copyright protection schemes of

Adobe's e-book, became world news in less than hours after his arrest and the case resulted in massive lobbying efforts to "Free Dmitry".ⁱⁱ Dmitry is free, now, but the problem of how to deal with the new technical protection schemes remains. Both the provisions of the Digital Copyright Millennium Act and that of the new European Union directive on intellectual property issues contain legal protection of copyright protection measures.ⁱⁱⁱ

It is generally assumed that these provision will help fight the rampant piracy that rights holders feel permeate cyberspace. It is, however, less clear why protection for copyright measures is thought to be such an effective solution. In fact, one could argue that it is paradoxical to expect that legal protection of technical measures, which in turn was born because of the lack of protection afforded intellectual property rights by legislation, will prove to be anything else than inconsistent and incoherent new legislation.

In this paper we will first discuss, shortly, what technical measures are, and then catalogue the major laws that apply to them. Then we will discuss what the motivation for these provisions is, and if it is correct. At the end we will introduce an empirical experiment to show some basic points about this form of legislation.

From ECMS to DRM

What are technical measures? And how have they evolved?

Charles Clark, renowned legal scholar, once concluded that the risk that the new emerging information infrastructure posed to copyright could be successfully met by designing new technologies of protection. His conclusion was formulated in a slogan: "The Answer to the machine is in the machine"^{iv}, and has been quoted innumerable times since.

The machine that answers the threat to copyright posed by the new systems, is copyright protection mechanisms.^v These come in many different flavours and have developed over time. In the early days of the gigantic systems like IMPRIMATUR – an EU-financed, project – the vision was that of a system that completely controlled the flow and content of the emerging networks.^{vi} The business model was complicated, and aimed to cover all handling and flow of the content in question.^{vii}

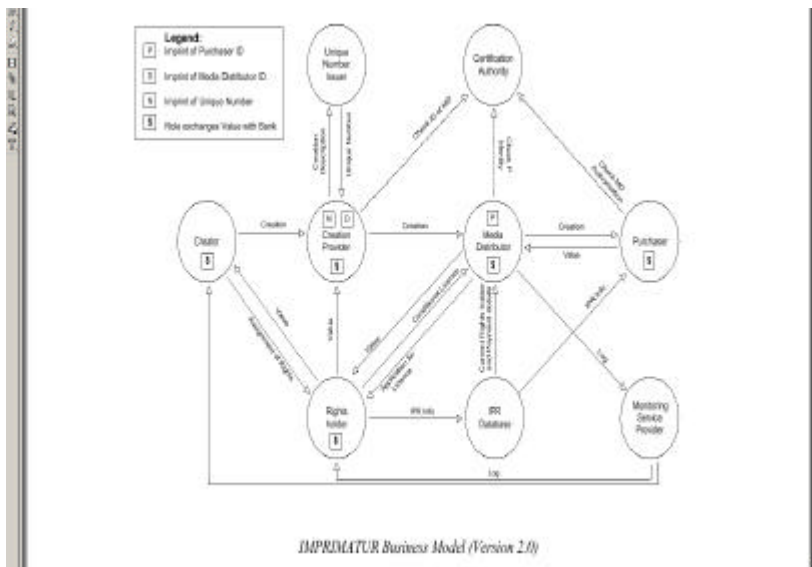


Fig 1 Imprimatur Business Model – System Monitoring and Flow Control

This system perspective is gradually being phased out and is replaced by copyright protection schemes that disregard the flow of copyrighted content, and concentrate on the use of that same content. So called Digital Rights Management tools, or DRMs.

Examples abound: the latest fad being compact discs that cannot be played in computer CD-rom readers. The idea behind these architectures is not to control the flow of information, but rather to control the use of the copyrighted content. Some are even being designed to harm the system of users who try to play them.^{viii}

The architecture is designed to limit use to cases where copying is not possible, rather than monitoring all use and charging for it.

Even if micro payment, flow based systems still exists, it would seem reasonable to observe that they are now seen as less feasible than the simpler use control mechanisms developed by companies today.

