

A Survey on Digital Rights Management Technologies

DRM Working Group
NDAP Research & Development
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Outline

- Introduction
- Components in DRM
- DRM Standards
- Commercial Solutions & Case Study

What is DRM?

- DRM is the chain of hardware and software services and technologies governing the authorized use of digital content and managing any consequences of that use throughout the entire life cycle of the content [IDC 2001]
- The technology for protecting files via **encryption** and allowing access to them only after the entity desiring access has had its **identity authenticated** and its **rights** to that specific type of access **verified** [Rosenblatt & Dykstra, 2003]

DRM

DRM : Digital Rights Management



Payment Approval
Payment request



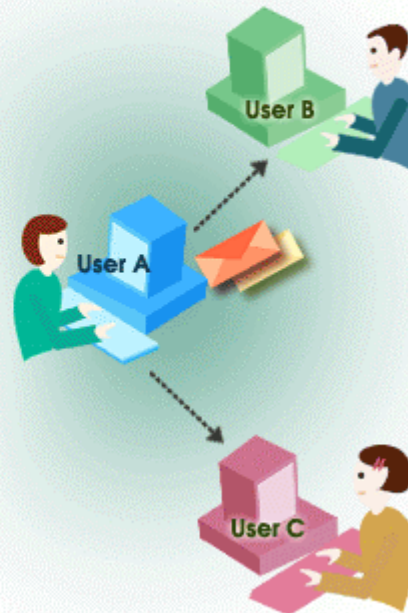
Billing list



User authentication

Content request

Authorized Encrypted Content



[Source: MarkAny.com]

- **Content** management
 - Cryptography
- **Policy** management
 - Policy: access rules for content
 - Authoring, distributing, evaluating policy expressions

Why DRM?

- To approximate content distribution model in physical world, and to invent new ones
 - Ex: Buying a book at a bookstore
 - Read, give, sell, lend
 - Copy, change, embed
- To prevent unauthorized copying, usage, or redistributing of content
 - Copying of digital files costs almost nothing
 - Different privileges needed for different users

