



浙江大学计算机学院  
数字媒体与网络技术

# Digital Asset Management

## 数字媒体资源管理

### 4. Digital Rights Management



任课老师：张宏鑫  
2017-10-23

# Agenda

- Overview
- Introduction of DRM (Sony & DRM)
- Protecting Digital Intellectual Property
- Rights Expression Language (REL)
- Case Study – Existing DRM systems

# DRM - Overview

- History and background of DRM
- Functional Architecture for DRM
- Key Players in DRM
- Business Imperatives for DRM
- The divide between content industry and IT industry
- DRM standards initiatives: decoding the alphabet soup
- Digital copyright law developments
- State of DRM market development and its future

# History of DRM

- In the pre-digital era, people's ability to do various things to or with content were limited.
- The networked digital age makes it possible to do just about anything to digital content, instantaneously and at virtually no cost.
- While this is a great opportunity for new content business models, it threatens the livelihood of content creators by making rampant piracy possible
- Also, more and more public and private entities are going digital and doing business online. Information is increasingly retrieved through computer networks by customers, employees and partners etc.

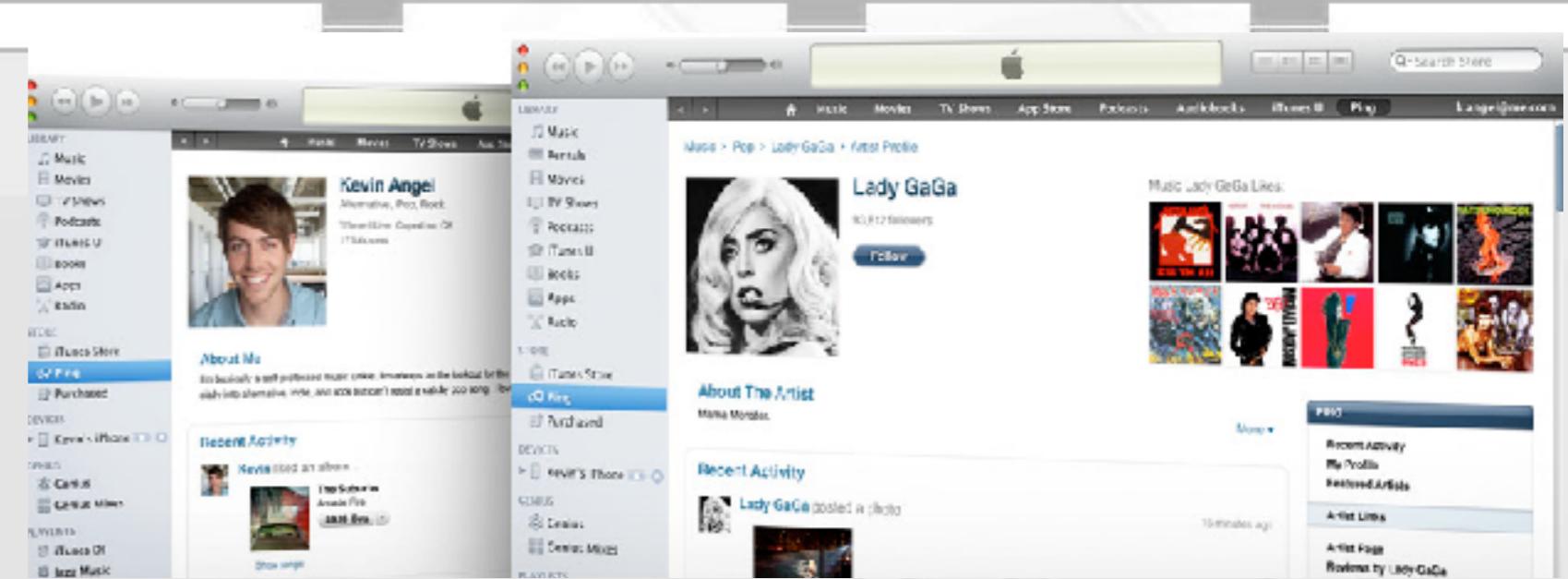
## ➤ Need:

- A technology that enables the **secure** creation, management, distribution and promotion of digital content on the Internet.

# DRM is everywhere



Play Station  
Game Store



iTunes: Apple's store

Shengda  
Bambook

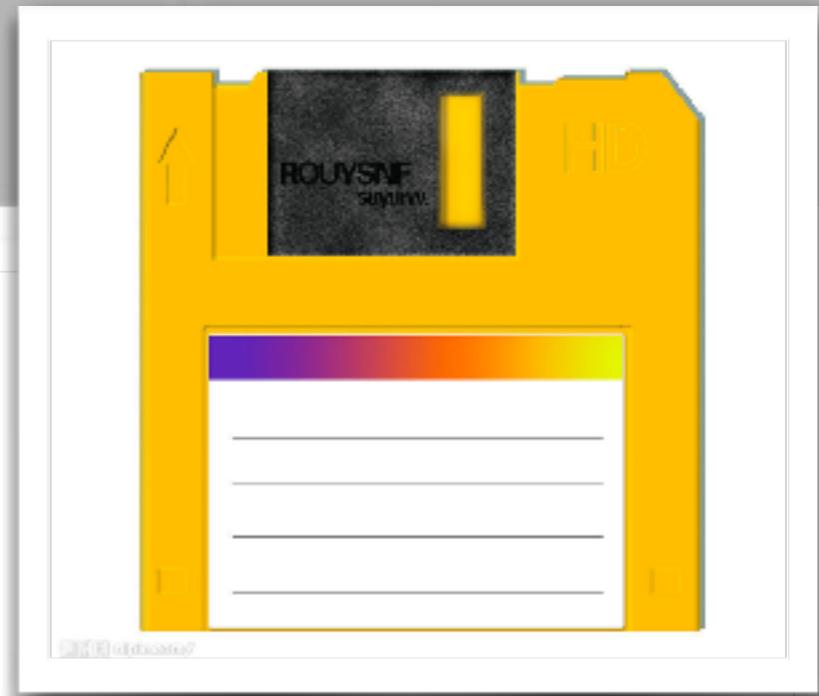


# JailBreak & Hack?

- Why people want to hack PSP, iPhone and many other devices?
- Why jailbreak becomes legal?

