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**DRM: Doesn't Really Mean Digital Copyright  
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# DRM: Doesn't Really Mean Digital Copyright Management\*

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## ABSTRACT

Copyright is a legal system embedded in a larger technological system. In order to examine the functions of copyright it is critical to examine the larger technological context of copyright: analog media and printed paper in particular. The copyright system includes both the explicit mechanisms implemented by law construct and the implicit mechanisms resulting from the technologically determinant features of paper and print. Specifically the copyright system did not address issues of physical integrity, binding of author's name, and authentication.

Digital rights management should address both the legal and technologically determined elements of the copyright system. An examination of that entire system yields a return to first principles for the design of digital rights management systems.

## Categories and Subject Descriptors

In a world where paper is no longer the medium copyright no longer protects the message. Changes in that medium to other analog media – wax recordings, vinyl recordings, magnetic analog tape recordings - have taken place by gradual extensions of copyright. Yet digital media are different in a fundamental manner – more than a new degree of change. In designing systems to implement copyright in the digital age, that change in medium should be taken into account. Currently the change in media is most often taken into account when those things either potentially lost or inherently threatened are identified as revenue schemes for digital content owner (Burk, 2001).

Digital Rights Management standards are being developed for digital content. Yet the question remains, what problems are the systems trying to solve? Most systems are explicitly modeled on copyright (e.g., Piva, Bartolini, & Barni, 2002) and others use the metaphors of piracy and author's moral rights to define or defend the design goals (e.g., Bolic, 2001). Thus the foundation of this examination is a utilitarian focus on the functions of copyright. I argue that the brilliance of copyright is that it provides attribution, access, and a definition of a fungible right thereby enabling epistemological surety and literacy, as well as a functioning financial information market. This paper is framed by the Western European experience of copyright; yet by focusing on function rather than motivation the results may be more widely useful.

After illuminating the utilitarian aspects of the copyright system, I propose a set of functional requirements corresponding to these functions. I then use these function requirements to examine three digital rights management systems: Giovanni, the Content Scrambling System, and the Adobe e-book. The well-known tools that break both CSS and Adobe e-book are also included in this discussion.

I conclude that while each of the DRM systems, and the systems that defeat the DRM, has elements of copyright, none solves the set of problems which copyright solved for the dawn of the print age. I further argue that were information all free, the information market might still fail. I close by proposing a return to first functional principles as a basis for DRM design.

## 1. Introduction

From the legal community the debate of digital rights management systems have been primarily concerned with the control of a particular market. (Rowe, 2002). Critics of digital rights management systems copyright have been concerned with the democratic implications of DRM Democratic concerns include fair use, (Burk, 2001), conflict between property rights and speech rights (Lessig, 2001, Litman, 1997, Netanel, 1996), the dangers of anti-

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circumvention laws (Samuelson, 1999; Lessig, 1999), and the threat to privacy (Cohen, 1996). Others have criticized the underlying economics of the extensions of copyright. (Gordon, 1992; Gordon, 1997)

From the technical community the debate includes building better DRMs – including more democratic as well as simply more powerful systems. Requirements for DRMs with respect to user privacy and the ability to prevent capture of content are both topics of DRM construction.

The critical issue that has been ignored is that copyright is and was a law embedded in a technological system, just as deeply as motor vehicle controls embed the assumption of the automobile. The copyright system includes technical and legal elements that together serve the purposes of more than ensuring author payment.

Given this fundamental oversight, this work begins with an extremely brief consideration of the role of printing and paper in the creation of copyright. Readers are urged to examine the primary sources for this work (Castells, 1997, McLuhan, 1997; Eisenstein, 1979). Here I argue for the conception of copyright as a larger technological and legal system, rather than a legal system alone.

In the second section I argue that the functions of the copyright system include binding of reputation to document, binding of ownership to document, educational availability and archiving. I then re-affirm the original assertion that copyright is an economic system by virtue of being a legal and technical one, and re-affirm some basic truths about information markets. This affirmation confirms my assertions with respect to the functions of copyright.

The third section is concerned with applications of the assertions in Section 2.

## **2. Copyright and its Precursors**

Technological change has long been the driver for copyright. As a class of policies, information property is the creation of the industrial revolution. Previously all information belonged to Crown or Church, with the rare author receiving some ownership. (Rose, 1993). The ability for individual tradable ownership of authorship and information rights were hotly contested and explicitly part of the debates and revolutions which raged across Europe in the eighteenth and nineteenth century. Individual ownership of ideas is in direct opposition to the absolute state.

