Copysmart : a trusted monitoring system for electronic works and document

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ABSTRACT

The rapid development of digital technology and information networks now permits a broad and easy dissemination of digital works and other electronic information. However, once published, it is difficult to control access, usage, manipulation and distribution of digital materials. The ease of reproduction of electronic information raises the problem of Intellectual Property Rights (IPR). But beyond the necessity to ensure the protection of digital information and the associated rights owned by the work's originators and the various rights-holders, the need to have a full management of IPR is getting crucial. More and more, authors, publishers, fee-collecting companies, producers, distributors, etc., are looking for tools which are able to determine the utilisation conditions of their works and to provide them with information on the usage, in order to get the reward corresponding to the exploitation of their works and to better market them.
Several projects have been initiated in order to meet the needs related to IPR management. In 1992, the European Commission launched under the ESPRIT Programme, the CITED project (Copyright In Transmitted Electronic Documents) with the objective of defining a global model for IPR management. CopySMART represents the industrialisation of the CITED model.

Handling Intellectual Property Rights of electronic works and other digital materials

1. Intellectual Property Rights

Intellectual property rights are legal instruments which confer a limited monopoly right in respect of intellectual property on the owner of things such as patents, trademarks and copyrighted works. As far as copyrighted works are concerned, IPR include authors' rights and neighbouring rights. We describe hereafter both types of rights as well as a concept that is common to both: fair use.

1.1 Author's right or copyright

Authors' rights (European system of IPR for literary and artistic works)
Copyright (Anglo-Saxon system of IPR for literary or artistic works)

The authors' rights include moral right and patrimonial rights:

- **Moral right** : exclusive right of the originator to disclose his/her work (right of dissemination), to claim authorship of his/her work (right of paternity), to modify, or to agree modification proposed by third persons to his/her work (right of respect), and to withdraw his/her work (right of withdrawal).

- **Patrimonial rights** or **exploitation rights** or **economic rights**: right of the originator, and, after his/her death, of his/her heirs (and for these, for a time period that depends on the applicable national laws and on the type of works), to exploit his/her work, in any form, and to draw financial profit from it.
  The **patrimonial rights** include reproduction right and representation right :

  - **reproduction right**, including mechanical reproduction right : the reproduction consists of the physical fixation of the work, by any process and on any medium, such as a mechanical-magnetic, film, digital, etc., recording, possibly after translation, adaptation, arrangement or any other alteration.

  - **representation or performing right** : the representation consists of the communication of the work to the public by any means, such as public presentation or public performance projection or display, broadcasting, etc.

    A specific type of economic right is presently under development : the *sui generis rights*, which apply to databases.

1.2 Neighbouring rights or related rights

These rights include :

- rights of the performing artists-interpreters : rights of the persons who play, sing, recite represent, etc, a work
- publishers/producers rights : rights of the persons or organisations (record producers, video producers) who fix the work on media aimed at a public dissemination.
- *Fair use* (UK), fair dealing (US) or *exceptions* to the exclusive right of the author (continental Europe) : most laws on copyright specify a limited number of exceptions to the authors, and neighbouring rights, such as :
* private copy, without commercial aim and without remuneration to the author,
* right to cite
* right for libraries to copy without any previous authorisation, but with a remuneration to the author.

Law-makers of different countries have been struggling with revision of IPR and privacy law to bring some order in the chaos of public networks such as the World Wide Web. Legal concepts exist, the major problem is the conformance of the technical systems of protection with these legal concepts.

2. Identification of the risks related to the distribution of digital works and materials

- **Works alteration** :
Digital works or other materials can be altered by misuse and not correspond to the original version created by the originator.

- **Works paternity** :
The originator of the works must be identified and registered as the author of the works in order to be sure to be considered as the actual originator of the work, for ownership and paternity in the works not to be stolen, and to preserve his rights.

- **Illegal copying of digital works**:
The development of digital technology raises the problem of reproduction right. Digitisation technology makes possible a perfect reproduction of any type of work, such as music, text, video, sound, images, on many types of media (CDI, CD-ROM, etc.). This easy reproductibility makes it very difficult to control electronic publishing and digital materials' dissemination.

- **Distribution and exploitation of digital works** :
A copy of the digital works can be used without the authorisation of the authors and/or the various rightsholders and without granting reward to them.

