

Preface

Borrowing a book from a library is now a typical, simple and costless procedure. A whole universe of knowledge is available to anybody, which establishes a basis for lifetime education for all of society. The act of borrowing a book seems easy, but it is based on a complicated mechanism involving laws, publication policies and many financial and technological parameters. This mechanism might be in balance and in everyday use, but this balance can be affected by the rapid digitization of the information provided (the books). The problem can be proven in a simple way: a book can be borrowed by one or two people at the same time within the same library. An electronic book can be borrowed by anyone with a telephone line, a computer and an Internet connection. From the Internet user's point of view, this news is positive; the library owns a book which is never exclusively borrowed and is always available for countless readers. In fact, this library is open twenty-four hours a day, seven days a week. On the other hand, this news is very stressful for publishers and writers. How many copies will be sold or published while digital networks allow worldwide access to digital information? How many books, movies, pieces of music and other, copyrighted information can be created, published and sold on the Internet while, to enable worldwide access for readers, listeners and viewers, one digital copy is enough? These initial thoughts and problems should not lead to aggressive and dangerous actions, which restrict or disallow access to cultural, scientific, educational and entertainment resources. This is the worst news for the Internet user and e-inclusion to Information Society is threatened.

The aforementioned simple (as it seems) problem describes exactly the modern digital dilemma that Randall D. (2001) predicted. The World Wide Web is a powerful vehicle for publishing and distributing information and is the world's largest infrastructure for making digital copies of this information. It is a technology with which free and efficient access to information could grow at an unbelievable pace but, at the same time, it could prove to be a force that deepens the discrimination line between those who have access to it and those who do not.

According to the House of Representatives (1998), Information Society technologies are changing the most common methods of providing access to digital content. The information available in digital form increases on a daily basis; the Internet is connecting worldwide digital content; and the World Wide Web is providing an efficient platform consisting of access services, which act as a gateway to scientific and cultural resources, music, movies and video archives. The technologies which provide access to digital content also provoke important problems concerning the protection and management of intellectual property rights (IPR) for this digital content. This happens mainly because technology supports efficient access to and enables the copying of copyrighted information. As a result, many legislative rules and laws for IPR, which refer to physical objects, are almost invalid for digital objects. The specific problem becomes even more intense as broadband Internet is applied worldwide and any Internet user has fast data transfer rates at his or her disposal. Other examples which prove the size of the problem include the free distribution of copyrighted music and movies through the Internet and the online sale of copyrighted digital art and cultural images without permission.

Digital rights management for e-commerce systems is a proposed solution for IPR protection and management. These systems combine a handful of technological solutions such as watermarking, data encryption, information systems, databases, and e-commerce applications so as to deal with the issue of the protection and management of copyrighted digital content.

The term digital rights management (DRM) was coined by some combination of vendors, their marketers, and industry analysts in the late 1990s, as Katzenbeisser and Petitcolas (2000) mention. Thus, defining DRM has become difficult and a better question to ask is “What has DRM become?” When content (information) is created, the control of a set of rights to that content is inherited by the owner, allowing browsing, editing, printing, executing, copying, etc. Traditionally, those rights have accrued from three sources:

- **Legal:** Rights that someone gets either automatically under law (such as inherent copyright) or by some legal procedure (such as applying for a patent).
- **Transactional:** Rights that someone gets or gives up by buying or selling them, such as buying a book or selling a manuscript to a publisher.
- **Implicit:** Rights defined by the medium that the information is in.

The most important aspect of DRM is that the first two sources of rights have not changed much with the advent of technologies such as the Internet, cell phones and MP3 files. Various parties have called for a complete replacement of the intellectual property (IP) law, but this has not happened and is not going to. Legislators have responded to new technologies by creating Directives and Acts.

Transactions have not changed that much, either, regardless of the fact that they can be performed over the Internet through e-commerce systems. The same laws apply, the same money is used, and the same goods can be purchased. What has really changed is the implicit nature of rights when applied to traditional media. The Internet has made these implicit rights explicit. This engenders problems and opportunities for content providers as well as consumers.

Understanding the implicit rights of traditional media types, the next example is considered. If a book is purchased, the buyer has rights to the content in the book. Some are legal (it is a breach of copyright law to make copies of the book and sell them) and other transactional (someone pays money for the right to read the book, to lend it, or to give it away). Most rights, however, derive from what is easy and what is difficult to do with the technology of a printed book.

Digital rights management refers to controlling and managing rights to digital intellectual property. The need for control and management has increased now that digital network technologies have taken away the implicit control that content owners get with legacy media.