“Information wants to be free” as a phrase may have originated in Stewart Brand’s WELL (Whole earth ‘Lectronic Link) but the concept was instituted (briefly, and as a notable failure) in revolutionary France. (Darnton, 1982) The licensing of the pre-Revolutionary regime of the resulted in excessively controlled debate resulting in a degradation of dialogue provided by the underground. In the case of the French Revolutionary period the adoption of copyright followed a reign of completely free information. In the records of the French revolution the popular political discourse suggests that an excessive control of information or a complete lack of control of information both result in a dysfunctional information market leading to all discourse plummeting to the pornographic: truly the lowest common denominator. (Darnton, 1982)

Britain similarly suffered a dysfunctional market after the refusal to renew the monopolistic Stationer’s Act. In Britain, authors were in arms and publishers had difficulty securing copies of works from abroad. Once the fundamental contours of copyright had been sculpted the form proved so potent as to sweep the globe, along with the movable type press. Printed paper, like other forms of information storage and transmission, created fundamental problems of economics and reliability of information. Copyright solved these problems. Now copyright is so deeply embedded into practice and thought that its success makes difficult the struggle for the appropriate response to the proliferation of information.

Copyright was created to address the issue of ownership and payment in a media that was relatively cheap, reasonably permanent, straight-forward to archive, and one that shows alterations rather easily. Before copyright the media was relatively expensive, isolated copies meant ease of loss, and isolated handwritten copies could be altered more easily than printed widely archived copies. The expense of making multiple copies made archiving the knowledge difficult, and the nature of hand selected copies resulted in difficulty in referencing and validation.

That copyright was created a moment of great discontinuity cannot be too strongly stressed. Before the printing press, content was very expensive to produce and even more expensive to distribute. Effectively there was no distribution, excluding the occasion loan for copying. Copying enabled mass creation and necessitated distribution. Distribution and reproduction were intimately related in the nature of copying via printing press.

The digital network means that copying and distribution are now extremely low cost (National Academy of Science, 2000). To distribute is now to copying, due to the inherent technology of digital reproduction.

Thus rather than focusing on the alterations in copyright across analog media, I consider copyright as created at the discontinuity. Essentially I seek a return to first principles to guide the design of digital rights management systems.

Like ICTs today, the printing press changed the economics and politics of information in early modern Europe. Any literate middle-class person could author and publish a leaflet and have it distributed across London, Paris, or Berlin. The nobility decried the opinionated chatter of the merchant classes to no avail. Those who controlled the equipment for data reproduction no longer had exclusive rights; as competition reigned the control of content was also lost. (Holdsworth, 1938).

For three hundred years, dialogue thrived, the scientific revolution raged, and copyright established itself as the rational mechanism for content control across the globe. Vastly different cultures adopted copyright. Over the last century new technologies, such as the phonograph, radio, motion pictures, and even high-speed presses, have monotonically increased the expense of producing and distributing information, leading to fewer publishers demanding greater copyright protection. Each new technology has led to new variations or clarifications in copyright. (

Change in technologies resulting in changes in the economics of information have yielded changes in copyright. Phonographs were the first challenge to the functionality of copyright. When there was no medium for recording song or voice the author could be assured of payment when the music was reproduced via sheet music sales. Similarly the author of a play could obtain reimbursement for small productions from the value of the scripts sold. Yet the ability to record song or play changed that equation. When the movies came along there were new concerns about ownership. Arguably no technology has been as radical and ubiquitous a change as networked digital information. (e.g., Wade, 1997; Castells, 1997; Beniger, 1989). In short, we are again at a place not unlike the period of discontinuity where copyright was created. This discontinuity is so great as to require more than a clarification of copyright consistent with the technological (and legal) trajectory of the past century. For the expansion of copyright with analog technological change, see (Lessig, 2001, Sterling, 1998).

Thus in this work I argue implicitly (by method) and explicitly that a new approach is needed, one which performs the critically important functions of copyright but in the fundamentally new information market.

## *2. 1 The Functions of Copyright*

At its creation, copyright was essentially an extension of freedom of communication, in that it replaced the Star Chamber, and fundamentally a mechanism for control in that it required deposit in the Royal Library. Before the Copyright Act the dual goals of regulation of press had been (often brutal) control of the content and exercise of political power for enrichment of the powerful few. First the printing guilds, then under the Stationers Act, the booksellers (as merchants overtook tradesmen in power), and always the Crown controlled and profited. Unique in the case of England a dual judicial system (the Star Chamber as well as the criminal and civil courts) created a set of sometimes-incompatible rulings. Thus with the final collapse of controls on licensing there was no single body of judicial findings on which to build. Printers were printing and selling as they wished. The information market was not functioning. The Copyright Act was, “an Act for the encouragement of Learning, by vesting the copies of printed books in the authors or purchasers of such copies during the times therein mentioned.” (Holdsworth, 1938, Vol. X)

The Copyright Act was radical in the following aspects:

1. The right went to the author, not the printer or bookseller.
2. The right had a finite term (14 or 21 years). Previously patents or privileges did not expire.
3. Violations of the Act were civil violations, never criminal violations.
4. Fair use concepts and educational goals were created.

Arguably the educational uses required in the Copyright Act were not entirely radical. The Copyright Act as signed by Queen Anne (thus becoming part of the Statute of Anne) did create the concept of fair use, requiring nine copies of each book so that each of the major universities could each have a high quality copy available in their libraries. Those libraries (Oxford, Cambridge, Sion College, the Royal library, four unnamed Scottish Universities, and Edinburgh) were also notable in that the presses of the Colleges were members of the Stationers Guild previously. (S. Anne, Article 1, Section 8, Clause 8, Section V.)