# DRM history

- Disk copy protection
- DVD/CD copyright protection



# DRM

- **Set of technologies that enable content owners to specify and control:**
  - the access they want to give consumers and
  - the conditions under which it is given.
- **It includes:**
  - **Persistent Protection:**
    - 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
  - **Business rights:**
    - Capability of associating business rights with a content by contract, e.g. author's rights to an article or musician's rights to a song
  - **Access tracking:**
    - Capability of tracking access to and operations on content
  - **Rights licensing:**
    - Capability of defining specific rights to content and making them available by contract

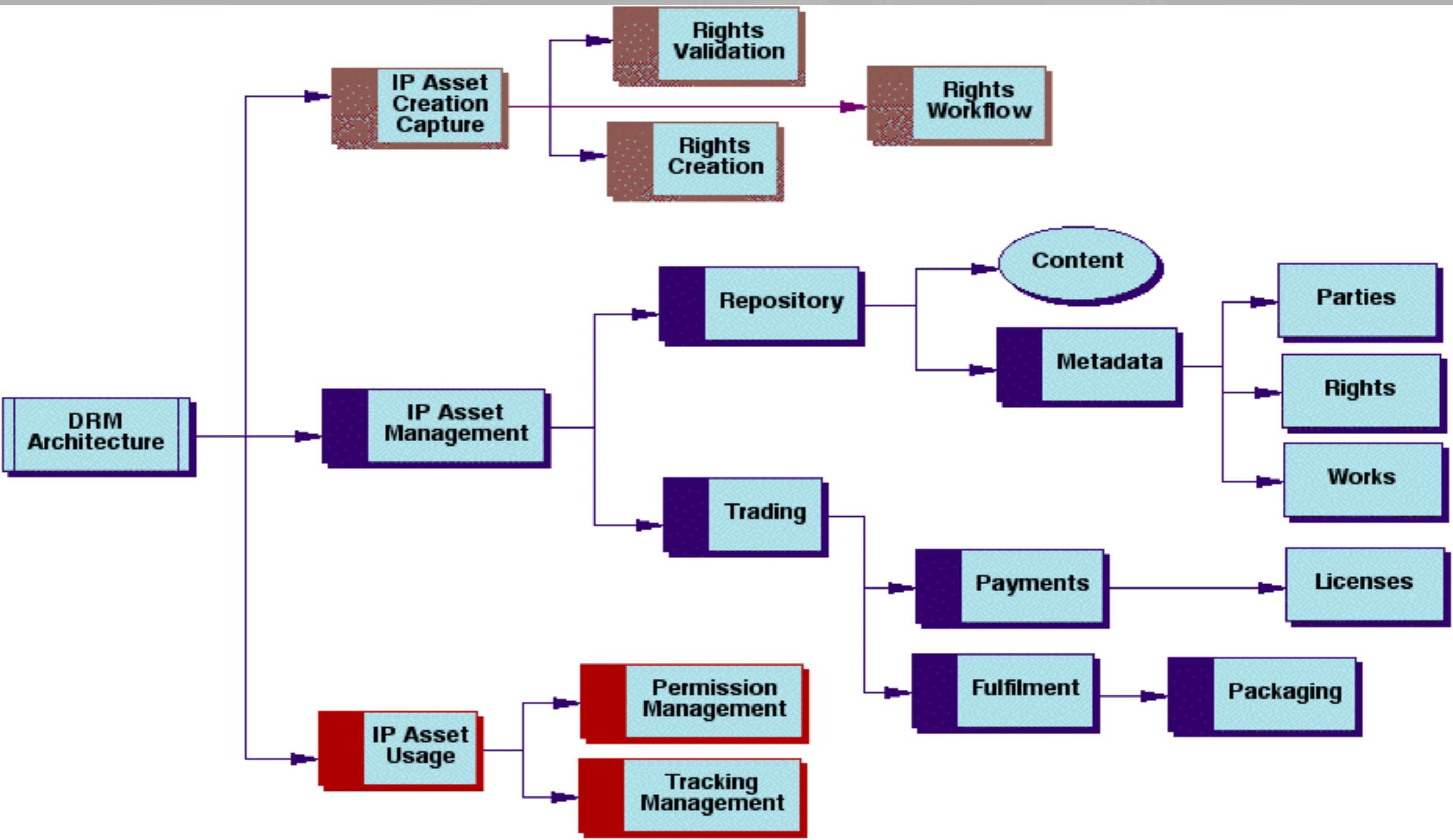
# DRM Functional Architecture

- **IP Asset Creation and Capture Module**
  - **Rights Validation** to ensure content being created includes the rights to do so
  - **Rights Creation** to allow rights to be assigned to new content
  - **Rights Workflow** to allow for content to be processed through series of workflow steps
- **IP Asset Management Module**
- **IP Asset Usage Module**

# DRM Functional Architecture

- **IP Asset Creation and Capture Module**
- **IP Asset Management Module**
  - **Repository functions** to enable the access/retrieval of content in potentially distributed databases and the access/retrieval of metadata
  - **Trading functions** to enable assignment of licenses to parties who have traded agreements for rights over content, including payments from licensees to rights holders (e.g., royalty payments)
- **IP Asset Usage Module**
  - **Permissions Management** to enable usage environment to honor the rights associated with the content, e.g., if user only has the right to view the document, then printing will not be allowed
  - **Tracking Management** to enable monitoring of usage of content where such tracking is part of the agreed to license conditions, e.g., user has license to play video ten times

# DRM Functional Architecture



# Interested Players in DRM

- **Government Agencies**

- Interested in controlled viewing and sharing of highly secure and confidential documents, audio and video data.
- “Need to know basis”

- **Private Corporations**

- Want to limit the sharing of their proprietary information
- Track accesses and any modifications made to it.
- E.g. news agencies like Reuters

- **Owners of commercial content**

- Content owners, artists, and publishers want to gain revenue through sale and promotions
- Concerned about protecting their copyrighted works from illegal use



# Interested Players in DRM (cont.)

- **Intermediaries (service providers, content distributors etc.)**
  - Concerned about minimizing costs of providing services
  - Cautious about protecting themselves from lawsuits over illegal distribution
- **Producers of end user equipment (PCs, players, etc.)**
  - Concerned about minimizing design and production costs
  - Unwilling to pay for features that only some users need
- **End users**
  - Interested in immediate access to desired content
  - Want to use the content conveniently

# **Business Imperatives (业务需求) for DRM:**

- Control Access During Workflow
- Downstream Use
- Modification of Rights Over Time
- Regulatory and Business Standards
- Outsourcing (外包)
- Protection throughout Content Life-cycle

# Business Imperatives for DRM: Downstream Use



- Companies need to deliver controlled access downstream so that content can be licensed, deployed and repurposed by business partners in accordance with the terms of agreements.

## – CASE:

Music publishers license DRM-enabled content to online transactional or subscription services. The DRM-enabled content allows both distributors and consumers to choose from multiple fee/free business models.