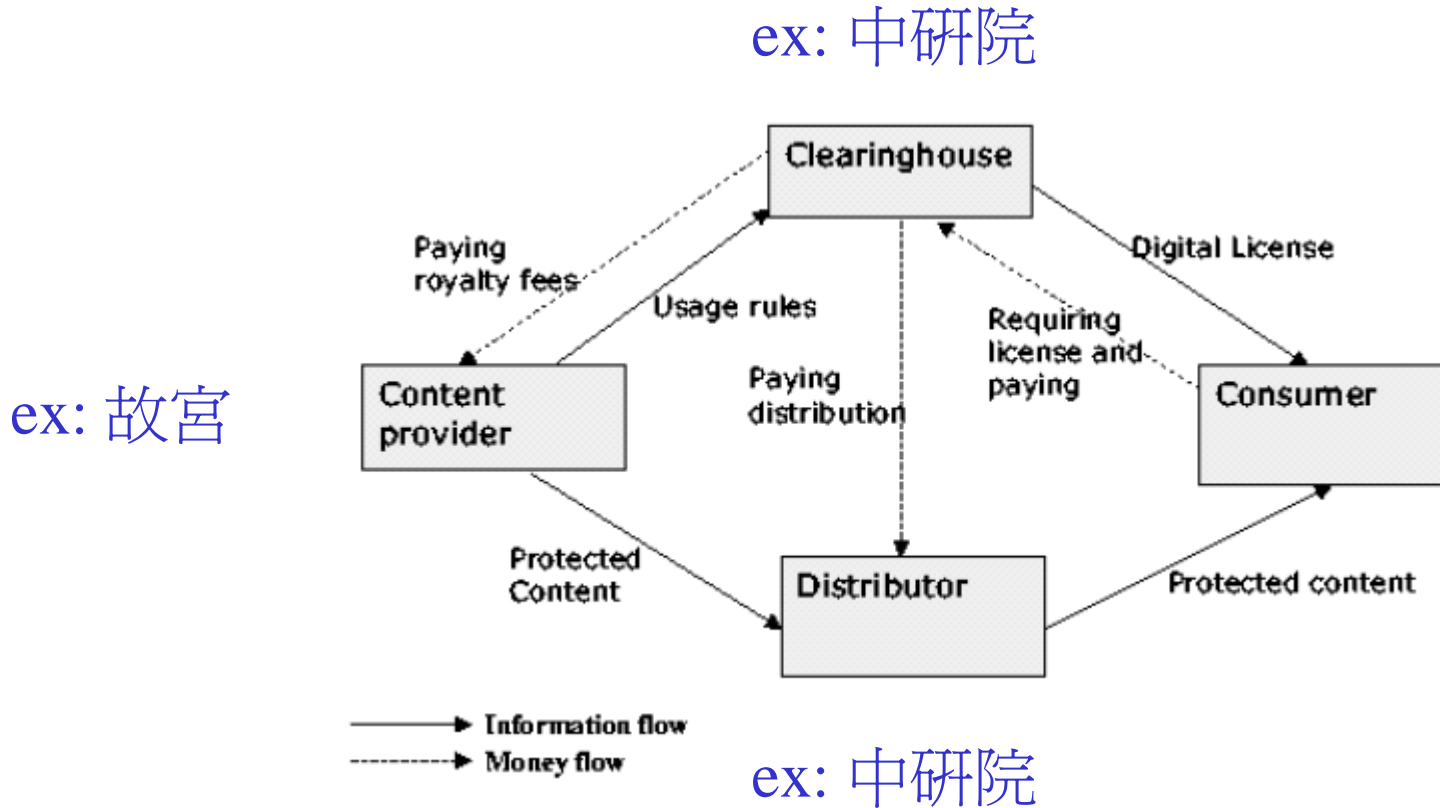
Evolutions of DRM Systems

- 1st generation of DRM:
 - Focused on security and encryption
 - Prevent unauthorized copying
- 2nd generation of DRM:
 - Covers the description, identification, trading, protection, monitoring, and tracking of all forms of rights usages over contents, including management of rights holders relationships
 - **Digital Management of Rights**, not Management of Digital Rights

Reasons for Slow Growth

- Users find it inconvenient to go through registration or authentication procedures
- Publishers have not built the internal systems necessary to manage content
- DRM systems are not interoperable with each other or with back-end systems
 - → Lack of technology standards

A Typical DRM Model



Please refer to p.5 of the DRM Technical Survey for more details

Some Commercial DRM Solutions

- Adobe Acrobat Reader
- Microsoft Windows Rights Management Services (RMS)
- InterTrust Rights | System

Please refer to pp.6-11 of the Technical Survey for more details

DRM in Digital Libraries

- Public/educational/promotional/research use vs. product sales
- Group users vs. individual user
- Expressiveness of rights
 - “Lending” a book,
 - “Fair use”
- NetLibrary (a division of OCLC Online Computer Library Center)
 - <http://www.netlibrary.com/>
- OnDisC Alliance (**O**nline **D**istributed **C**ontent)
 - <http://www.ondisc.ca/>

Main Components in DRM

- Cryptography
- Digital Watermarking
- Rights Model & Rights Expression Language

Different Levels of Protection

- System Security
 - Authentication
 - Password
 - Access Control
 - Access rights for (object, people, location, time)
 - Auditing
 - Event logging
- Data Security
 - Encryption
 - Key management
 - Fingerprinting/Watermarking
 - For embedding rights information
 - Rights enforcement
 - For enforcing embedded rights information
- Network Security
 - Cryptography
 - Confidentiality
 - Tracking
 - Non-repudiation

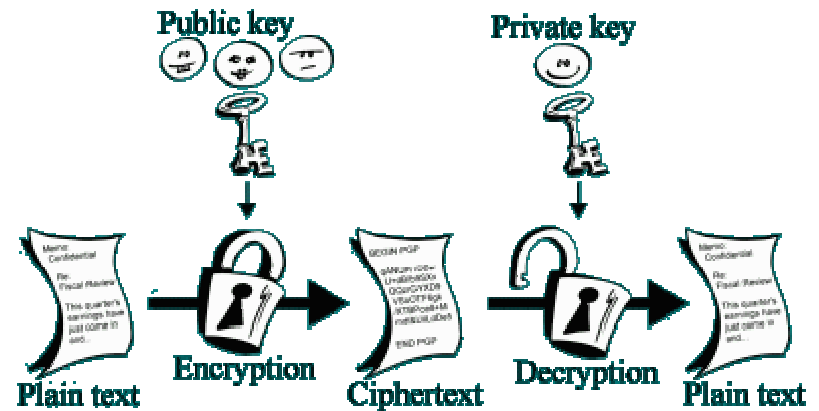
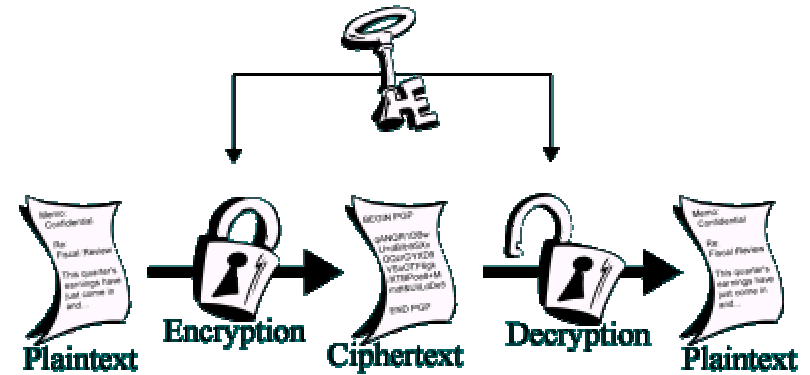
To prevent unauthorized copying

To make unauthorized copy useless

To provide evidence for illegally redistributing or owning objects

Cryptography

- Encryption (lock)
 - Symmetric: 1 key
 - Ex: DES, AES, ...
 - Key management (secret sharing)
 - Asymmetric: 2 keys (public, private)
 - Ex: RSA, ...
 - Public key cryptography



Watermarking



Visible watermark

[Source: <http://www.dlib.org/dlib/december97/ibm/12lotspiech.html>]

Examples of Digital Watermarking



Original
unwatermarked
image



Digimarc
watermarked
image



Exaggerated view
of imperceptible
Digimarc
watermark.