The depository rights were not radical. Depository laws have an established history, dating from copy requirements of monarchs seeking to build personal/national libraries (Harris, 1995). (The division between a royal library and national one is difficult, as not only was the crown the state but also because some royal libraries were open to scholars and some national libraries strictly limited access.) Yet depository laws very rarely required deposit in more than one institution. Thus the depository requirement for the Royal library is in the traditional of depository requirements while the university requirements reflect something qualitatively and quantitatively different.

The requirements for deposit simplified the creation of scholarship. Such an ordering is made possible by the printing press. Annotated quotations, peer-review based orderings, and claims of previous proven foundation via reference require some archival trusted information mechanism and some ordered manner to search the archive. In the case of the printed book the page itself and the nature of repeated printings provide the possibility of this certainty. Page numbers, editions, and the ability to reference a work such that a distant colleague can locate and confirm my assertions are a function of the press. Building upon the innate nature of the press, in that it produces identical copies identifiable at specific times and place, reference and review as used in modern scholarship were enabled. Practical application of the fundamental practice of peer review requires multiple copies of an identical document. Yet the printing press can only provide this function is there is an archive and a regulated way of identifying authorship, as well as enforcement functions to prevent wide-spread plagiarism. Copyright and the press together enable referencing and simplified the creation of communities of shared knowledge. (Netanel, 1996; Eisenstein 1979).

The problems with which scholars and legislators now study are not new, but ancient. By using the functions of copyright and the engineering practice of designing from first principles, I move forward to examine the functionality and coherence of the analog copyright system for networked digital copyright. As I propose that this must be different from although grounded in copyright, for clarity I call it *netright*. *Netright* must enable the same functions for reference of trustworthy material as copyright in order to provide the same value. As copyright was grounded in the mass copying made possible by the press, *netright* is a technology grounded in the mass distribution made possible by the net.

Note that paper, print and copyright in 1709:

- made it possible to own rights to expressions of information
- prohibited plagiarism from any work by extending the scope of works covered
- made information available to royalty and scholars

The creation of the right to own an expression created a market right. In fact, it created two market rights. One right was the right to copy and resell the material; that is a physical or monetary right. The other right was the right to have one's name associated with the material. The problem of illegal copying was distinct from the problem of usurpation even in the earliest days of the book (Johns, 1998). This continues today, as illegal copying is distinguished from plagiarism. (Should a student turn in a false paper it is no defense to say that a fair price was paid for the material.)

In summary then, here are the functions of the copyright system as embedded in the technology of the printed page:

1. Market
  - a. Reputation
    - i. First sale: increases distribution
    - ii. Contracts bind reputation to information
    - iii. Fair use can expand or decrease this value
  - b. Monetary value
    - i. First sale can reduce this value
    - ii. Fair use can reduce this value
2. Epistemological trust
  - a. Registration of information, including editions
  - b. Intact author information
  - c. Certainty of access
3. A human right of expression
4. A moral right

I do not treat the human rights aspect. The concept of copyright as a human right was created by Kant in an essay on unlawful publishing in 1785 which used natural law to argue for moral ownership for the production of one's mind. (Sterling, 1998) The argument for author's right supposes that the work bears "the mark of the author's personality". I do not address this function except to say that in utilitarian terms it can be seen as part of the reputation right. Given that the elicitation of author's rights followed the creation of copyright by some decades, and the American insistence on rejecting such a notion as late as 1956, this is defensible.

I also do not trace the history of the trade-off between ever more broad information protection and ever more specific definitions of fair use. (Vaidhyathan, 2001). Nor am I addressing the sources of intellectual property (Fischer, 1999). The various ideological arguments over the theoretical economic models that underlie copyright are of tangential interest (Netanel, 1996).

I focus exclusively at the point of technological and economic discontinuity, where the economics of the press began to dominate the economics of information.

## *2.2 Issues in Information Markets*

The effects of printing are so ubiquitous as to be invisible. Again I refer the reader to the superior histories of the press and print noted at the beginning of this section, but also take a moment to review the highlights.

Before the invention of the press, authoring was simple compared to copying. Copying enabled the survival of information from the Summarians, through the Roman and Byzantine empires, through Arab universities and finally to Europe. To copy a work was in no way theft but rather the only way to save a manuscript. Without laborious copying any authored document would be lost. Each book copied consisted of a set of articles selected by the copier. To copy was to edit, in that modern editing is the selection and ordering of material for inclusion. (e.g., Eisenstein 1979; Febvre

& Martin, 2000). Even that most basic ordering – alphabetical order – was in no way standard in Europe before the printing press. “A comes before b because a is the first letter of the former and b is the first letter of the latter and a comes before b ...by the Grace of God working in me, I have devised this order.” (Eisenstein, 1979). To copy was to be the agent of the author, to serve the author’s greatest interest. Not to copy was to resign the author’s words to certain destruction. Only after the printing press was invented was there a conflict between copier and author.