For example, the content could be included in both the free-play list for one-time use on multiple devices, or it could be licensed on a fee-for play use by media companies, publishers corporate, government or institutional users.

Further, with DRM-enabled content, owners may chose to permit licensees the ability to re-distribute or enter into republication agreements.



# Business Imperatives for DRM: Modification of Rights Over Time

- Systems must be able to accommodate changes by updating parameters of rights and usage as needed to accommodate new distribution models.
- Lack of ability to change access rights to content can be a serious business liability, cost a lot of money and be a disincentive to customers.
  - Example: The U.S. Supreme Court decision in *New York Times v. Tasini* (2001) compelled content industry vendors to remove or modify core research records in database archives, because creators of content in those archives were not being properly compensated. Compliance costs for vendors included additional staffing to re-code or remove records, systems development expenses, along with increased demand on customer service and marketing departments.
- DRM, in such cases, can facilitate collaboration, creating the ‘trusted environment’ needed for collaboration by persistently protecting critical Intellectual Property (IP) beyond the boundaries of business processes and corporate organizations.

# Business Imperatives for DRM: Regulatory and Business Standards

- *Integrity, authentication, security, privacy and accountability* are ‘watchwords’ for new legislative and regulatory standards.
  - *Example:* HIPPA regulations mandate new levels for privacy and authentication for document management in healthcare institutions and the medical community.
  - *Example:* Warranties and liability requirements demand strict assurances that the latest, most comprehensive, and appropriate instructions, product information and warning of potential hazards are in the hands of the users.
- Integrated DRM-CMS solutions can offer corporations, public sector institutions and regulated industries enterprise-wide assurance that content and document operations comply with current regulatory regimes, accountability, privacy, and security legislation.

# Business Imperatives for DRM: Outsourcing

- Offshore processing and data-conversion service bureaus have long been a staple of trade, technical, professional and database publishers
- Software and entertainment products are routinely outsourced. There is a growing trend to rely on outsourced personnel for the roles companies traditionally reserved for employees
- Bottom line is many people working on digital content products and processes do not have long-term commitment or loyalty to the company.
- Security and communication become large issues and require a level of embedded knowledge within core business processes.
- DRM ensures that information expressed in a standard format to minimize ambiguity, provide an efficient and accurate way to update operational routines, and assure appropriate levels of accountability.

# **Business Imperatives for DRM: Protection throughout Content Life-cycle**

- Piracy, whether of software, music, film, images, or text, costs billions of dollars each year.
  - It squanders valuable company time and resources by requiring costly efforts to detect and deter theft.
  - Further, it creates an atmosphere of distrust that can become counterproductive to developing new business models for digital content.
- DRM-enabled protection continues throughout the distribution of the content, auditing its use and accounting for its fees and licenses.

# An Example of DRM Implementation

OzAuthors  
(An online e-book store)  
Rights Interface

**OzAuthors**

Publish ebook

**7 Usage rights & pricing**

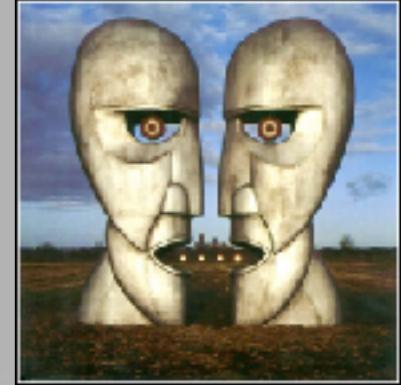
Usage	Details	Price
Preview	5 pages Low-resolution Image (GIF)	Free
<input type="checkbox"/> Read	<input checked="" type="radio"/> Secure <input type="radio"/> Not Secure	\$0.00
<input checked="" type="checkbox"/> Read & Print	<input checked="" type="radio"/> Secure <input type="radio"/> Not Secure	\$10.00

**8 Revenue disbursement**

Member Name	Reason	%
<input type="checkbox"/> Libby Gleeson	By (author)	80
<input type="checkbox"/> Renato Iannella	Illustrated by	10
<input type="checkbox"/> Dale Spender	Edited by	10