All in all this area of applications is growing quickly. Some even feel that it has accomplished everything that is needed, and that all that remains is to implement the systems.^{ix}

Legislation concerning technical measures

The legislation concerning technical measures is not completely new, but it is only recently that it has been implemented in national legislations. The basic model of both American and European law stems from the WIPO-treaty of 1996, where it was laid down that:^x

Article 11
Obligations concerning Technological Measures

Contracting Parties shall provide adequate legal protection and effective legal remedies against the circumvention of effective technological measures that are used by authors in connection with the exercise of their rights under this Treaty or the Berne Convention and that restrict acts, in respect of their works, which are not authorized by the authors concerned or permitted by law.

These rules were then implemented in national legislation. In the US this took the form of the Digital Millennium Copyright Act of 1998.^{xi} The law was criticised early on by scholars fearing that the rules on copyright protection would lead to unwanted consequences. Some even feared that this would be a problem that required the constructions of new rights to read anonymously.^{xii}

In Europe the treaty was implemented much later, due to intensive internal discussions.^{xiii}

The Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society (Official

Journal L 167, 22/06/2001 P. 0010 – 0019) is still not implemented in many national legislations (including Swedens). This directive was also met with severe criticisms.^{xiv}

The rules in the directive are worth quoting in extenso:

Article 6

Obligations as to technological measures

1. Member States shall provide adequate legal protection against the circumvention of any effective technological measures, which the person concerned carries out in the knowledge, or with reasonable grounds to know, that he or she is pursuing that objective.
2. Member States shall provide adequate legal protection against the manufacture, import, distribution, sale, rental, advertisement for sale or rental, or possession for commercial purposes of devices, products or components or the provision of services which:
 - (a) are promoted, advertised or marketed for the purpose of circumvention of, or
 - (b) have only a limited commercially significant purpose or use other than to circumvent, or
 - (c) are primarily designed, produced, adapted or performed for the purpose of enabling or facilitating the circumvention of, any effective technological measures.
3. For the purposes of this Directive, the expression "technological measures" means any technology, device or component that, in the normal course of its operation, is designed to prevent or restrict acts, in respect of works or other subject-matter, which are not authorised by the rightholder of any copyright or any right related to copyright as provided for by law or the sui generis right provided for in Chapter III of Directive 96/9/EC. Technological measures shall be deemed "effective" where the use of a protected work or other subject-matter is controlled by the rightholders through application of an access control or protection process, such as encryption, scrambling or other transformation of the work or other subject-matter or a copy control mechanism, which achieves the protection objective.
[...]

This article is complemented by a similar one dealing with rights management information.

Both implementations of the WCT of 1996 are close to the original and result in laws where technical measures are protected in law.

But why? Why have legislators chosen to protect technical measures in law?

Arguments for protecting technical measures in law

It is important to examine the motivations for introducing protection for copyright protection schemes in the law. We can discern at least two different reasons for this: the first is systematic, and deals with the issue of whether these technical measures should be seen as an extension of the intellectual property rights. The second is economic and

deals with economic analysis of piracy, and how it is best stopped. Both reasons deserve explication and will be developed below.

It is of course obvious that the strategic goal is to construct an environment conducive to e-commerce with immaterial products and intellectual property rights, but why is the protection of technical measures thought to foster such an environment?

Systematic arguments

Intellectual property rights are hard to discuss, since they are, by the very nature of what they protect, abstract and hard to grasp. Different metaphors are used, and indeed, the property-tag at the end of “intellectual property” is also only a metaphor – albeit one deeply rooted in the legal community.^{xv}

The property metaphor has become systematic, and the field is often analysed as if the legal rules applicable should fulfill the same criteria as those dealing with pure property rights. In this perspective it is easy to see that the protection of technical measures, i.e. measures taken to prevent the stealing of “property”, should be protected.

The argument could be put forward like this: When a rightsholder applies a technical measure, he or she is doing the equivalent of what we do when we lock our doors. Those who circumvent those measures break in. If they proceed to copy the work as well, well then they also steal. The protection of technical measures in intellectual property simply equals that of the protection against breaking and entering.

This argument, while seductive, begs the question of whether the property metaphor should be applied when discussing digital rights management.

Another systematic argument is that intellectual property right has two basic motivations: firstly to promote innovation by constructing a bargain in which a time-limited monopoly is awarded to the creator in exchange for the creation to be released into the

public domain. Secondly, intellectual property rights are seen as investment protection rights.^{xvi} And thus, some might argue, it is reasonable to protect also those investments made to protect the original investments – i.e. investments in protection schemes and technical measures. This argument seems consistent with the limitation in the European directive to such technical measures that are deemed efficient, since efficiency is defined as a certain degree of sophistication in technical measures used, and thus a certain value of the investment made.