[Source: DigiMarc.com]

Watermarking

- To embed a digital code (or mark) into images, audio, video, or printed documents that is readable by computers
 - *Transparency*: visible, invisible
 - *Security*: location of marks cannot be derived
 - *Unambiguous*: uniquely identifying the owner
 - *Robustness*: tolerance to attacks
 - *Capacity*: amount of information embedded
 - *Blindness*: reference to the source image

Please refer to pp.12-14 of the Technical Survey for more details

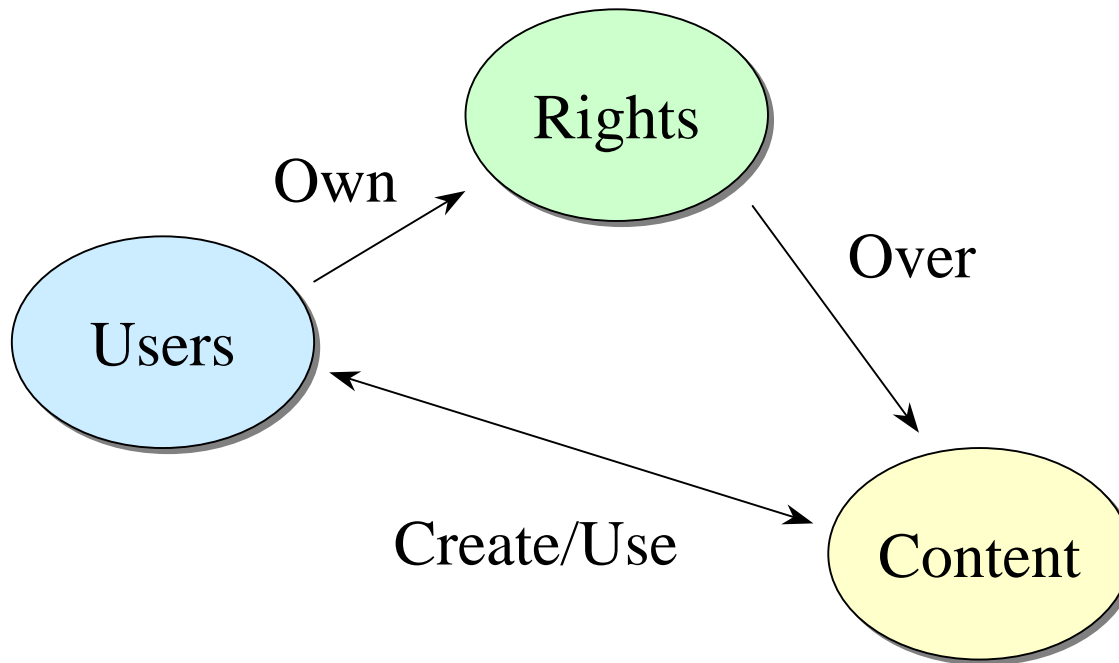
Traitor Tracing

- To make each copy unique by embedding *marks* into each copy
 - To discourage piracy by enabling the merchant to identify the traitor
- Watermarking
- Fingerprinting