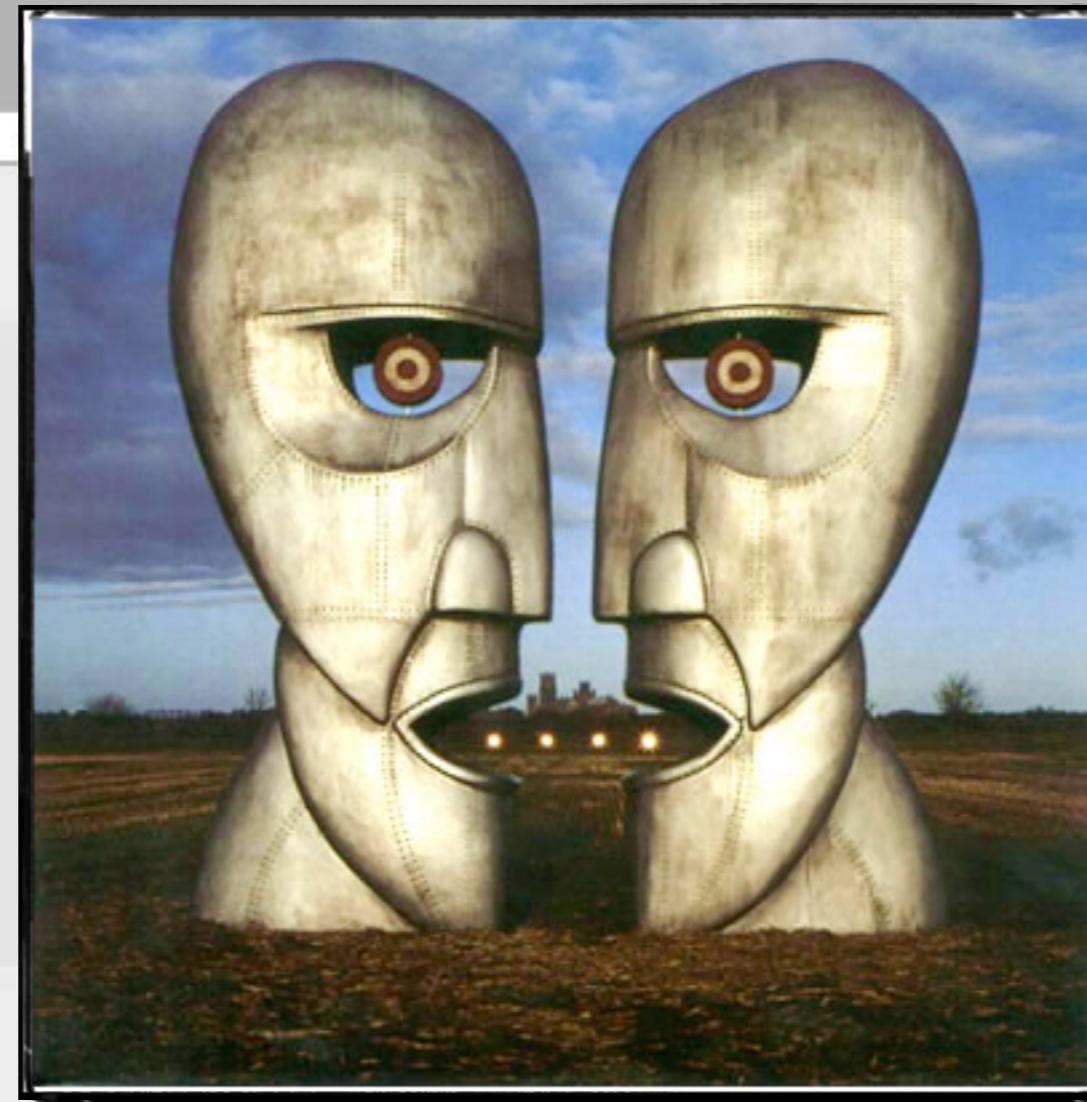
# The Division



- **The content development industry:**  
(e.g., the recording industry and the movie studios)
  - the need for immediate DRM solutions that stop all unauthorized copying and distribution.
- **The IT industry:**
  - DRM solutions should support the concept of "fair use,"
    - allows consumers to make copies of some types of copyrighted content for their own personal use.

# The Division

content provider



IT

- In the US, these disagreements have led to an increase in both DRM-related **lawsuits** and new legislative initiatives.



# Fair Use (合理使用)

- Copyright principle based on **the belief**:
  - the public is entitled to freely use **portions of copyrighted materials** for purposes of **commentary and criticism** (评论、批评)
- Unfortunately, if the copyright owner disagrees with your fair use interpretation, the dispute will have to be resolved by courts or arbitration.
- The four factors for measuring fair use:
  - the purpose and character of your use
  - the nature of the copyrighted work
  - the amount and substantiality of the portion taken, and
  - the effect of the use upon the potential market.



# Examples of Fair Use Court Cases (I)

- **Universal City Studios v. Sony Corp., 464 U.S. 417 (1984)**
  - The Supreme Court determined that home videotaping of a TV broadcast was fair use.
  - One of the few occasions when copying a complete work was accepted as a fair use.
  - Evidence indicated that most viewers were "time-shifting" and not "library-building"
  - *Important factors:* The Supreme Court reasoned that the "delayed" system of viewing did not deprive the copyright owners of revenue

# Examples of Fair Use Court Cases (2)

- **Kelly v. Arriba-Soft, 03 C.D.O.S. 5888 (9th Cir. 2003)**
  - A search engine's practice of creating small reproductions ("thumbnails") of images and placing them on its own website (known as "Inlining") did not undermine the potential market for the sale or licensing of those images.
  - *Important Factors*. The thumbnails were much smaller and of much poorer quality than the original photos and served to index the images and help the public access them.



# Examples of Fair Use Court Cases (3)

- **Religious Technology Center v. Lerma, 40 U.S.P.Q. 2d 1569 (E.D. Va. 1996)**
  - Entire publications of the Church of Scientology were posted on the Internet by several individuals without Church permission.
  - The court held that the use was not fair, since fair use is intended to permit the borrowing of portions of a work, not complete works.

# Digital Copyright Millennium Act (DCMA)

- 1998 law designed to increase copyright holders' rights.
- Creates civil and criminal penalties for creation or distribution of DRM circumvention tools.
- As a result, a user attempting to circumvent copyright protection, even for legitimate reasons, violates federal law.
- What this means?
  - Open-source software developers rely on reverse engineering to write programs that can interact with hardware. This practice is illegal under the DCMA.
  - Reverse Engineering and Cryptanalysis can also be interpreted as illegal under the DCMA.
  - Is Norton Anti-Virus illegal?

# A Media Consumption Culture Shift: Pay-Per-Use and the Marginalization of Content Sharing

- DRM could also acclimate users to a system where sharing of content is not permitted. In 1996 in *The Right to Read*, Stallman envisioned a world where copy protection prevented the anonymous reading of books, lending books to others, or the mere possession of software tools that could be used to bypass copyright law:
  - *This put Dan in a dilemma. He had to help her--but if he lent her his computer, she might read his books. Aside from the fact that you could go to prison for many years for letting someone else read your books, the very idea shocked him at first. Like everyone, he had been taught since elementary school that sharing books was nasty and wrong--something that only pirates would do.*
  - The Right to Read*, Richard Stallman, 1996.

# Microsoft Palladium



- A system that combines software and hardware controls to create a **"trusted" computing platform.**
  - purports to stop viruses
  - store personal data within an encrypted folder.
  - depend on hardware that has
    - either a digital signature
    - or a tracking number.
  - filter spam.
  - incorporate DRM technologies for media files of all types (music, documents, e-mail communications).
  - + purports to transmit data within the computer via encrypted paths.

# **Major Legal Developments: Dmitry Sklyarov and Adobe eBook Copy "Protection"**

- In June 2001, a Russian programmer named Dmitry Sklyarov published a program that can defeat a DRM technology used to secure Adobe eBooks.
- In July, at the behest of Adobe, the Department of Justice arrested Sklyarov for violating the DMCA shortly after he presented a paper on cracking Adobe ROT-13 copy protection.
- Sklyarov remained in jail for several weeks and was released on \$50,000 bail. The Electronic Frontier Foundation (EFF) assisted in his defense and in December 2001, federal authorities dropped charges against him.
- Federal authorities have now pursued ElcomSoft, Dmitry Sklyarov's employer. The case is being litigated in Federal District Court in California.

# **Major Legal Developments: Ed Felten and Suppression of Academic Inquiry into DRM Systems**

- In April 2001, a team of researchers headed by Princeton Prof. Felten announced that they could defeat a DRM system developed by the Secure Digital Media Initiative (SDMI).
- SDMI and the Recording Industry Artists of America (RIAA) threatened Felten and his team with a lawsuit under the DMCA. Felten's team decided not to publish the paper.
- Ultimately, SDMI and RIAA retreated from the treat of lawsuit, fearing that the DMCA may have been stricken as constitutionally overbroad when applied against a group of professors presenting an academic paper.
- In June 2001, the Electronic Frontier Foundation (EFF) bought suit against RIAA to obtain a declaratory judgment that Felten could present the SDMI research. Additionally, EFF sought the invalidation of the DMCA as an unconstitutional restriction on free expression.
- In August 2001, Felten presented the SDMI paper at the USENIX conference. In November 2001, a Federal District Court dismissed EFF's case. In February 2002, Felten decided not to appeal the dismissal.