It is the aim of this book to present the state of the art technologies for digital rights management systems, which are designed, implemented and applied through e-commerce systems and to discuss recommendations, key points, disputes and limitations of these technological solutions.

The main objective of the book is to concentrate on new innovative technologies used for the design and implementation of advanced e-commerce systems, which facilitate digital rights management and protection for the transacted content. Specifically, the focus will be on technologies such as data encryption and watermarking (Wayner, 2002), peer to peer networks, very large databases, digital image, sound and video libraries, multimedia content based services, electronic licensing, digital certificates, rights expression languages, metadata standards, etc., which are used within the e-commerce systems. In addition, special focus will be given to implemented e-commerce systems, whose aim is to support organizations active in the sectors of entertainment, content industry, music, cinema and culture and to protect, manage, exploit and disseminate multimedia content and its intellectual property rights.

THE CHALLENGES

E-commerce systems are becoming more and more important as a new and effective method to distribute, transact and exploit digital multimedia content. Interactive applications and GUIs, digital image, sound and video databases, e-payment systems, and e-licensing mechanisms are a few of the many opportunities created through the evolution of e-commerce.

In this framework, intellectual property rights (IPR) protection and management of multimedia content is gradually becoming a critical issue, primarily because reproduction costs are much lower for both legitimate IPR holders (content owners) and those infringing intellectual property legislation. Further, digital copies are perfect replicas and computer networks have changed the economics of distribution. Networks enable the distribution of multimedia content worldwide and do so cheaply and quickly. As the US Computer Science and Telecommunications Board (1999) has described, it is easier and less expensive both for the rights holder to distribute a work and for an individual to make and distribute unauthorized copies. Finally, the World Wide Web has fundamentally altered the publication of information, allowing everyone to be a publisher with worldwide reach.

In addition, the production and sharing of information in electronic form has been integrated into everyday life, directly affecting intellectual property legislation. Today, casual everyday activities such as downloading files and forwarding information found on the Web can, at times, violate intellectual property laws. Other activities, such as making copies of information for private use, may require difficult interpretation of fair use provisions of the law to simply justify their legality. Consequently, individuals have the capability and the opportunity to access and copy vast amounts of digital information, yet lack a clear picture of what is acceptable or legal. On the other hand, the necessary amendments of legislation in several cases does not fully address with the problem, resulting in certain legislative weaknesses.

A fundamental problem is that institutions of the Digital Content Industry want to make information widely available for educational or commercial reasons, but the legal environment makes this difficult. Where the rights-holders are known, this can be negotiated, but the costs of clearing the rights for digital images taken by an individual for non-commercial purposes can be prohibitively expensive.

The consequences of the aforementioned parameters are obvious and digital content is being used, copied, distributed and published without the necessary license. In many cases, commercial exploitation is also taking place without the necessary legal provisions and permissions by the copyright owners. An Internet user with an average ADSL connection at home who utilizes peer to peer networks for exchanging data has the ability to transfer more than 25Gbytes of digital content per day. This content may include music, movies, television series, documentaries, books, photographs and images of all kind. In addition, copyrighted content of the world's cultural heritage is being distributed and sold through the Internet. More than 4,000 illegal copies of the Picasso's "Guernica" are published on the Internet and more than 1,000 digital images of the Athens Parthenon are being sold through digital image stores without permission by the copyright owner. The music and movie industries are facing economic losses, and this directly affects the jobs of thousands of people. In addition, the phenomenon of unauthorized use of digital content on the Internet causes skepticism within Digital Content Industry organizations, who are not willing to distribute digital content through e-commerce systems, unless certain technical protection means are being applied.

SEARCHING FOR A SOLUTION

Universities, research institutes, laboratories and corporations who are active in dealing with the issue of protection and management of IPR of digital content aim mainly at providing a safe environment for content distribution and publication (Cox, Miller & Bloom, 2002). The US Government, the European Union, Canada, Japan, Russia and all the countries with a developed content industry have recognized the need for finding effective solutions for this important issue. The intensive activity is proved by the establishment of many governmental bodies and committees, which are dealing with the issue and its legal, financial and social aspects and, in parallel, by many funded research projects, which aim at developing technologies for copyright protection and management.