How can copyright create a fair market in which the modern digital value chain is validated? Answering requires understanding the nature of the change in information economics. In the networked digital age copying is costless. Alteration of documents and redistribution is trivial. Again I recommend primary sources for further discussion. (Shapiro & Varian, 1999; Whinston, Stahl & Choi, 1997, National Academy of Science, 2000).

From being inexpensive copying has become nearly free. Distribution costs have been reduced to almost nothing, a course of affairs which will continue at a rate surpassing even the decrease in cost of computing power (Odlyzko, 2000b). Yet the functions of copyright are still necessary: production can be expensive either monetarily for a Hollywood studio or in sweat of the brow from a single creator. The simplification of misappropriation of goods does not imply that such a state of affairs creates a functional market.

A related issue now and in past implementations of information technology is the issue of epistemological surety. With widespread misappropriation, how does a reader know to trust the content, the attribution, or the consistency of a document?

In terms of the function of copyright there are two further distinctions between paper and digital information. First, reputation is bound to paper. Second, distribution is archiving in a paper medium.

When an author’s name is added to a paper document removing it is difficult, and leaves traces of the action. The author’s name stays on a book: on the cover, the title page, sometimes even the pages. It takes significant effort to convincingly alter authorship information on a book or a paper and redistribute. In contrast, maintaining author information is difficult in digital transmission, requiring the retransmission of an entire document and often even the difficult construction of the context of the document (e.g., URL, author, date visited). The critical problem of persistence is being addressed with great optimism but yet little result in the Web Consortium project the Semantic Web.

Distribution is archiving in paper distribution. Books are distributed in a format that requires conscious decision to store or remove. Storage is simplified with books. Newspapers and books when distributed are distributed to individuals who might store them and to libraries which hold archives. In contrast, distribution via web sites requires distribution into caches that are automatically cleared.

Filtering is integrated with publishing, distribution, and copying in the world of the printed page. Editors choose which material to publish, and merchants choose which to provide. The fundamental physical nature of the printed page makes filtering a requirement for physical production and distribution just as the finite number of possible pages requires the selection processes of journals.

One final issue is radically different. Herb Simon most famously coined the concept of an attention span economy. As the sheer volume of information increases those services, software, or practices that reduce information flow are becoming increasingly valuable. Corporations seek to decrease the information flow to consumers using affinity marketing and personalization. As an example, weather.com offers information for three selected zip codes versus offering every user the entire database of world weather conditions. The value of all the weather data on the globe is so much as to be of no value if I cannot sort it to determine if there will be rain on my picnic.

Trustworthy information is not a new problem. Reliability of information, currently referred to as integrity in computer security, has an ancient history. In Babylon clay tablets were the mechanisms for recording information and contracts. Where there was significant concern that one holder of the contract might alter the clay on which the details were impressed, four “copies” of a contract were made. (While our concept of exact copies does not apply, the critical details were the same.) First two of the copies were baked. Then these two copies were encased in the clay of the other copies and baked inside, illustrating a need for self-validating contracts. (Harris, 1995)

Trusted third parties may be new in that cryptographers implement them using write-once optical media and digital cryptography but the concept of a trusted third party is as ancient as the library or record-keeping temple. While self-validating contracts were used for transactions that were critical only to the parties to the contract, third party validation was used for critical information. The earliest libraries were temples and then royal archives, where information for greater social importance was stored. The seat of government or the highest temple would hold the canonical document and copies could be provided to those institutions lower in the hierarchy. In this way there was a trusted third party where those concerned with the integrity of information could be validated (Lerner, 1998).

Now filtering requires more participants. Increasingly filtering is used to select distinct information for individuals rather than trusted selections per se. Compare the selection of texts for temple inclusion, to the library selection process, to the interactive selection processes of Amazon. In the previous two cases specialists make selections for a wide number of people based on professional training. The relative value of the information they selected enabled the

pre-press library to survive. Depository laws, community support and democratic values enabled press-based libraries to survive. What is the value of filtering and what additional filtering models must be supported for the information economy to function in the digital networked age? And more to the point, how do current DRM technologies enable or prevent the filtering and rating function?

Currently libraries continue to receive public support but are overwhelmed at the cost and difficulty of archiving on-line material. Archives (such as the WayBack machine) are prohibited from providing archival access by copyright – an essential feature of the analog copyright system. In addition, individual users develop following with web pages, blogs, personal selections, and electronic subscription or newsletter services with few avenues for archival storage. Of these, arguably a blog is itself some sort of archive given the temporal ordering of items of interest to a selected community, although it is most compelling compared to the pre-museum curiosity collections (Rodzilla, 2002; Blood, 2002).

Thus in addition to the reputation market, monetary market, certainty of access/archiving, referencing systems, and binding of content to creators, the next copyright must function to allow the rewarding of filtering or to explicitly provide support for a filtering market. This is not a set of trivial design requirements. To examine the state thus fare, I examine four digital rights management systems.