Initiatives regarding IPR management

The CITED model : modelling and experiencing Electronic Copyright Management

Electronic Copyright Management Systems (ECMSs) cover a wide range of IT systems which aim at providing authors, publishers and distributors of digital works with tamper-resistant mechanisms for identifying, labelling copyrighted materials and monitoring access to these materials, as well the usage which is made of them, in such a way that copyright holders can legitimately receive their royalties and proofs on the basis of the legal use which is made of their works.

CITED was an ESPRIT project funded by the European Commission from 1991 to 1994 with the following objectives:

- to study the needs of the world information industry concerning ECMS,
- to review the existing laws in various European countries concerning IPR,
- to design a generic model likely to be applied by the information industry to develop interoperable ECMS,
- to make a preliminary study of the standardisation process that should be used to make that interoperability possible.
- to develop pilot CITED ECMS software and to provide a demonstration to prove its feasibility.

CITED has defined a functional model which describes the services one can expect from an ECMS. These services provide for a set of functions which are necessary to different ECMS users : creators, authors, fees-collecting societies, publishers, producers, distributors, end-users in order to ensure a reliable interchange between them.

The services include the following :

- the marking of digital objects and works, and the management of these digital marks (detection, clearing, duplication, modification, deletion). Examples of marks include: digital object identifiers, digital signature, watermarking, fingerprinting, sum check,
- the definition and the management of technical conditions of use,
- the capturing of legal clauses and local regulation features to be applied for the exploitation of the digital objects and works,
- the management of a repository of patterns of well-known attacks on the ECMS,
- the specification of decisions and countermeasures to be triggered as reactions by the ECMS when faced with identified attacks or misuses,
- the setting up of links with the payment systems for the management of the commercial conditions of the digital objects and works,
- the registration and the administration of sound users,
- the monitoring of the usage which is made of the protected material,
- the collection of evidences and statistics on usage operations performed on the digital objects and works,
- the notarisation of evidences in trusted third-party databases.

The CITED model allows for the publishing, the delivery and eventually the modification of digital objects within unpredictable scenarios provided that the administration and management rules attached to the digital objects are respected. It allows for setting up a tracking system for the legal supply, administration, acquisition and utilisation of protected digital objects and works. The model defines the security services needed for a trustworthy administration and management of digital marks, contractual clauses, commercial conditions, and payment in open and distributed environments (e.g. WAN, Internet) or closed environments (e.g. LAN, Intranet). IT systems compliant with CITED specifications will be able to inter-work in a secure way thanks to the interoperability of services which are compliant with state-of-the-art standards.

CopySMART : a system ensuring IPR management

1. The Actors' Needs

The different actors who will interact with technical systems protecting IPR can be grouped in five classes :

(1) originators : they create the copyrighted works, and are referred to as content providers.

(2) collecting societies : they collect the fees from the trading of copyrighted works and pay royalties to the copyright holders.

(3) publishers/producers : they produce and publish the works in marketable form, establish the distribution and licensing contracts with the originators, and act as content providers on behalf of the originators.

(4) distributors (services providers) : they disseminate and sell the works to the end-users according to the distribution contracts signed with the content providers.

(5) end-users (customers) : they get the rights to use the copyrighted work according to the corresponding licensing contract.

(6) Trusted Third Parties (TTP) : they ensure the credibility and the trustworthiness of the transactions which take place between the other agents through the ECMS.

These different agents concerned in the world information industry have various ECMS requirements that can be summarised as follows:

Originators' requirements :
- to unambiguously identify the copyrighted work,
- to secure its legitimate use and to prevent its illegitimate use,
- to ensure its integrity,
- to receive appropriate compensation for a legitimate use of the copyrighted work.

Collecting societies requirements:
- to identify the originators and their copyrighted works,
- to be made aware of the usage operations performed on the copyrighted works,
- to recover the fees associated with these performances,
- to calculate and pay the relevant royalties to the originators and to other rights holders.

Publishers/producers requirements:
- to identify the copyrighted works,
- to identify the rights holders and the distributors,
- to secure the ECMS data,
- to define the privileges to be allotted to end-users,
- to identify the other concerned agents: originators, collecting societies, distributors, etc.
- to obtain feedback data on the usage made of their copyrighted works in order to improve them,
- to be informed of the sub-licensing operations performed by authorised agents.