These projects concentrate on new innovative technologies used for the design and implementation of advanced e-commerce systems, which facilitate digital rights management and protection for the transacted content. Specifically, the focus is on technologies such as:

- Methodologies and techniques of content digitization
- Geographically dispersed and interoperable databases
- Peer to peer networks
- Metadata for digital rights management
- Digital image, video and audio processing
- Telecommunications and signal processing
- Digital watermarking of multimedia content
- Unique identification systems for digital objects
- Internet technologies
- E-commerce systems
- Electronic licensing mechanisms and applications
- New and innovative file formats
- Streaming applications for audio and video
- Rights expression computer languages

The use of the aforementioned technologies provides solutions, applications and information systems, which aim at digital rights protection and management. This book provides an in-depth analysis of all the above technological solutions and their combination and use in integrated e-commerce systems.

ORGANIZATION OF THE BOOK

The book is organized into five semantic sections and includes fifteen chapters. A brief description of each section and chapter follows:

Section I, “*Overview*,” the specific section provides an overview of the terms, methodologies, architectural issues and technological perspectives of digital rights management in e-commerce systems.

Chapter I, “*Intellectual Property Rights*” this chapter provides an overview of Intellectual Property Rights and related subjects, including some approaches to IPR protection management and privacy.

Chapter II, “*Digital Rights Management: A New Trend or a Necessity?*” in this chapter, the need for using copyright protection tools in our digital transactions is highlighted. The legal framework and the current activities of organizations as World Intellectual Property Rights Organization (WIPO) is also

provided in this chapter, along with the existing DRM technologies and the future research directions in this field.

Section II, “*Protecting Digital Rights in E-Commerce Systems*” In this section, an in-depth analysis of technological means for copyright protection of multimedia files is presented. Specifically, the most advanced watermarking algorithms and applications for multimedia are analyzed and evaluated.

Chapter III, “*Image Watermarking*” digital watermarking is an appropriate solution for copyright protection of digital rights. This technology allows a secret message to be hidden in an image file, without the detection of the user. The watermark is not apparent to the user, and does not in any way affect the use of the original file. The watermarking information is predominantly used to identify the creator of a digital image file. This chapter presents the basic terms and definitions as well as the most advanced watermarking methodologies.

Chapter IV, “*Watermarking Techniques for DRM Applications*” This chapter presents a mathematical formulation to define a digital watermarking model, and lists and discusses general requirements with more emphasis given to aspects of security, robustness and imperceptibility. After this general discussion, the two main classes of digital watermarking schemes, namely the spread-spectrum watermarking and the side-informed watermarking are explained by highlighting their main advantages and drawbacks. This analysis is completed by providing a detailed description of a practical implementation of a digital image watermarking scheme, designed in the past years by the authors. Next, the use of watermarking systems in the framework of a DRM is analyzed. Finally, future trends are discussed and the conclusions are drawn.

Chapter V, “*Watermarking and Authentication in JPEG 2000*” This chapter introduces JPEG2000 as an application field for image authentication and the new technology of digital image watermarking. The new compression format has a lot of unexplored characteristics that both the watermarking and the authentication communities should carefully take into account. Thus, a brief introduction to the standard is given at the beginning, discussing its structure, features, novelties and capabilities. Following that introduction, watermarking techniques are presented, at first into the wavelet domain (the DWT is part of the JPEG2000 core) and then right into the JPEG2000 pipeline.

Chapter VI, “*Securing and Protecting the Copyright of Digital Video Through Watermarking Technologies*” The basic principle of watermarking is the addition of the watermark signal to the host data that copyright protection should apply. The addition is taking place in a way that the watermark signal is discrete and secure among the rest signals. Its retrieval, either partial or complete, from the rest of signals must be possible only by using a secret key. In this chapter, digital video watermarking is analyzed. Its applications, requirements and the most important trends are presented and some of the most significant techniques of the specific process are described.

Section III, “*Distributing, Managing, and Transacting Digital Rights in E-Commerce Systems*” This section deals with the issues of distribution, management and exploitation of copyrighted material and its digital rights through e-commerce systems. The issues are very important as they set the landscape and its restrictions regarding the transaction of digital rights via networks, web services and the Internet.

Chapter VII, “*Digital Rights Management of Images and Videos Using Robust Replica Detection Techniques*” Intellectual property rights protection and management of multimedia data is necessary for the deployment of e-commerce systems involving transactions on such data. Recently, replica detection or fingerprinting has emerged as a promising approach for the rights management of multimedia data. In this chapter, a review of two replica detection techniques is presented. The first technique utilizes color-based descriptors, an R-tree indexing structure and linear discriminant analysis (LDA) to achieve image replica detection. The second one is a video fingerprinting method that utilizes information about the appearance of individuals in videos along with an efficient search and matching strategy.