# References

- “*Integrating Content Management with Digital Rights Management*”, Bill Rosenblatt and Gail Dykstra, May 14 2003
- <http://www.epic.org/privacy/drm/>
- <http://www.dlib.org/dlib/june01/iannella/06iannella.html>
- <http://www.eff.org/IP/DRM/>

# Agenda

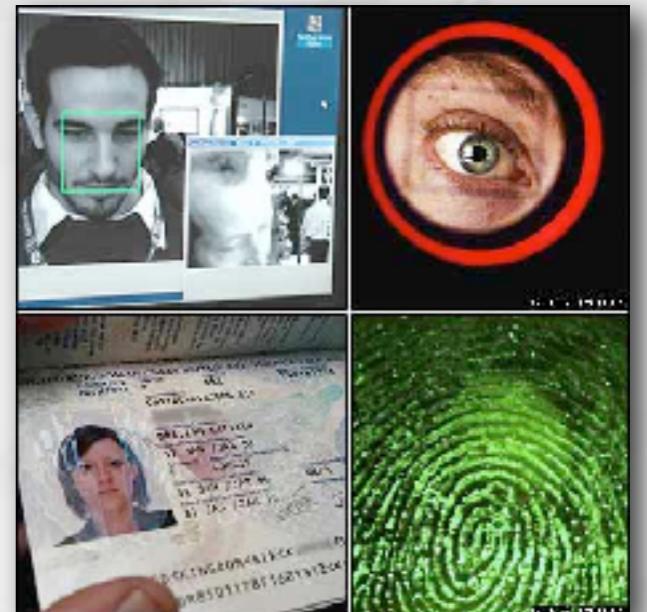
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# DRM – Introduction (Sony & DRM)

- History
- DRM & Sony
- DRM Technology
- Sony Aftermath
- Review - Moral of DRM

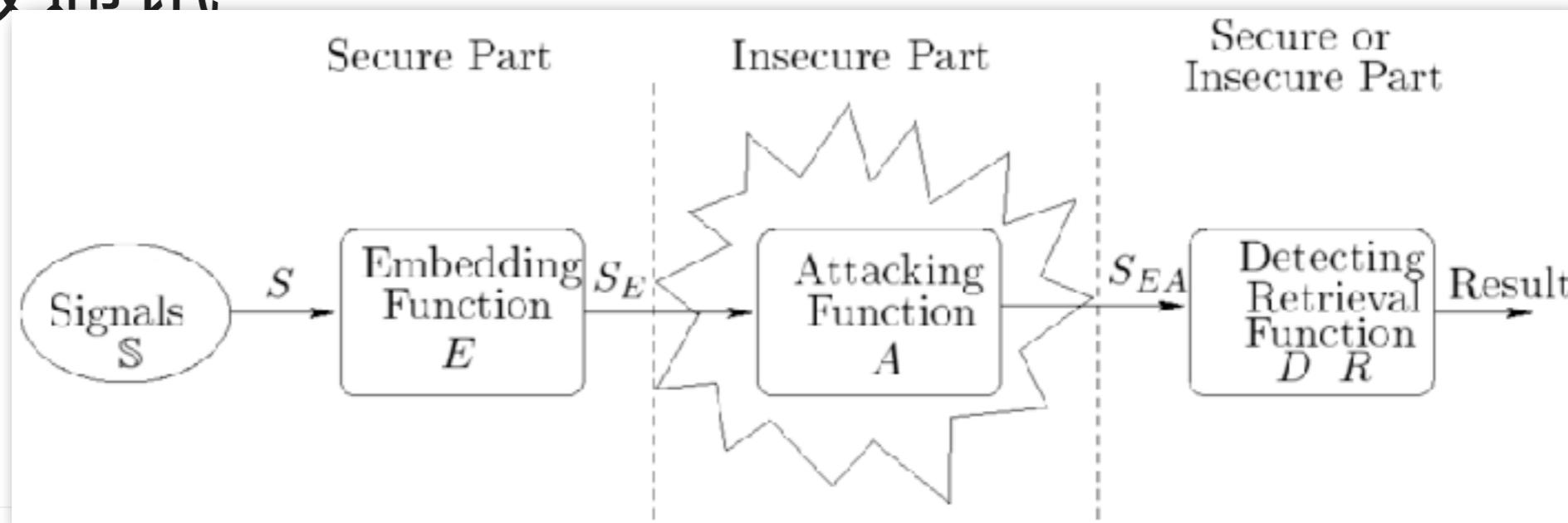
# Previous Technologies

- PKI – Public Key Infrastructure
- PGP – Pretty Good Privacy
- S/MIME
- Access Control Systems
- Smart Cards
- Biometrics

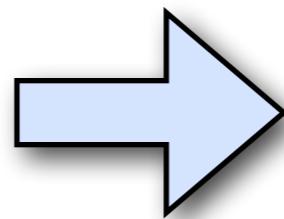


# Preventing Copying With Watermarking (水印)

- digital art
- 票据防伪
- 数据隐藏
- 隐蔽通讯



# Stenography



1. removing all but the last 2 bits of each color component
2. X 85

# Digital Watermark

- Invisible ink on multimedia data
  - image
  - video
  - music
  - graphics

# How are these technologies **different** to DRM?

- Only protect the data in transit
  - E.g. over the Internet or on CD
- Once the data is opened, it can be:
  - edited
  - copied
  - printed
  - saved as an unprotected file

And then

- Redistributed to anyone else in an unprotected format.