Distributors requirements:
- to identify the copyrighted work,
- to identify the rights holders and the end-users,
- to add value to the copyrighted work,
- to manage tariffs, invoicing to and payments by the end-users,
- to compute and pay the royalties to the rights holders,
- to audit the ECMS files,

- to manage complaints from end-users and rights holders,
- to control the data and money flows between the various concerned agents,
- to report on performed usage operations to the publishers/producers and the collecting societies.

End-users requirements:

- to easily access the copyrighted works,
- to be informed on the cost of the requested utilisation operations to them,
- to get warranty on privacy, confidentiality and information integrity,
- to pay the right price to get the right copyrighted work.

The Collecting societies :

- to standardise the identification of the copyrighted works,
- to preserve ownership and the integrity of the chain of rights,
- to ease the access to copyrighted works,
- to receive reports on the sales and usage of the copyrighted works,
- to collect fees and to pay the royalties to the copyright holders.

The TTP :

- to guarantee a level of trust compatible with the value of the assets,
- to manage the key certificate which is used to authenticate and clear the agents and the transactions,
- to clear the transactions according to the specified contracts and the applicable laws and regulations.

2. The ECMS Basic Services

Prior to its utilisation, an ECMS behaviour must be defined. This is achieved via to the *preparation services* which include:

- the **Marking services** which attach digital marks with the protected material,
- the **Characterisation services** which describe the features of the digital material to be protected,
- the **Rights Specification services** which define the administration and management rules to be applied on the protected material when used,
- the **Wrapping services** which convert the protected material into an object which can be accessed, used, customised as specified by any CITED compliant ECMS.

Once the behaviour has been specified, an ECMS must operate according to its specifications. This is achieved thanks to the *exploitation services* which include :

- the **clearing services** which give information on the digital works, ensure registration of end-users, allot use rights (privileges) to end-users,
- the **monitoring services** which monitor and tracks the access and the usage of the digital works in respect with the attached management rules.
- the **reporting services** which generate data recording by the monitoring services in the form of audit data (for auditing the ECMS) or usage statistics and evidence (for commercial tracking).

- the **metering services** which evaluate the resources consumed by end-users, manage the account balance of registered agents, compute royalties to be shared by the copyright holders.
- the **payment services** which manage the payment of charged service and update the agents' credits.

These services rely on security services and interoperability services.

Security Services

The security services ensure the integrity, the confidentiality and the availability of the exchanged data. They give appropriate countermeasures to the major threats identified in open networks :

- the breaching of secret data which occurs when a non-authorised person gets the keys which are used to encrypt/decrypt sensitive data,
- unauthorised log-on which occurs when a non-authorised person gets passwords of other agents,
- denial of service which occurs when someone succeeds in preventing the ECMS from functioning correctly (virus bomb, spoofing, etc.).

The main security services are :

- the **identification and authentication** services for identifying and authenticating agents interacting with the ECMS,
- the **access control** services, coupled with firewall protection, which enforce the ECMS monitoring service,
- the **audit** services which enforce the ECMS reporting service,
- the **encryption** service which enforce the ECMS marker service and manage the encryption/decryption of ECMS sensitive data,
- the **trust channel** service which set-up and manage a trust virtual communication channel between the ECMS and the agents and ensure **non-repudiation** of origin and delivery of data.
- the **key management** service which manage (create, distribute, authenticate, delete), the encryption keys and the certificates which are used to clear the transactions.

ECMS trustworthiness should require an ECMS assurance level in the range of the ITSEC E4 level or the class B2 in the orange book (TSEC).

Interoperability Services

These services ensure information interchange among distributed ECMS components or between different ECMSs.

3. Presentation of CopySMART :

CopySMART is an Electronic Copyright Management System (ECMS) which enables one to develop secure application for the the protection and dissemination of multimedia works and

any other digital material such as text, images (JPEG, MPEG files), sound, music (MIDI files), video etc., in an off-line (e.g. CD-ROM) or on-line (e.g. Internet) environment.

CopySMART is addressing publishers, fee collecting companies, licensing agencies, distributors, libraries and universities who give access to end-users to any type of electronic documents.