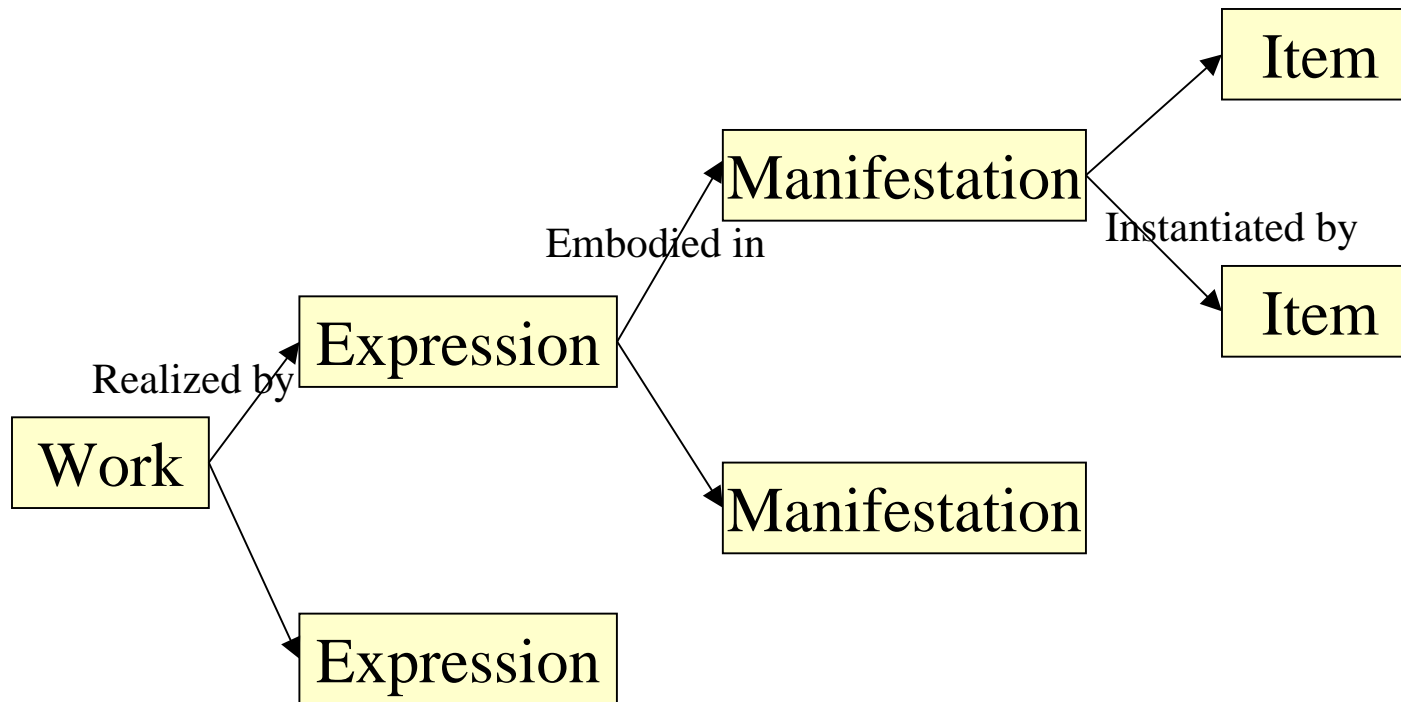
Functional Architecture for DRM Systems

- Intellectual Property (IP) Asset Creation and Capture
 - Rights Validation, Creation, Workflow
- IP Asset Management
 - Repository, Trading functions
- IP Asset Usage
 - Permissions, Tracking Management

Core Entities Model



IFLA Content Model



Example of IFLA Content Model

- Work: “The Name of the Rose” by Umberto Eco
- Expressions:
 - Original text
 - English translation
 - Screenplay
- Manifestations of English translation
 - Hardcover
 - Paperback
 - Digital audio book
- Items
 - A hardcover book purchased from Barnes-and-Nobles
 - A digital file purchased from Amazon

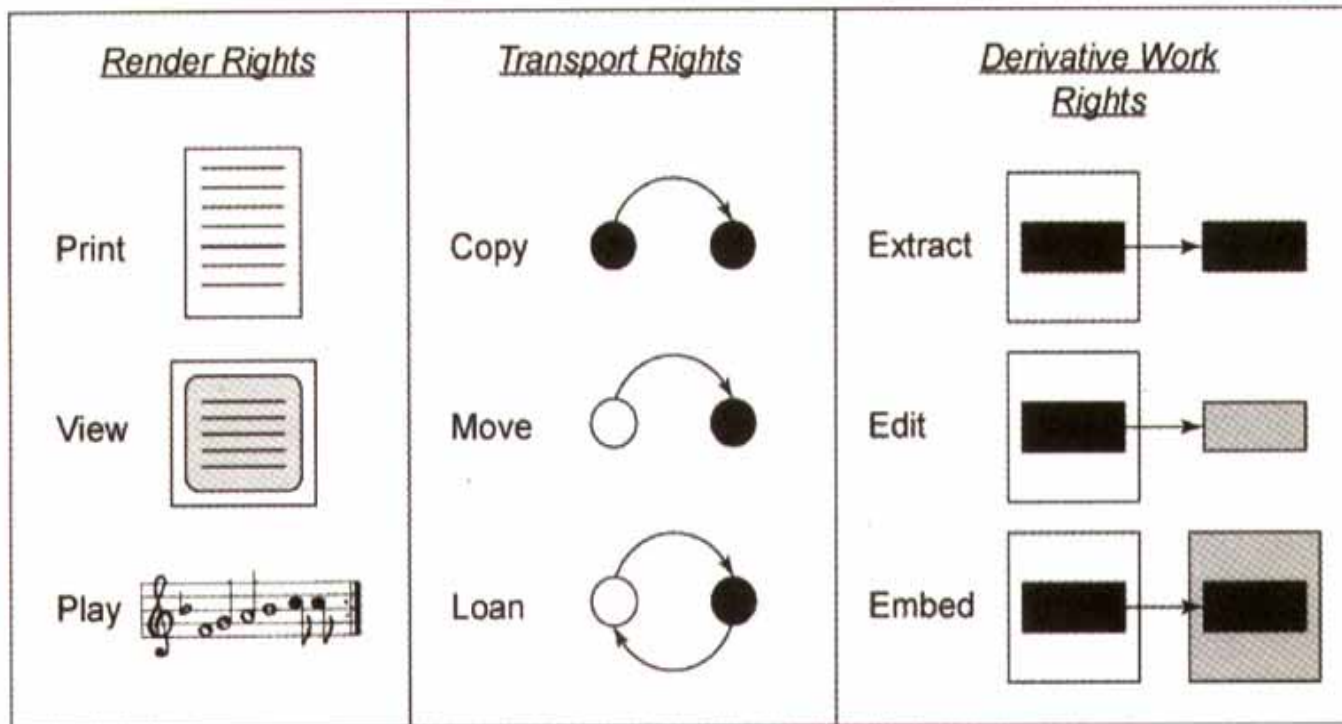
Identifying and Describing Entities

- Rights
 - URI (Uniform Resource Identifiers)
 - DOI (Digital Object Identifiers)
 - ISTC (International Standard Text Code)
- Contents
 - ONIX for books
 - IMS for educational learning objects
- Users
 - vCARD (RFC 2426) for people and organizations
 - MARC Relators code list for roles