### **3. Description of Three Systems and Their Functions**

Digital rights management systems attempt to implement the copyright system in the digital realm. Changes in the technology from analog to digital offer users some new options, such as creating back-ups, while potentially removing other, such as ease of archive and personal mark-up. An implicit question answered by DRM design decisions is on what properties of paper are valuable enough to reproduce in DRM and which can be removed or made subject to payment. Those implications of design decisions are made explicit for three designs in this section.

In this section I describe three copyright systems: Giovanni, Content Scrambling System, and the Adobe Ebook. Noticeably this requires examining DeCSS and the eBook reader. In order to be consistent in this description ownership or copyright data that are about but not in the content are called metadata. The data that are the content is called, reasonably enough, content. Data that cannot be altered without subversion of the system is called secure data. The use of this terminology is meant to assist in providing clear descriptions. In no way do I intend to imply that all the systems here provide cryptographic security, or that all data that a content owner might want control over is meta-data.

#### *3.1 Giovanni*

Blue Spike offers a suite of products, so my focus here will be on Giovanni. Giovanni is Blue Spike's digital watermarking technology. Giovanni can be used for identification, authentication and auditing of digital audio works. Giovanni is often classed as mechanism for protecting audio content, and indeed there is a company focus on making the watermarking inaudible. Yet Giovanni can be used for any content; and it is the explicit goal of Giovanni is to be available for all media.

In the Blue Spike model a producer will create content and then mark it as his or her own. This information will be presented for sale at the Blue Spike server.

The creator or owner of the content selects attribute data to be embedded in the content. The resulting secure content is then stored and made available over Blue Spike's servers.

Giovanni begins by generating a single random number from Giovanni's key and the seed for a hash function. This random number is divided into two segments,  $r_0$  and  $r_1$ .  $r_0$  is hashed with the attribution data to create a payload the correct size to data to embed, thereby creating the secure content. Then  $r_1$  is used to determine the placement in the content of watermarked data generated with  $r_0$ . Thus the payload is encrypted and embedded into the content.

Blue Spike has a model that requires author registration. Blue Spike offers to manage the enforcement of the content as well, by searching for Giovanni signatures across the network.

Blue Spike includes the option of embedding purchaser sensitive information in addition to producer information in a good. It is not exactly clear from the documentation how this is done, presumably the same symmetric keys are used and the purchaser information is added to the hashed payload. In the case of the producers, the identifying information may be pseudonymous as long as the producer can prove him or herself the rightful owner. In the case of the customer the information is based on payment information meaning that the data embedded are sensitive data.

#### *3.2 CSS*

The content scrambling system (CSS) is the standard for the content protection system architecture (CSPA). Thus CSS is embedded into DVDs and DVD players. In the case of CSS the content is the DVD movie itself, and the metadata consists of a region code.

Region codes are a decimal digit which determines in which region a DVD can be sold. The region code prevents regional arbitrage by buyers and allows large-scale geographic price discrimination by merchants. Therefore a primary function of CSS is regional price discrimination<sup>1</sup>.

CSS encrypts the contents of a DVD so that only approved readers can access the code. A key that decrypts each DVD is stored in DVD players. Every DVD player has a small set of player keys (in case one key should be compromised). Every DVD has on it a key. Each CSS-protected DVD begins with a hashed disk key (5 bytes). After the hashed value, the full disk key is then listed encrypted in every possible player key.

There is a set of 409 player keys. Every CSS licensee is given a key from this set. Thus if a CSS licensee implements an unacceptable player, the license can be revoked by removing the corresponding encrypted disk key.

The player confirms that it is using the correct key for the given disk by hashing the decryption of the disk key. The hashed, decrypted key should be equal to the 5 bytes at the beginning of the CSS block.

Once the disk key has been determined, the DVD player uses the disk key to decrypt a title key. The content is either encrypted in the title key or encrypted in a permutation of the title key and the list of encrypted disk keys.

DeCSS breaks the encryption provided by CSS so that a DVD can be decrypted and played on any arbitrary player without altering region code. A primary function of DeCSS was to allow users to play DVDs on the Linux operating system using open code<sup>2</sup>.

All players limit the number of times a region code can be altered. The Macintosh OS X DVD player limits the change to three times. Other players limit the number of changes five times. The number of times a player can allow the user to alter the region code is a function of the license associated with the DVD player key. Should any player manufacture a device that allowed arbitrary region code alterations then the license of that producer would be revoked.

### 3.3 Adobe eBook

The Adobe eBook software provides for digital encryption of content and is associated with a series of sellers who agree to provide copies of an eBook-protected book for resale. eBook merchants provide conversion to digital format, author rights management services via eBook and offer to provide distribution. Different providers offer different bundles of services associated with eBook. However eBook can be purchased with server software so there is no archival requirement with eBook services.

As with PDF, Adobe provides a free eBook reader compatible with the eBook digital rights management system.

In contrast with paper books eBooks expire.

The Advanced Ebook Processor directly addresses the core question of which of the characteristics of paper books are worth preserving in the digital realm, with the Ebook and the Advanced Processor having fundamentally different answers.