Economic arguments

The economic arguments are far more interesting than the systematic ones, and will be the focus of this study. When reasoning about protection for technical measures in economic terms, there are a number of hypotheses that must hold for this protection to be rational, but the basic condition for motivating the protection of technical measures economically is that it in some way results in a cost structure that benefits the rightsholders.

To be able to assess this, we need to assess the costs connected with copying today.

What are the costs, and how have they changed?

To be able to examine this in detail, it is necessary to sketch an example situation and to define the set of costs that is involved in this situation. A typical copying situation – say someone copying music and giving it away or selling it – involves at least the following costs.

- **Costs of time spent copying.** This is not unimportant. A historical retrospective clearly indicates that this was one of the major costs in the medieval ages, where time spent copying was considerable.

- **Costs of material.** Again this is a cost that we seem to neglect today, but that has been significant.
- **Costs of quality reduction.** Even if this cost is often had by the recipient of the copy it is a cost pertaining to the copying situation.
- **Costs of distribution.** This cost varies with the size of the intended market, but in the case of a record producer wanting to redistribute a certain title to a network of shops (a physical copy) this will be a significant cost.

In the case of illegitimate or illegal copying the following costs must also be included in the equation:

- **Sanction costs.** This is a cost calculated as the negative utility of a punishment times the probability of being caught – an expected risk cost.
- **Social costs..** In a society where copying is considered an immoral act, it is to be presumed that the copier will be disparaged by others, thus losing social capital – a definitive cost that is discernable in the disregard we hold for plagiarizers.

What then is the *actual* cost structure imposed in a copying situation on the Internet? It might seem obvious that the new digital technology indeed reduces cost, but it is necessary for the discussion that will follow to investigate in what ways it does so.

- **Costs of time.** The time needed to copy an mp3-file is infinitesimal and the resulting cost is totally negligible.
- **Costs of material.** The zeros and ones that constitute an mp3-file cost but the electricity needed to power the computer. But the computer actually represents a significant cost to many households – but it is a one time cost, that is not keyed to the number of costs made. A computer,

once bought, has the ability to manufacture numerous copies in no time at all.

- **Costs of quality reduction.** Zero in the digital environment.
- **Costs of distribution.** As the cost of bandwidth is reduced the resulting cost of distribution is also cut. Today the cost of distribution is quite clearly very low.

These are the costs for legitimate copying, and the collected picture they give is one of an environment that should be ideal for content producers, since it practically removes all transaction costs involved in the copying situation. (And – parenthetically – the Internet also reduces search and transaction costs involved in buying content).^{xvii}

If we stop here and consider for a moment what would have happened if this cost structure was combined with one where the costs of illegitimate copying were *high* we find that this would probably lead to a development where the content industry would almost immediately shift to this new medium. It is therefore understandable that the solutions suggested by the content industry are focussed on increasing the costs of illegitimate and illegal copying.

The costs for illegitimate copying are, however, worryingly low:

- **Expected sanction costs.** Considering that the number of illegal and illegitimate copies is enormous and that this is a practice that has almost been adopted by every user of the Internet, the risk of actually getting caught is perceived as very low.^{xviii} The sanction that would be imposed – fines – is considerable, but since the estimation of the probability of getting caught is so extremely low this does not matter for most users. Add to this the fact that many users are under the impression that private copying is not an illegal act (an

assumption that would nullify this cost entirely) and it becomes clear that the situation looks rather bleak.

- **Social costs.** It is probable that illegal copying of music files, movies and pictures is perceived as an act that increases social capital today. Being in the know, giving away home-burned CD:s and new movies before they appear on the big screens is something that is considered cool and interesting. There is no social cost, but rather a social gain involved in copying. Of course, this varies with age, social and economic groups, but the overall picture, I would argue, is one where copying is perceived as a positive act.

The resulting cost structure is one where the actual copying is free, and the perceived risks and social stigma involved is zero, or even positive. The conclusion is then obvious: copyright cannot survive in this environment. How can this threatening situation for ipr e-commerce be addressed?