Rights Expressions

- Rights Model
 - Schemes for specifying rights to a piece of content that a user can obtain in return for some consideration, such as registering, payment, or allowing her usage to be tracked.
- Types of Rights
 - *Render Rights*: Print, View, Play
 - *Transport Rights*: Copy, Move, Loan
 - *Derivative Work Rights*: Extract, Edit, Embed

Possible Types of Rights

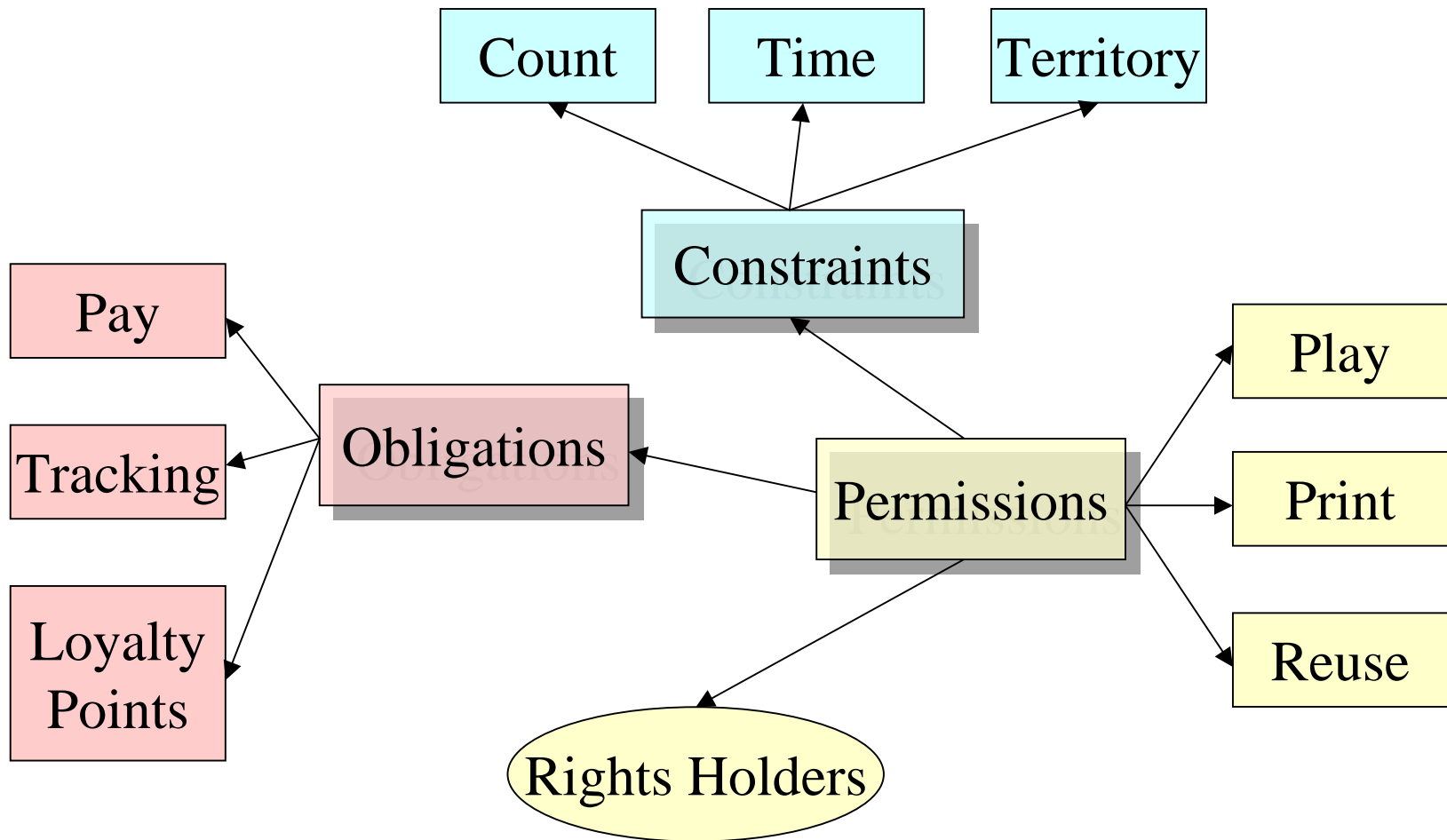


Please refer to p.16 of the Technical Survey for more details

Rights Expressions (cont.)