*Rely on TRUST once the content is delivered*





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# Sony & DRM



# Sony's Problem:



- One of the big 4 music companies.
  - Copies of its music are easily made by **ripping** from CD's.
- BMG's music was continuously being illegally downloaded and shared across the internet.
  - Large sales being lost.
  - Hard to track popularity data

# Sony's Response

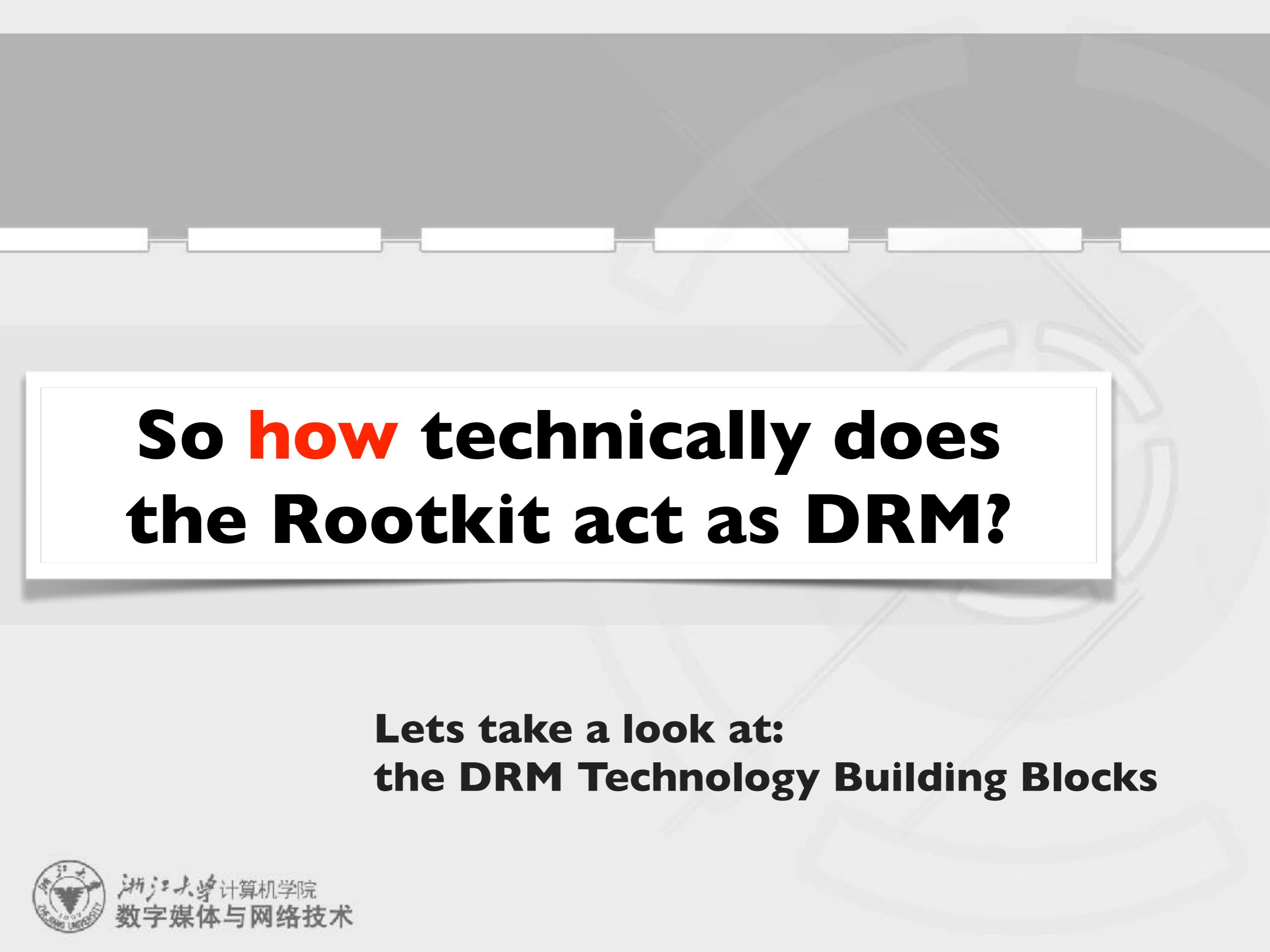
“The industry will take whatever steps it needs to protect itself and protect its revenue streams...It will not lose that revenue stream, no matter what  
... **Sony is going to take aggressive steps to stop this.**”

# Sony's Solution:

- DRM!
- More specifically:
  - A **rootkit** concealing a software called ‘Extended Copy Protection’ was installed on every CD user’s machine.

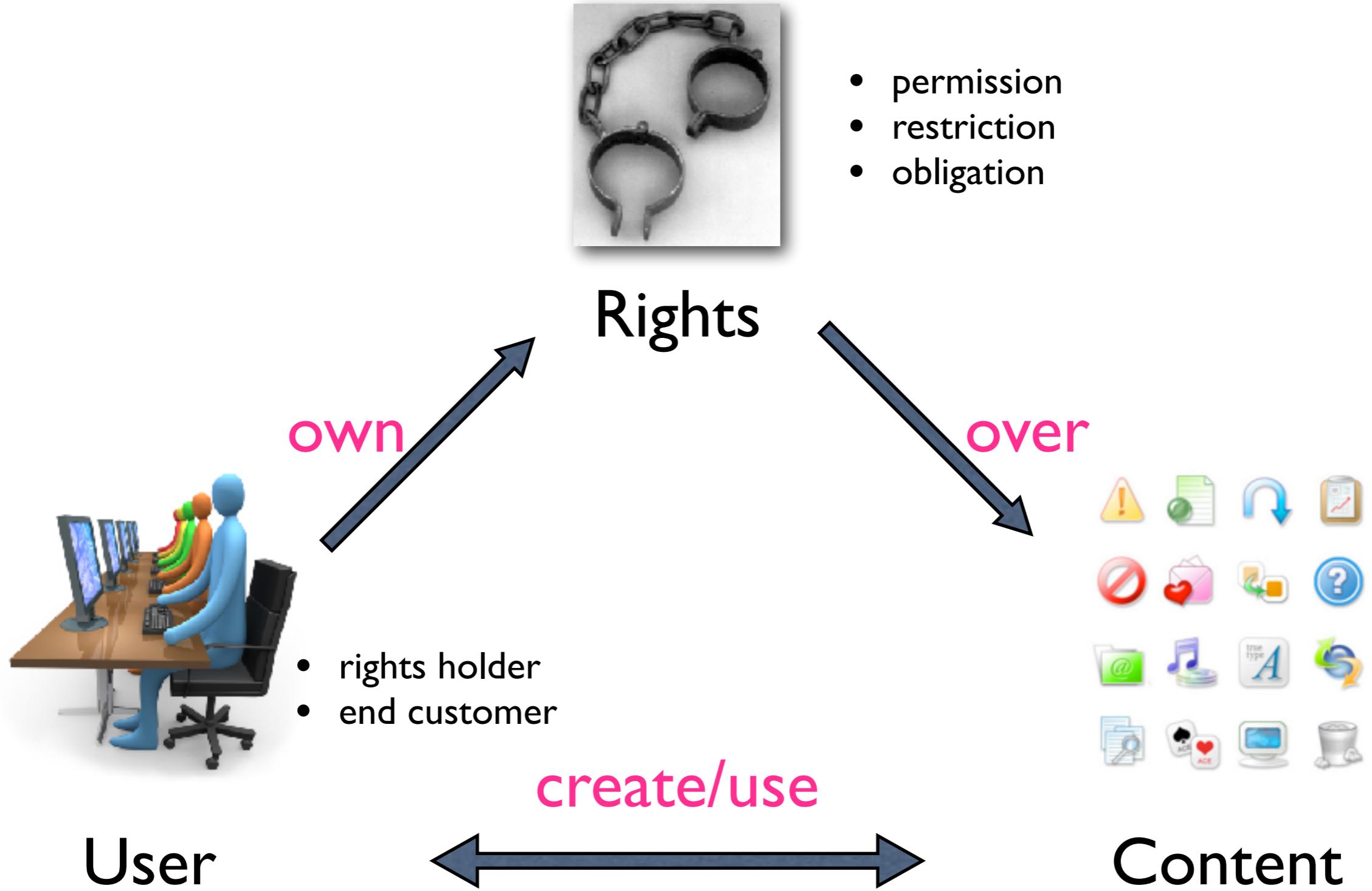
# The Rootkit:

- Remains resident in the user's system
  - intercepting all accesses of the CD drive to prevent any media player or ripper software other than the one included with XCP-Aurora from accessing the music tracks of the Sony CD.
- Player software will:
  - Play songs
  - Allow only a limited degree of other actions
    - e.g., burning the music onto a certain number of other CDs or
    - loading it onto certain supported devices, e.g., a few portable music players. (iPod not supported)



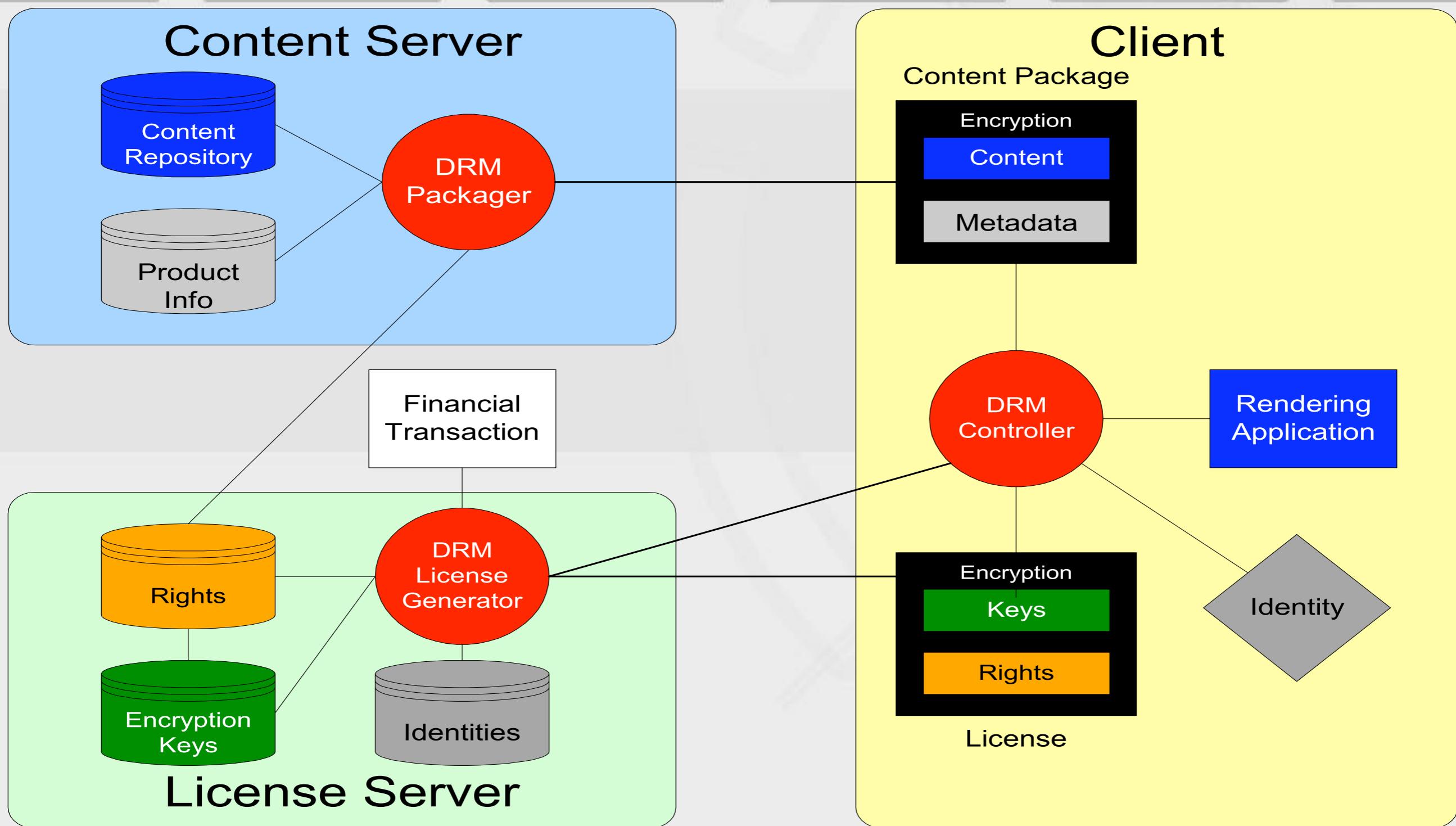
**So **how** technically does  
the Rootkit act as DRM?**