## 4. Analysis

In this section I bring together the functions of copyright and the functions of the digital rights management systems. A hypothesis which must be assumed to be true or false for this analysis to be useful is that all illegal copying substitutes for purchasing. While there is evidence to the contrary (Osorio, 2002, Pahfl 2001) the concept of illegally copying as revenue lost will be assumed in the tabulated analysis. Then in each discussion I will briefly revisit the issue of illegal copying as lost revenue.

The second, related issue creating uncertainty in this analysis is the issue of access. If all illegal copying is a direct substitute for legal copying the obvious implication is that the value of increased access is negligible. There is simply loss of revenue for the author. If illegal copying functions as free advertisement, and encourages additional purchases then increased access yields increased revenue. If illegal copying yields widespread awareness of a work, then the author loses monetary value but gains reputation value.

Finally there is a third conflict is evident between the functions of copyright: how does availability alter the veracity of a document? When there is an increase in availability and a decrease in security in a document, what dominates? If the content are not available, or the availability is strictly controlled, then the useful functionality of surety is limited as fewer can learn from or build on the information. A timely example is the alteration of *E.T.: the extra terrestrial* for re-release. In the 2002 release potty humor was deleted, and police are seen with flash lights instead of guns. These

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<sup>1</sup> I use the phrase price discrimination in the economics sense, implying no moral wrong. In fact, there is a strong economic argument that for high fixed cost, low marginal cost goods price discrimination is necessary for the market to function. A most common form of price discrimination is the "stay over Saturday night" used by airlines to discriminate between corporate and vacation travelers. Notice that air travel providers are in a high fixed cost, low marginal cost business.

<sup>2</sup> Since a fundamental element of open code is the ability of users to alter the code, no provider of open source players can enforce a limit on the number of times the region code is altered.



digital changes would be misleading to any scholar using E.T. to study the culture of the seventies. These changes were made possible by the existence of few master copies. Similar controls of documents and copying technology allowed Stalin to alter official historical documents when previously favored officials were purged. In both cases, the alteration is detectable by virtue of copies in archives beyond the reach of the editor.

Increased access increases surety as widespread reproduction increases the difficulty of subverting reliability. For example, for reliable timestamps (Haber & Scott Stornetta, 1991,) the outputs of hash trees are intermittently published in the NY Times. As the NY Times is widely archived, it would be inconceivably difficult to alter all versions of the published material. Similarly if a document exists in many archives not even the author can go back and alter the content without detection. For example, when there are improved results or clarifications in papers on-line then the publisher or author can improve or correct in real time. In a paper version the improvements correspond to a new edition number or revised publication. Therefore after a claim becomes substantiated or an error corrected, referencing functions on paper.

Having considered these common issues I now consider the systems described above according to the functions of copyright. In each cell the function of copyright listed in the second column. Along each row the ability of a system to fulfill that function is listed in the corresponding column. The increase or decrease in the ability of a system to support a particular function is noted by a minus or plus sign, respectively.

The monetary incentive reflects the creation of a primary market.

Table 1: Adobe eBook and the Advanced eBook Processor

<b>Functions of the Copyright System</b>	<b>Adobe eBook With respect to paper texts</b>	<b>Advanced Ebook Processor with respect to eBook</b>
Tradable good	-	+
Tradable right	+	-
Attribution	+	-
Archiving	-	+
Access	+/-	+

Advanced Ebook Processor enables the right of first sale (or secondary distribution) and illegal copying. The increase or decrease in market value is a function of the nature of illegal copying as substitution or complement for legal copies.

Note the Adobe Ebook confirms the features of digital content that are a loss to consumers while negating the gains for consumers. Specifically the Ebook removes first sale, archival storage, and the ability to mark passages. The Ebook deletes the right of first sale and related rights (rentals). The Ebook essentially takes all alterations of the copyright system resulting in technological change and negates those granted to the consumer.

Given that Advanced Ebook Processor removes the tight binding between author and content, the implication is that eBook decreases reputation value. However this is subject to the issue of distribution as opposed to encryption as surety mechanisms.

In terms of access eBook arguably increases access in that it provides a portable format and support for creating digital books. However, in the long term, eBook decreases access because the format will change over time and user access to the encrypted books expire. Advanced Ebook Processor increases access and availability because it prevents expiration and ensures availability when the Adobe-owned format is altered.

In contrast to other on-line book formats, eBook prevents cut and paste of significant sections. Of course, the centuries old tradition of transcription for plagiarism and illegal copying remains available. Thus in comparison with paper texts there is not effective change between an electronic book and a traditional book with respect to authorship and reputation value.

Table 2: CSS, DeCSS and the Functions of the Copyright System

<b>Functions of Copyright</b>	<b>of</b>	<b>CSS</b>	<b>DeCSS</b>

Tradable good	-	+
Tradable right	+	+/-
Attribution	neutral	+/-
Archiving	-	+
Access	-	+

CSS does not prevent bulk reproduction and resale of content. When content are mass produced the only issue would be that the region code remains. This means that a large-scale commercial production of illegal copies must purchase originals in the target market. In effect, this prevents consumers from purchasing illegally copied goods in another region and returning home to sell them. Also, by making it more likely that an illegal copy will not work in a CSS-compliant player, CSS may function to reduce demand for illegal copies of DVDs.