One way is to introduce a new cost, a circumvention cost. This cost consists of two major parts: the first is simply the time, computer resources and hardware needed to circumvent some sort of copyright protection. To this we now add – through the use of legislation – an expected punishment cost that is calculated simple as the gravity of the punishment times the risk of being punished.

The first part of this cost is quite possible to add, for the copyright industry, without the second. Indeed, they have methodically done so for the last years, adding copyright protection schemes in all different manners, forms and shapes. The second, however, depends on the decision of the legislator.

For it to be rational for the legislator to implement the legal protection of copyright protection, it would suffice to show that this will indeed increase costs in such a way that unwanted copying and piracy is affected by the legal protection.

The basic hypothesis of those advocating economic reasons for the legal protection of technical measures, then, has to be that this protection will result in such an expected punishment cost that it will affect the negative digital copying, (without resulting in adverse effects for other stake holders performing legitimate copying).

This hypothesis makes some basic assumptions about the copying market that are interesting. Firstly, the number of people circumventing must be rather high or the means of detecting those circumventing must be rather good. Otherwise users will not expect to get caught. In other cases where circumvention is prohibited – such as in using television receivers with illegal decoders – the number of circumventers is necessarily rather high. Each person has to circumvent the protection (and use the decoder) individually. It is not the case that a few people decode satellite transmissions and then redistribute them through an open network. In this case the number of circumventers is so high the prohibiting circumvention seems to be a reasonable course of action. In this case the receiving of the transmissions does not constitute a crime, either, so to stop this the only available solution is criminalizing circumvention. (It is worth noting that it takes considerable construction to find examples where someone circumvents copyright protection without also making themselves guilty of illegal copying.)

Secondly it seems that this line of argument assumes that catching those circumventing will actually have an impact on the amount of circumvention. This translates into an assumption about the costs associated with circumvention, and the number of market actors that can perform circumvention of technical measures. It would be reasonable to prohibit circumvention if a) it was possible to quickly identify and apprehend those

circumventing and b) they would not be substituted by others. Since then the circumvention rules would address the most efficient way of stopping piracy, and result in a situation conducive to the growth of e-commerce solutions for content.

Now, we can ask two basic questions.

- 1) Is the number of users circumventing high, as in the television case (thus motivating a prohibition on circumvention)?
- 2) Is the cost of circumvention so high as to motivate the removal of those actors on the market that are able to circumvent protection schemes?

These two questions will be examined by conducting a simple experiment.

Does the social dynamics of filesharing networks substantiate the hypotheses above?

To examine the questions above I propose a simple experiment. By examining available filesharing networks we will attempt to get a picture of how the social dynamics of copying actually looks. To be able to sketch some answers to the questions we develop two indices: the crack/copy ratio and the content distribution factor. The experiment is small in size, but it is the first in an ongoing project where we study the social dynamics of filesharing networks.

Crack/copy ratio

The crack copy ratio is simply a measure of how copy behaviour in filesharing networks looks. How many users are engaged in cracking (circumventing) copyright protection and how many users are simply content with copying works that have once been circumvented? In other words: is this a case of “crack once, copy everywhere” or are users as engaged in cracking as they are in copying?

To investigate this we used popular file-sharing service Kazaa, and performed several searches for popular films. Kazaa is designed to list identical files in a tree structure, to make it possible to shift downloading from one user to another when the first user goes off-line, loses his connection or simply disconnects the downloading user. So it is quite possible to see the crack/copy ration graphically in this program as the number of root nodes and the number of branch nodes.

The crack copy ratio is then simply calculated by dividing the number of copies available in the network with the number of unique files (cracks). This opens for some copying where the uniqueness of the file in question is merely due to post-crack editing (to fit the film on a CD, for example), but gives a roughly adequate indicative picture (without being statistically sound).