- Rights expressions should consist of:
 - *Permissions*: what you're allowed to do
 - *Constraints*: restrictions on permissions
 - *Obligations*: what you have to do/provide/accept
 - *Rights holders*: who is entitled to what
- Example:
 - ODRL (Open Digital Rights Language)
 - XrML (eXtensible rights Markup Language)

Rights Expression Model



Digital Object Identifier (DOI)

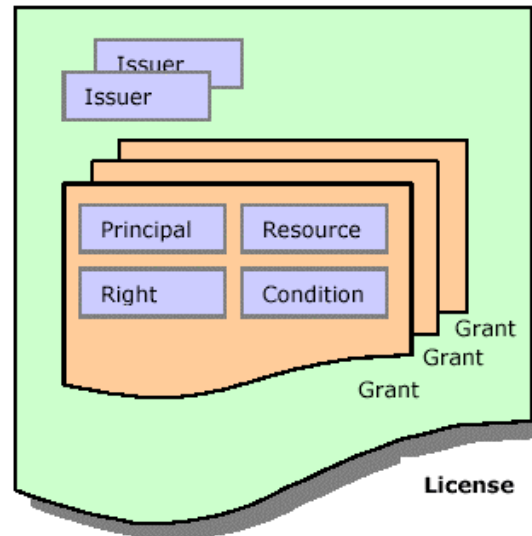
- <http://www.doi.org/>
- *A digital identifier for any object of intellectual property*
- DOI provides a means of persistently identifying a piece of intellectual property on a digital network and associating it with related current data in a structured extensible way
- An implementation of URI

eXtensible rights Markup Language (XrML)

- <http://www.xrml.org/>
- XrML is a general-purpose, XML-based specification grammar for expressing rights and conditions associated with digital content, services, or any digital resource
- A direct descendent of Stefik's DPRL (Digital Property Rights Language)
- XrML 2.0 by ContentGuard, Nov. 2001

An Example XrML License

- *Licenses*: policy statements
 - *Issuer* authorizes *principal* to exercise a *right* with respect to a *resource* subject to (zero or more) *conditions*.



Licenses

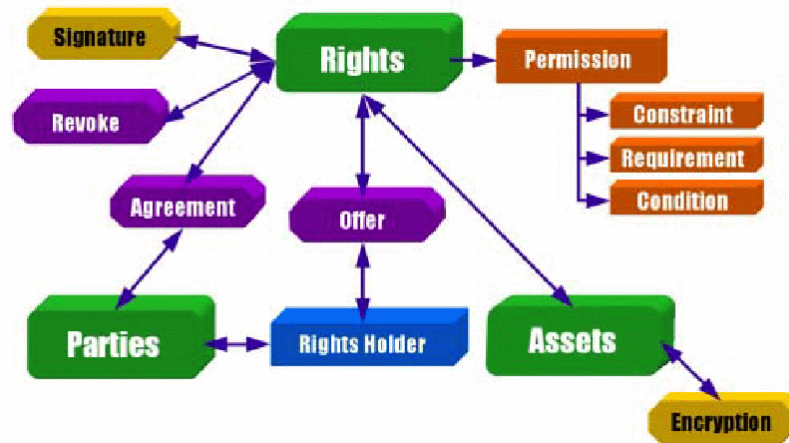
- Multiple authorizations from the same issuer may be grouped into a single license
 - John says, “Bill has the right to print the book.”
- Grants may be chained either through direct trust of the issuer or transitively through licenses that grant rights to issue other licenses
 - Alice says, “Bob has the right to issue a license to anyone to print the book.”
 - Bob says, “Carol has the right to print the book.”

XrML 2.X Licenses

- Patterns, variables, and quantifiers
 - Alice says, “Anyone who can read the book has the right to print the book.”
- *Prerequisite rights* that condition the grant contained within the license
 - Alice says, “Bob has the right to read the book if Bob is a member of the book club.”
 - “Compliance checking” algorithm for XrML 2.X is more complicated than simple “chain walking”.
 - DAG (Direct Acyclic Graph)

Open Digital Rights Language (ODRL)

- <http://odrl.net/>
- by R. Iannella, specification version 1.1 freely available



DRM Standards

- MPEG-21
- CPPM/CPRM (Content Protection for Prerecorded/Recordable Media)
- DTCP (Digital Transmission Content Protection)