Thanks to implementation of legal clauses registered together with authors and publishers, CopySMART gives a controlled access to any digital information in a completely trusted environment. Thus the different actors of the chain (authors, fee collecting companies, publishers, distributors, up to end users) can interchange their works rapidly and trustfully. CopySMART enables the marking of digital materials in order to ensure data identification and tracing so that it preserves digital works' ownership and integrity thanks to identification and secured transmission, and ensures reward of copyright holders when needed.

3.1 Monitoring of the use of digital materials and their transmission:

CopySMART secures the use of digital materials and monitors their transmission. The 'originator' of electronic works chooses and settles the rules of utilisation so that end-users can make use of protected materials, in respect of which utilisation conditions have been settled in advance. Publishers, distributors (libraries, universities, etc.), register utilisation conditions attached to the digital works in an electronic licence contract, in respect of legal clauses, the applicable law and reported attacks. Use rights and contractual clauses are tightly wrapped together with copyrighted materials in order to have a controlled execution. Access to protected information by end-users is allowed after their authentication (with use of pseudonyms for respect of privacy) based on a personalised smart card issued by the publisher or distributor and containing the authorised usage operations end-users are allowed: access, view, copy, print, etc.

3.2 Metering the use of digital materials:

Thanks to traceability functions, CopySMART enables one to measure the usage of transmitted information and to keep proof elements of the exchange of information. Thus, content holders and service providers can :

- implement better marketing in order to improve the service offered to end-users: statistics are provided by the system (number and type of usage made from the documents, kind of information used etc.),
- certify the execution of transactions: recorded tracks may represent, if needed, proofs of the use and copy made from the documents.

CopySMART offers Trusted Third Party services in order to supply the different actors with evidence, to authenticate the accomplishments of transactions and to register deposit of marked materials.

3.3 CopySMART: Development Kit and Exploitation Kit

In order to build a secure application to ensure a trusted exchange of information between the different actors, two different phases are existing:

* **CopySMART Development Kit** (CDK) is a set of software modules used to implement the various functions in order to execute them with the CopySMART Exploitation Kit on the end-user workstation. This kit is used to prepare digital works or material for their exploitation in a trusted environment. CDK provides tools enabling to mark and to identify any type of material in order to ensure ownership, data integrity and in respect of privacy during exploitation. CDK enables publishers and distributors to register all legal clauses attached to the digital works in order to guarantee that the usage of materials is made according to these pre-defined clauses.

CDK is used during the development phase to ensure the following operations :
- to mark the digital works or other material
- to specify the contractual clauses
- to wrap digital works
- to specify and integrate the commercial conditions
- to bind the wrapped materials together with data located in the exploitation environment
- to handle end-user
- to determine the functional level (i.e. the level of security and services) required

* **CopySMART Exploitation Kit** (CEK) enables to monitor the use of protected digital works or material at the end-user workstation in order to let end-users use the protected material in respect of utilisation conditions which have been settled in advance thanks to CopySMART Development Kit. The wrapped application and material is played by the user under control of CopySMART which executes usage monitoring and security functions resident in software and hardware components. CopySMART ensures the end-user authentication, the clearing of marks and rights attached to the copyrighted information.

CopySMART Exploitation Kit consists of :
- the CopySMART software module which monitors the running session
- a smart card which contains identification and authentication data concerning the user, the use rights granted by the service provider and access path to various remote service.
- a smart card reader

CEK is used during the exploitation phase to ensure the following operations:
- access control
- clearing of rights
- traceability
- handling of payment

4. Industrial applications

Electronic commerce in digital works and materials covers a wide range of industrial applications such as :

- electronic publishing (CD-ROM publishing such as business directories, financial, legal, statistics data..., video games, multimedia works, etc.)
- on-line distribution such as on-line data base
- digital libraries
- electronic messaging
- administration
- software delivery
- direct marketing companies and mailing
- distance learning training
- interactive television and pay-per-view TV.

Conclusion

As electronic commerce in digitised information is developing, the aim of the implementation of an ECMS such as CopySMART is to provide the different actors of the distribution chain (from authors, publishers, distributors up to end-users) with the necessary tools for building a trusted business environment enabling them to develop access to protected digital works and materials while they are enabled to monitor the utilisation and distribution of their works in respect of the end-user's privacy.