This is an example list of the copy / crack ratio:

Movename	Filename	Filesize	# users	C/C ratio
Swordfish 20020312:10:33	Swordfish.DVDRip.DivX.DoMiniOn	712952	26	
	SwordFish [DVDRip DivX]	709358	1	
	Passwort Swordfish	687808	3	
	Swordfish.DVDRip.DivX.DoMiniOn	623340	1	
	Swordfish(divx-full)	310026	11	
	Swordfish [1&2of2]	118046	3	
	1	116902		7,5
Hannibal 20020312:10:34	Hannibal.divx	373408	14	
	Hannibal	714340	10	
	Hannibal DVD rip cd 1 & 2	704976	1	
		702152		
	Hannibal (cam 1&2)	221963	7	
		200581		8
The Skulls 20020312:10:45	Skulls.DivX	710576	8	8
Shrek 20020312:10:50	Shrek-DVD-RIP-SUPER-HIGH-QUALITY-NO-	718062	18	
	Shrek pl	712374	1	

	Shrek {DvdRip DivX}640*352	705908	2	
	Shrek German VCD 1 & 2	444344	4	
		391019		
	(MEG)shrek full	342344	11	
	Shrek	319594	5	
	Shrek DivX	316174	2	
	(smr)shrek-ts-1&2	150869	9	
				7,5
American Beauty	American Beauty (Divx)	685268	23	
	2_American Beauty-DVD Rip – DivX	855552	1	
	American Beauty	464014	15	
	American beauty 1 & 2	394934	1	
		464402		10
A Beautiful Mind	(tmd)a.beautiful.mind-ts (1 & 2)	178754	29	
		164414		
	A Beautiful Mind 1&2	309976	29	
		187208		
	A Beautiful Mind (part 1&2)	568 384	1	
		646096		19,666667
Jalla jalla	Jalla Jalla	720 386	3	
	Jalla Jalla (Swedish) DVD Rip Div X	710862	1	
				2

Fig 2 Table of Copy/Crack ratio

These seven films are only an example of what can be found, and the other results^{xix} substantiate this ratio. As can be discerned from the results, the average copy/crack ratio is around 8. This means that it is 8 times more common to copy than to produce original files. In this table I have solely used file sizes, even though some files are obviously edited cracks rather than original cracks.

The deviations are interesting as well. *A Beautiful Mind*, with a very high ratio, has not yet been released as a DVD and therefore a simple copy of the film being recorded with a handheld videorecorder is all that the network has to offer. As soon as movies migrate into more normal formats the cracks become more usual and the ratio sinks. The film

Jalla, jalla is an example of a national fil (it is in Swedish) where the limited number of users coincide with those having ripped the movie.

Content distributions in Filesharing networks

Some users are truly more active in cracking than others. The signature DoMiNiOn, for example, exhibits numerous cracks in the Kazaa network. Even if we do not know that the signature is only one single user (and not a group, as is common in hacking circles) it is clear that the cracking practices of this one individual is providing the filesharing community with considerable amounts of content.

Another way of discussing content distribution over filesharing networks is to examine how content is distributed over the nodes in the network. That is, examining what percentage of users actually contribute to the network overall. In the coming studies we are performing we will aim to construct a model of the social dynamics of the filesharing networks to show how these distributions look.

Conclusions

In having examined the filesharing networks two things stand out clearly. The first is that it is clear that very few cracks are actually made, and that most users of these networks are satisfied with merely copying the cracks available.

In a shallow analysis this seems to confirm the suggestion that legal protection of copyright protection will eliminate the piracy markets, since very few people actually crack copyright protection schemes. Most users simply copy.

This is, however, a much too quick conclusion to draw. Two things remain to be proven. The first is the likelihood of catching the cracker, or the expected sanction cost. It is not

easy to see why the fact that few users actually cracking copyright protection schemes will mean that it is easy to apprehend these users.

The second fact is that it remains to be shown why the crack/copy ratio looks as it does. Is it because high costs and extensive knowledge is required to be able to crack the technical measures used to protect copyrighted works? Or is it merely because the demand for cracks is limited?

We would argue strongly that it is the latter explanation that is the correct one. Anyone can rip a DVD, but why do that if there are rips available? Even if the rightsholders succeed in eliminating the crackers, these crackers will quickly be substituted by new ones, since the costs (in knowledge and otherwise) are tremendously low. There exists software and solutions for cracking copyright protection today that are quite easy to use and utilise. The relatively few number of cracks should not be explained by arguing that the costs of cracking are high, but rather by pointing out that the demand for cracks is low. There only needs to exist enough cracks to start the exponential distribution process abundant in the file sharing networks.