CSS increases the monetary value of the DVD because it allows regional price discrimination. CSS limits this value as the secondary market is decreased because first owners cannot resale across boundaries. If this constrains the right of first sale, there is a possible increase in monetary value to the owner.

DeCSS decrypts the content on the player, allowing excerpts and therefore misappropriation. It increases each of access and availability, In addition, it creates the ability to make derivative works. Unlike the case of books direct transcription is not an option in video content. Therefore DeCSS may increase the .value of the tradable right if it increases the use of a good for building other information goods. This reuse will also increase the reputation value.

DeCSS enables archiving by creating an unprotected bit stream and allowing any player to be used. DeCSS increases access by allowing initial cross-border trades and an expanded secondary market.

Table 3: Giovanni and Free Information

Functions of Copyright	Giovanni	Free Information
Tradable good	Neutral	-
Tradable right	+	-
Attribution	+	Neutral
Archiving	+	+
Access	Neutral	+

Arguably the Giovanni system should be far preferable to those seeking to maintain fair use and access of traditional information markets. Giovanni offers critical functionality that is aligned with the value of copyright to society: archiving, maintenance of author information, and no innate restrictions on access. The basic concept, to allow people to view rather than to assume each viewer is about engage in a criminal act, is embedded in copyright.

Giovanni offers critical functions of copyright. Giovanni maintains copies as an archive as well as ensuring that those who have purchased services can alter the format of the material to keep up to date.

If the watermarking in Giovanni prevents alteration to other formats and effectively locks the information producer in one technological time, then it is less certain that this Blue Spike offering is optimal. If the watermarking allows for a history of use, just as this document embeds references and quotation from other works, then Giovanni offers a method for building complex hyper-linked trustworthy documents.

Giovanni does not function to provide a tree-like mechanism so that the interrelationship between documents can be traced. However, with market dominance it could provide something not unlike citeseer (<http://citeseer.nj.nec.com/>) with inclusions in future works rather than specific references. (For example, such a reputation or linking system need not require an explicit reference to Shakespeare if the creator notes something rotten in the state of Denmark).

The practice of embedding consumer information assumes that only the consumer would release the data and does not address the possibility of data theft. In the case of data theft the consumer is subject to the inherent punishment of exposure of sensitive information. Given that identity theft costs the victim on the order of thousands and recovery takes an average of eighteen months this would be a punishment unlikely to be sustainable as a matter of policy. While the feature is optional, the choice is up to the producer. In the case of embedding information the producer is allowed to select the level of risk for the customer without customer input. In addition this option precludes the ability read anonymously.

Does Blue Spike does not solve the problem of persistent storage or search? The question with respect to Giovanni is if a single company can serve the role of the Royal Library – creation of effective copyright protection, archiving, and access. Of all the systems, Giovanni is the nearest to serving the functions of the copyright system for digital content.

## 5. Conclusions

Systems which fall under the rubric of copyright today by virtue of protecting content sometimes do enhance the market element of the copyright system; however, sometimes at the price of the other functions of the copyright system. Similarly code that breaks content control mechanisms enhances some functions of copyright and undermines others.

Authors want to be remunerated with some combination of reputation and wealth. The increasing value of the readers' attention span should also be considered in the information economy. Neither those who seek to manage authors' rights nor the defenders of access rights are entirely aligned with the purposes of copyright in that no system motivates and awards filtering, rating and distribution.

Future work entails examination of more digital rights management systems. One interesting question is the relationship between the surety function and the market function, and the nature of the trade-off illustrated in these few cases. Is this an inherent trade-off, or is it possible to design a system that offers both? These extensions of the work are currently being addressed in ongoing research.

Of course, the most interesting question is designing a system for netright that places copying in the place of history past, technology present, and replicates functions well met for a different age. If information can be said to have desire, then information wants to be used and trusted.