Please refer to pp.18-20 of the Technical Survey for more details

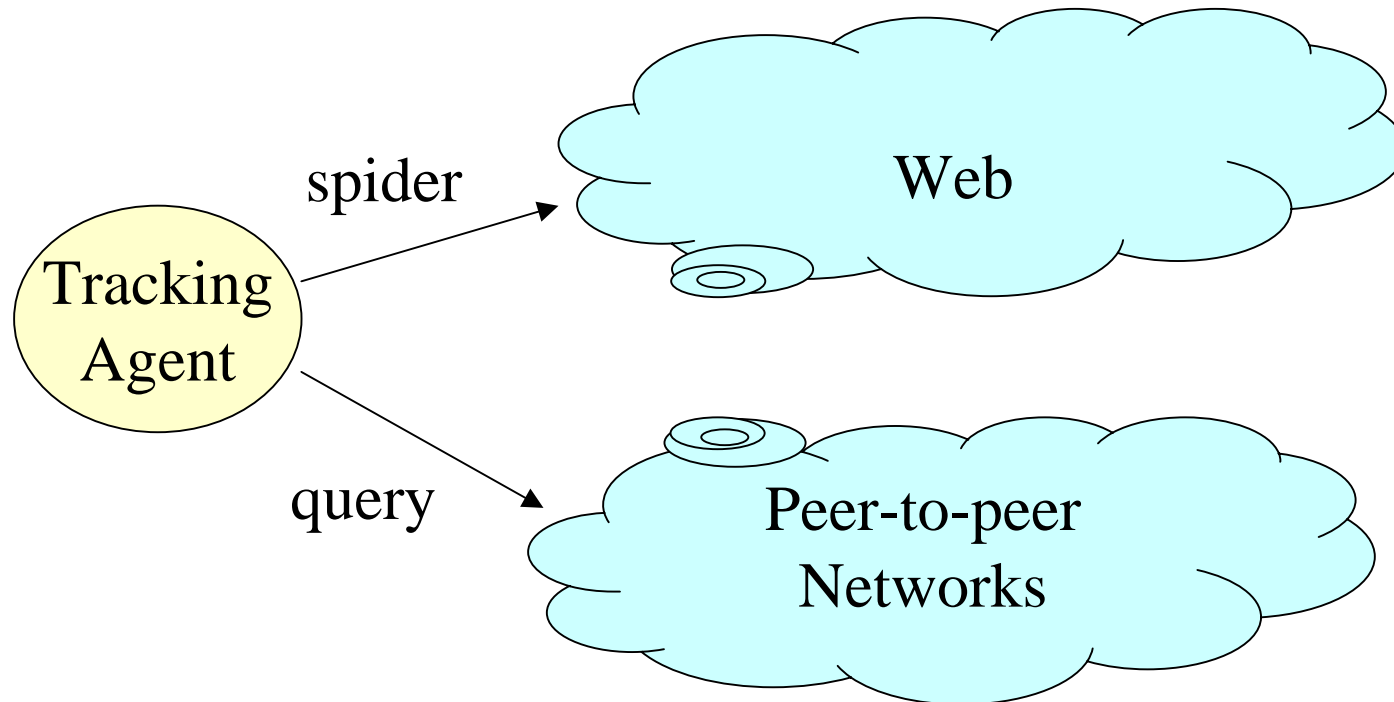
Rights Usage Tracking

- To track the usage statistics of each object
 - All accesses to the object have to be recorded
 - Online checking: download, play, print, ...
 - OS support: copy
- To provide evidence for illegally redistributing or owning objects
- It's highly related to content dissemination

Tracking Techniques

- Registration-based
 - Signature registration: checksum, hash value (MD5)
 - Signature matching
- Embedding-based
 - Signature embedding: fingerprinting, watermarking, digital signature
 - Signature extraction

Tracking from Different Media



Case Study

- Corbis
 - Business Model
 - Thumbnail, watermarked Web image, Web image
 - Royalty-free, rights managed
 - Protection Mechanism
 - Watermarking: Digimarc Digital Watermark
 - Spidering: Digimarc MarcSpider

Please refer to pp.20-21 of the Technical Survey for more details

Commercial DRM Solutions

DRM Classification

- Multimedia Protecting
 - MP3 、 DVD 、 VCD
- Confidential Information Protecting
 - eBook 、 Digital Images

Commercial DRM Solutions

| Company | Product | Description |
|--|--|---|
| Alpha-Tec LTD (www.alphatecltd.com) | A series of watermarking tools | <ul style="list-style-type: none"> ●EIKONAmark ●Authentication Check ●AlphaCrawler |
| Digimarc (www.digimarc.com) | A series of watermarking tools (adopted by Corbis) | <ul style="list-style-type: none"> ●digital watermarking ●Digimarc MarcSpider™ |
| LTU (www.ltutech.com) | Image Seeker (adopted by Corbis, Live Visual Search Demo: http://corbis.ltutech.com/) | Image-Seek is a content-based visual search and retrieval software. It Combines visual & keyword search |
| Microsoft (www.microsoft.com) | Windows® Rights Management Services | RMS for Windows Server 2003 is information protection technology help to safeguard digital information from unauthorized use. Windows RMS enables protection of sensitive information, such as Web content, documents, and e-mail, through the creation and enforcement of persistent policies that live with the information—no matter where it goes. |
| PicScout (www.picscout.com) | PicScout | PicScout provides its customers with a total copyrights enforcement service. PicScout uses its robust engine to crawl various media channels, track image piracy and pursue legal enforcement. |

Commercial DRM Solutions

| 廠商名稱 | 產品 | 功能 |
|---|---|---|
| 工研院電通所 (http://www.ccl.itri.org.tw/) | 數位學習內容保護平台 | <ul style="list-style-type: none"> ●數位浮水印技術 ●數位內容版權保護技術 ●數位學習內容保護技術 ●數位內容付費機制 |
| 永豐紙業 (www.oiprint.com.tw) | 數位版權保護家 | <ul style="list-style-type: none"> ●利用USB Key，讓閱讀時的版權管理型成一可隨身攜帶的載體。 ●對同一份電子書內容，根據不同之讀者進行個人化的加密。 ●這將使得不同使用者間，在USB Key 不借用之條件下，將無法解開其加密內容。 ●消費者使用特製的Reader 閱讀，閱讀程式根據《個人私鑰》，將電子書解密後，開啓閱讀。 |
| 欣領航網路科技 (www.esecure.com.tw) | eGATE 系列產品 | 提供客戶利用網際網路的科技，在電子商務的領域，不論在任何時間、地點，均能透過尖端網路安全技術的運用，進而達到在電子商務交易過程中，認證性 (Authentication)、完整性 (Integrity)、機密性 (Confidentiality)、不可否認性 (Non-Repudiation) 的功能，讓商業交易或資訊交換的過程都能安心使用，進而創造客戶更大的商機與效益。 |
| 優碩資訊科技 (www.trustview.com.tw) | TrustServer TrustView (for Office, PDF, and Web) | <p><Permissions Management></p> <ul style="list-style-type: none"> ●採用標準256-bit的AES(Advanced Encryption Standard)加密技術，PKI 認證、X.509 certificates數位權證。 ●TrustView Client 為Plugin 形式，可支援Microsoft Office與Adobe PDF。 ●使用者用合法帳號登入Server通過認證並得到作者的同意權限，才能開啓這份文件。 <p><Tracking Management></p> <ul style="list-style-type: none"> ●提供事件記錄與查詢，記錄用戶的每一個動作，以方便日後的文件管理及追蹤。 |