All in all the new legislation will fail to make a difference, because it has not taken into account how the social dynamics of file sharing networks function. The paradoxical legal protection of technical protection that was supposedly to answer the lack of legal protection and enforcement will remain a legal curiosity for the foreseeable future it seems. And this will be a serious problem for e-commerce and the evolution of content provider models on the Internet.

References

- ⁱ Lessig, L. *Code and Other Laws of Cyberspace* (Basic Books 1999) See also Biegel, S *Beyond Our Control* (MIT Press 2001), where the idea of architectural regulation is explained. Lessig himself also analyzes the idea in *The Future of Ideas* (Random House 2001), with a special focus on intellectual property rights.
- ⁱⁱ See various web sources such as the freesklyarov.org or eff.org that have massive document collections pertaining to the case.
- ⁱⁱⁱ See Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society Official Journal L 167, 22/06/2001 P. 0010 - 0019
- ^{iv} Ch. Clark, 'The Answer to the Machine is in the Machine', in: P. Bernt Hugenholtz (ed.), *The Future of Copyright in a Digital Environment*, The Hague: Kluwer Law International, p. 139
- ^v These are sometimes called Trusted Systems, see Stefik, Mark *The Internet Edge: Social, Technical and Legal Challenges for a Networked World* (MIT Press: Cambridge 1998)
- ^{vi} See for full documentation on this interesting project and vision the Imprimatur website <http://www.imprimatur.net> [valid 2002-04-05]
- ^{vii} A more complete history is found in Lundblad, N *The Answer to the Machine* (SISU report 1998:08)
- ^{viii} Slashdot.org "Sony Intentionally Crashes Customers' Computer" posted by michael [http://slashdot.org/articles/02/04/03/226233.shtml?tid=141]
- ^{ix} Gervais, Daniel "Electronic Rights Management Systems", *The Journal of World Intellectual Property*, vol 3, January 2000, no 1.
- ^x See WIPO Copyright Treaty and the agreed statements of the Diplomatic Conference that adopted the Treaty and the provisions of the Berne Convention (1971) referred to in the Treaty (WIPO Copyright Treaty)(1996) at [http://clea.wipo.int/lpbin/lpext.dll/clea/LipEN/46e4b/48c86?f=file%5Bdocument.htm%5D#JD_754a b]

^{xi} See for a short introduction the US Copyright Office Summary at

<http://www.loc.gov/copyright/legislation/dmca.pdf>.

^{xii} Cohen, Julie "The Right to Read Anonymously: A Closer Look at "Copyright Management" in *Cyberspace*, 28 *Conn. L. Rev.* 981 (1996). This issue was also later studied by the IMPRIMATUR-group in *Privacy, Data Protection and Copyright: Their interaction in the Context of Electronic Copyright Management Systems* (Institute for Information Law, Amsterdam 1998). See also Samuelson, Pamela "Regulation of Technologies to Protect Copyrighted Works" *Communications of the ACM* July 1996/ Vol. 39, No. 7 – wherein an early criticism of the provisions for copyright protection is provided.

^{xiii} See Hugenholtz, B Opinion, 'Why the Copyright Directive is Unimportant, and Possibly Invalid', *EIPR* 2000-11, p. 499-505

^{xiv} Hugenholtz, B 'Code as code, or the end of intellectual property as we know it', *Maastricht Journal of European and Comparative Law*, Volume 6 (1999), No. 3, p. 308-318. see also supra note xiii

^{xv} For a discussion on copyright metaphors see Litman, J *Digital Copyright* (Prometheus Books 2000) pp 77-89 and Rice, David A. "Copyright as Artifact: Foundation for Regulation of Circumvention Technologies and Contractual Circumvention of Copyright Limits" *BILETA* 2001, Edinburgh 9-10/4

^{xvi} This has often be criticized. See Cohen, Julie "Copyright and the Perfect Curve", 53 *Vand. L. Rev.* (Nov 2000), but also Seipel, Peter *Upphovsrätten, informationstekniken och kunskapsbygget. I: Vitterhetsakademiens årsbok* 1998

^{xvii} This has been observed by many authors. Most noticeable by Internet visionary and EFF founder Barlow, John Perry "The Economy of Ideas" *Wired* Mar 94

^{xviii} The number of Napster users was huge by the time Napster was shut down, and the total amount of files shared has increased since.

^{xix} See appendix I