## Bibliography

1. Branscomb, 1995, *Who Owns Information*, Basic Books, New York, NY.
2. J. R. Beniger, 1989, *The Control Revolution : Technological and Economic Origins of the Information Society*, Harvard University Press.
3. R. Bolick, 2001, Publishers' Requirements for Digital Rights Management, *W3C DRM 2001 Workshop*. INRIA, Sophia Antipolis, France.
4. R. Blood, 2002, *The Weblog Handbook*, Perseus Publishing, Cambridge, MA.
5. D. Burk and J. Cohen, 2001, Fair Use Infrastructure for Rights Management Systems, *Harvard Journal of Law & Technology*, Vol. 15, No. 1, pp. 41- 83.
6. M. Castells, 1997, *The Information Age: Economy, Society, Culture* Blackwell Publishers, Massachusetts.
7. Cohen, J. 1996, "A Right to Right to Read Anonymously: A Closer Look at Copyright Management in Cyberspace", 28, *Connecticut. Law review*, 981
8. R. Darnton, 1982, *The Literary Underground of the Old Regime*, Harvard University Press, Cambridge MA
9. E. Eisenstein, 1979, "*The Printing Press as an Agent of Change*", Cambridge University Press, Cambridge, UK.
10. L. Febvre & H. Martin, 2000, *The Coming of the Book*, Verso, London, UK.
11. W.W. Fischer, III (1999) "The Growth of Intellectual Property: A History of the Ownership of Ideas in the United States," in *Eigentum im internationalen Vergleich* (Vandenhoeck & Ruprecht, 1999),pp. 265-91
12. W. Gordon, 1992, "Asymmetric Market Failure and Prisoner's Dilemma in Intellectual Property," 17 *University of Dayton Law Review* 853.
13. W. Gordon, 1997, "On the Economics of Copyright, Restitution and 'Fair Use': Systemic Versus Case-by-Case Responses to Market Failure," 8 *Journal of Law and Information Science* (Australia) 7.
14. S. Haber and W. S. Stornetta, 1991, "How to time-stamp a digital document", *Journal of Cryptology: the journal of the International Association for Cryptologic Research*, Vol. 3, No. 2, pp. 99-111.
15. M. H. Harris, 1995, *History of the Libraries in the Western World*, The Scarecrow press, London, UK.
16. H. Hochheiser, 2001, "Privacy, Policy and Pragmatics an Examinations of P3P's Role in the Discussion of Privacy Policy", *University of Maryland Working Paper*, 2002.

- 17 Holdsworth, 1938, *A History of English Law*, Methuen & Co Ltd, London, UK.
- 18 A. Johns, *The Nature of the Book: Print and Knowledge in the Making*, University of Chicago Press, Chicago, IL.
- 19 Lerner, 1998, *The Story of Libraries from the Invention of Writing to the Computer Age*, Continuum Books, New York, NY.
- 20 L. Lessig, 1991, *Code and Other Laws of Cyberspace*, Basic Books, NY, NY.
- 21 Lessig, 2001 *The Future of Ideas*, Basic Books, New York, NY.
- 22 J. Litman, 1997, Reforming Information Law in Copyright's Image, 22 *University of Dayton Law Review* 587: <http://www.msen.com/~litman/dayton.htm>.
- 23 Litman, 2001, *Digital Copyright*, Prometheus Books, New York, NY
- 24 Marshall McLuhan, 1997, *The Gutenberg Galaxy*, University of Toronto Press, Toronto, Canada, pp 23-31
- 25 National Academy of Science, 2000, *The Digital Dilemma: Intellectual Property in the Information Age* National Academy Press.
- 26 N. W. Netanel, 1996, Copyright and a Democratic Civil Society, 106 *Yale Law Journal* 283.
- 27 A. Odlyzko, 2000, The History of Communications and its Implications for the Internet, *University of Minnesota Working Paper Series*, University of Minnesota, Minneapolis, [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=235284](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=235284); Posted: August 30, 2000; Last Accessed: May 6, 2002.
- 28 A. Osorio, "Primary Income Loss and Secondary Network Effects in Illegal Copying of Software" *Information Technology Group, Center for International Development, Working Paper Series*. Harvard University, Cambridge, MA.
- 29 M Pahfl, (2001) "Giving Music Away to Make Money, *First Monday*, Vol 6 No 8. [www.firstmonday.org/issues/issue6\\_8/pfahl/index.html](http://www.firstmonday.org/issues/issue6_8/pfahl/index.html)
- 30 Piva, Bartolini, Barni, 2002, Managing Copyright in an Open Network, *IEEE Internet Computing*, May/June, PP. 18-26.
- 31 M. Rose, 1993, *Authors and Owners*, Harvard University Press, Cambridge, MA.
- 32 J. Rodzilla, 2002, *We've Got Blog*, Perseus Publishing, Cambridge, MA.
- 33 Jonathan Rowe, 2002, "Tollbooth of the Mind", *the Christian Science Monitor*, June 27m 2002, pp.9 sec 2.
- 34 Samuelson, P., 1999, "Why the anti-circumvention regulations need revision", *Communications of the ACM*; New York; Sep 1999.
- 35 A. Shapiro & H. Varian, 1999, *Information Rules*, Harvard Business School Press, Boston, MA, c1999.
- 36 Sterling, LLB, 1998 *World Copyright Law*, Sweet & Maxwell, London
- 37 United Nations, 1995, *The United Nations and Human Rights 1945-1995: The United Nations Blue Book Series. Vol. VII*, United Nations; New York, New York.
- 38 Vaidhyanathan, 2001, *Copyrights and Copywrongs*, New York University Press, New York, NY.
- 39 R. Wade, 1987, *The Spirit of the Web*, Sommerville House Books, CA.
- 40 A. B. Whinston, Dale O. Stahl, Soon-Yong Choi., 1997, *The Economics of Electronic Commerce*, Macmillan Technical Pub.. Indianapolis, IN.