Chapter VIII, “*Digital Fingerprinting Based Multimedia Content Distribution*” In this chapter, the digital fingerprinting technology that is used to trace illegal distributors in multimedia content distribution is investigated. First, the background and basic knowledge of digital fingerprinting based multimedia distribution are reviewed. Then, some existing fingerprinting algorithms are introduced and compared. Additionally, the methods to embed the fingerprint securely are overviewed and analyzed. As an example, the secure audio distribution scheme is presented, and its performances are evaluated. Finally, some open issues and the future trends in digital fingerprinting are proposed.

Chapter IX, “*A Digital Rights Management System for Educational Content Distribution*” Any business that wishes to control access to and use of its intellectual property is a potential user of digital rights management (DRM) technologies. Traditional DRM has a passive one-way downstream consumption of content from producer to consumer and focuses primarily on concerns of digital rights enforcement. This model does not translate well to the education environment where openness, informal decision making, sharing of ideas and decentralization are valued. Collaboration and multiple authorships are common in the educational environment, as is the repurposing and modification of digital content used for teaching and learning. A DRM system for educational content distribution must be substantially more sophisticated and flexible than what is available right now to gain support in the educational community.

Chapter X, “*Digital Rights Management and E-Commerce Transactions: Online Rights Clearance*” This chapter investigates intellectual property rights clearance as part of e-commerce. Rights clearance is viewed as another on-line transaction that introduces certain technological and organizational challenges. An overview of the current intellectual property rights legislation is used to describe the setting which business models and digital rights management systems are utilized to perform safe and fair electronic trade of goods. The chapter focuses on the technological aspects of the arising issues and investigates the potentials of using advanced information technology solutions for facilitating on-line rights clearance. A case study that presents a functioning on-line rights clearance and protection system is used to validate the applicability of the proposed approaches.

Section IV, “*Strategies and Case Studies*” The section presents strategies and case studies of the use of digital rights management in organizations and sectors such as cultural heritage.

Chapter XI, “*Digital Rights Management in Organisations: A Critical Consideration with a Socio-Technical Approach*” When designing a DRM system, an integrated view of a number of parameters is required, so as to understand their interdependencies. The external business environment, as determined by market conditions and related decisions of regulatory and normative authorities, can play a significant role. For example, DRM measures have to comply with intellectual property laws that provide a framework for protecting different forms of subject matter (copyright, patent, trademark, industrial design rights, trade secret, etc.). This chapter discusses and investigates a holistic framework for the development of value added DRM solutions using Leavitt’s diamond as a model. In his effort to analyse organisational change, Leavitt (1965) proposed the classification of organisations in four-dimensional diamond, in which Task, Technology, People, and Structure are interrelated and mutually adjusting.

Chapter XII, “*An Advanced Watermarking Application for the Copyright Protection and Management of Digital Images of Cultural Heritage Case Study: ‘Ulysses’*” The issue addressed in this chapter is the design implementation and evaluation of a watermarking application, especially focused on the protection of cultural heritage. The application described here focuses on protecting digital surrogates of high quality photographs of artifacts, monuments and sites and on countering copyright infringement of on-line digital images. This is achieved by the integration of an innovative watermarking method to a specialized and usable user interface. The system is specifically applied to “Ulysses” the Official Cultural Portal of the Hellenic Ministry of Culture (HMC).

Chapter XIII, “*Digital Rights Management in the Cultural Heritage Arena: A Truth or a Myth?*” Digital rights management (DRM) describes a set of functionalities which control access to, and the use of, copyrighted material. In particular, they focus on the acquisition of revenue from copyright material, and the prevention of its re-use and misuse in the online environment. This document describes a DRM system in the cultural heritage sector. The value of the DRMS to the content repositories and also to the end users is described.

Section V, “*Legislative Issues*” In this section, legal issues are analyzed and the most crucial legislative parameters which affect digital rights management and the distribution of copyrighted material on-line through e-commerce systems are discussed.

Chapter XIV, “*Digital Rights Management: A European Law Perspective*” The purpose of this chapter is to provide a brief overview of the legal framework available at EU level that applies to DRM information and technological protection measures. For this reason, the relevant legal instruments are identified and briefly described, while at the same time an effort has been made to identify the most important points of concern that arise from the interpretation and application of the law. The review concludes by reference to the ongoing discussion over DRM designs in an effort to best combine the requirements of the law into technological solutions and vice-versa.

Chapter XV, “*Legal Issues for DRM: The Future*” DRM systems have been implemented in the past few years by the Content Industry as the panacea against all copyright (and intellectual property rights in general) infringements over the Internet. The chapter attempts to assess the validity of this statement, identifying its strengths and record until today and highlighting its shortcomings in an increasingly complex e-commerce (Web 2.0) environment.

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