Case Study: Corbis

Overview of Corbis

- Corbis is a leading provider of image-licensing solutions and services to creative professionals and companies dealing in image-based consumer products.
- With 25 million images, it is the leading provider of digital images to both the consumer and creative professional markets
- It provides imagery to creative professionals in magazine, book and newspaper publishing, advertising and graphic design, and Internet and new media publishing.
- The company uses its extensive Internet technology to allow customers to quickly and conveniently access and purchase images and related products.

Digital Images on Corbis Web Site

- Thumbnail:
 - Smaller than 128*128 pixels
 - they can be browsed by all users.
- Watermarked Web Image:
 - Smaller than 640*640 pixels
 - Containing the letter of Corbis on it
 - They can be browsed by all users.
- Web Image:
 - Same resolution with Watermarked Web Image but the perceptible watermark has been removed.
 - User can browse them on the web site after registration.

Business Model

The Corbis collection can be divided into two sections:

- (1) Rights Managed
 - licensed for specific predefined usages
 - Client identifies how, where, and to what extent they would like to use an image(s) and the agency provides permission to reprint the image
 - The usage fees are based on the usage as requested
 - Clients are typically granted one-time usage rights
 - Not allowed to edit or alter the images unless authorized.

PRICE ITEMS

[More Info](#)

Rights Managed Images

Step 1 of 2: Set Usage

To calculate price, complete the information below and click "Calculate Price".
An asterisk (*) denotes a required field.

Select a Saved Usage [Help](#)*Category [Help](#)*Use Type [Help](#)**This Use Type covers:** Use in a paid advertisement in a consumer, trade or Sunday supplement.Exclusive Rights: [Help](#) Multiple Uses: [Help](#)**Note:** selecting "Exclusive Rights" or "Multiple Uses" will restrict your ability to get online pricing.*Geo. Distribution [Help](#)

*Language [Help](#)

*Image Size [Help](#)*Total Circulation [Help](#)*Industry [Help](#)*Duration [Help](#)*Duration Start Date [Help](#)

Business Model

- (2) Royalty-Free
 - The Royalty-Free license grants you non-exclusive use of the image or CD you select
 - Available digitally for direct purchase and download
 - Once you purchase an image, it is pre-cleared and ready to use in a variety of ways
 - To alter an image and create unique works of your own is allowed
 - Individually priced based on creative image selection, and resolution.



This image is also available on CD:

[back to top](#) ▲



Football Glory
RFC702
 50 Images

[View images on this CD](#)

Pricing

[back to top](#) ▲

All [Royalty-Free](#) single images are individually priced based on resolution and creative image selection. Files downloaded directly from the website are in JPEG format. If you need a TIFF format or a larger output size, [contact Customer Service](#) for assistance. Online pricing is not available. Please [contact Corbis](#) to request pricing.

| | <i>Image Size</i> | <i>Dimensions</i> | <i>Output Size</i> | <i>Resolution</i> | <i>Availability</i> |
|----------------------------------|-------------------|-------------------|--------------------|-------------------|---------------------|
| <input type="radio"/> | 640 KB | 427px × 640px | 12.7cm × 20.32cm | 72 ppi | Immediate |
| <input type="radio"/> | 2 MB | 853px × 1280px | 5.08cm × 10.16cm | 300 ppi | Immediate |
| <input type="radio"/> | 14 MB | 1700px × 2550px | 12.7cm × 20.32cm | 300 ppi | Immediate |
| <input type="radio"/> | 32 MB | 2731px × 4096px | 22.86cm × 33.02cm | 300 ppi | Immediate |
| <input checked="" type="radio"/> | 50 MB | 3484px × 5226px | 27.94cm × 43.18cm | 300 ppi | Immediate |

Restrictions

[back to top](#) ▲

[Questions about Restrictions?](#)

Prices vary depending on resolution and creative image selection.

IMAGE DISTRIBUTED AS ROYALTY-FREE.

Copyright Protection Mechanism

- Corbis was an early adopter of Digimarc digital watermarking solutions since 1996.
- Digimarc digital watermarking
 - Add a unique image ID to images, and to track those images as they were distributed digitally.
- Digimarc MarcSpider™
 - Searching more than 50 million images on the web a month to determine where digitally watermarked images have been

Tracking Results

- Identifies up to 50 commercial infringement cases a month
- Provides information and evidence used by Corbis to capture licensing revenue that would otherwise have been lost
- Contributes to compliance revenue that Corbis recovers each year (over \$1 million in 2003)

Thanks for Your Attention!