**Lets take a look at:  
the DRM Technology Building Blocks**



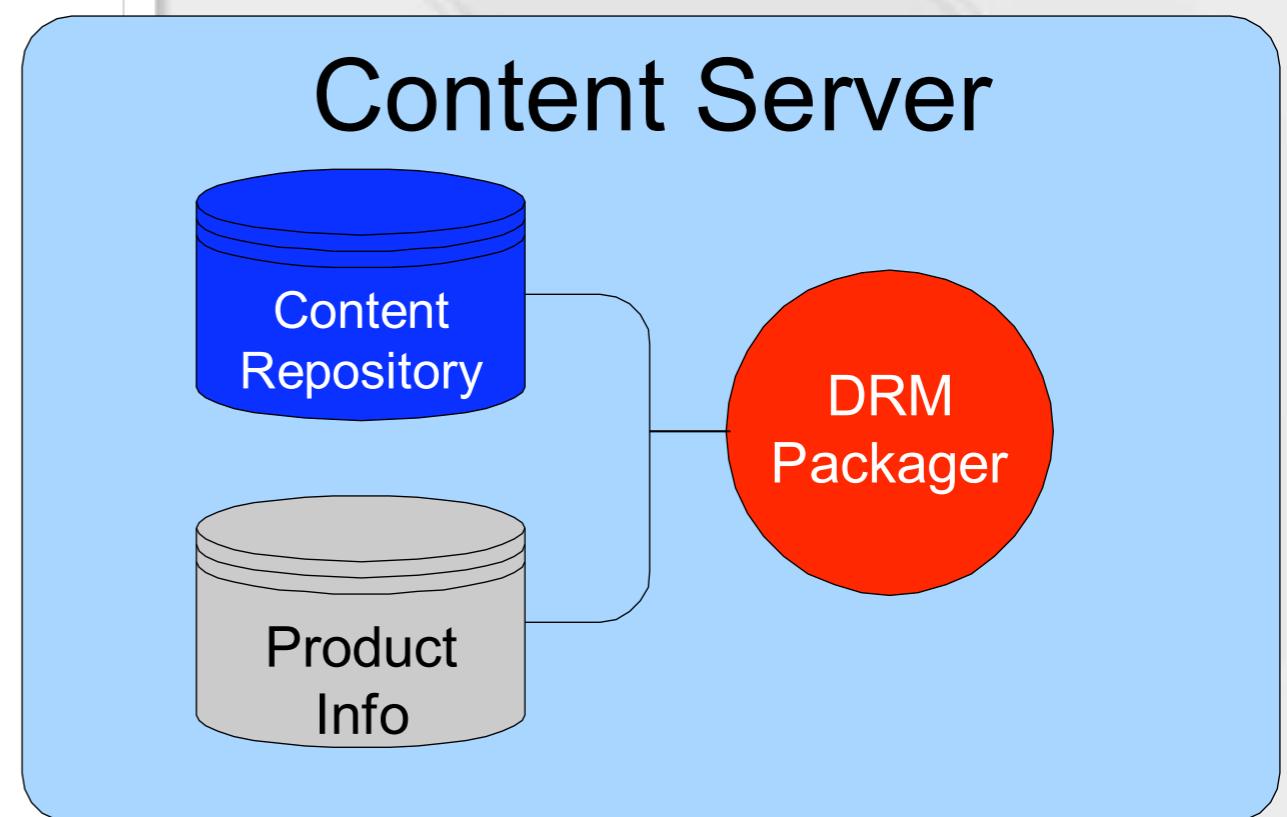
# DRM basic Model

# DRM Reference Architecture



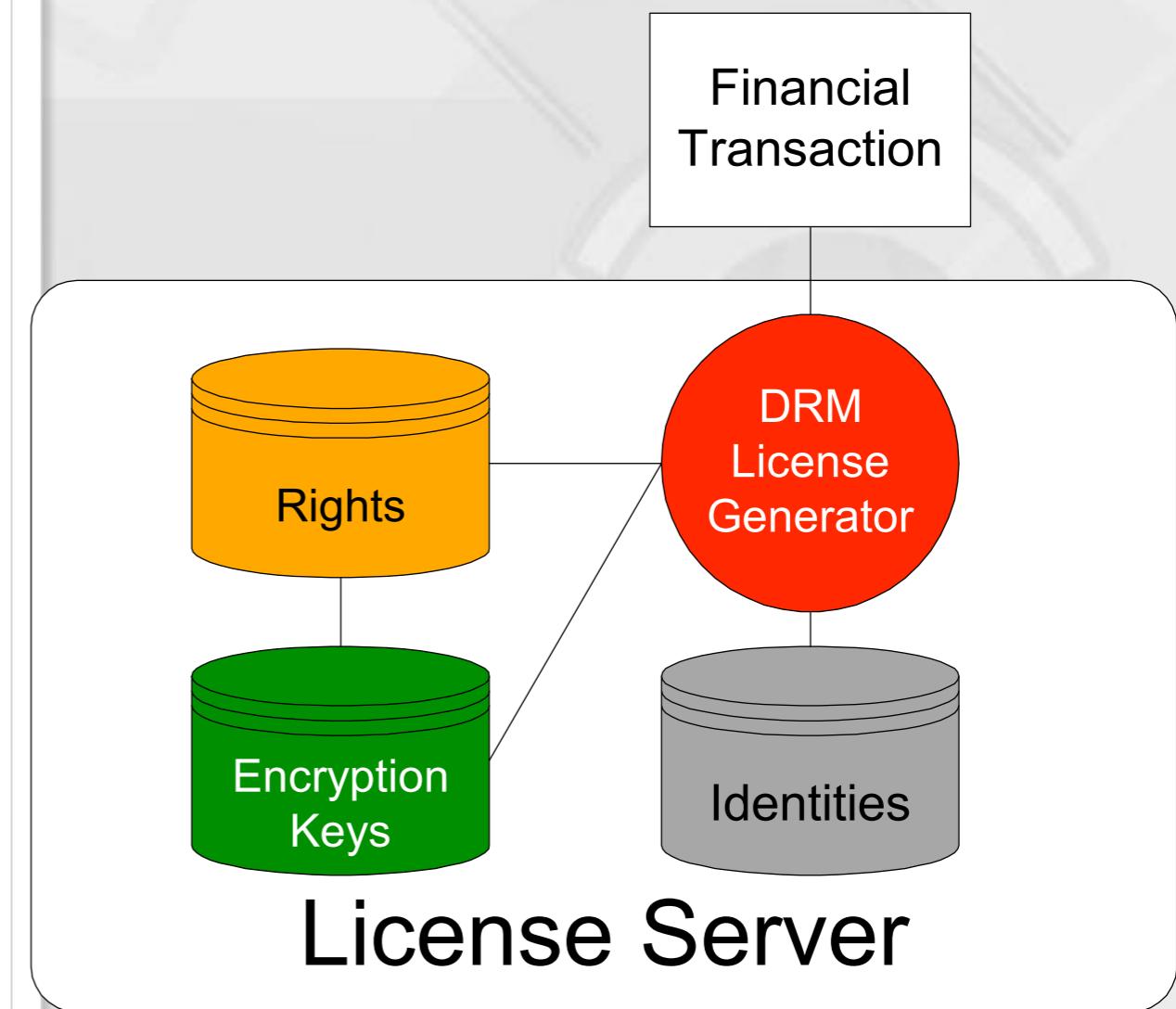
# Content Server

- Content Repository
  - Content Management system
  - Digital Asset Management system
  - File server
- Product Info
  - **Rights**
  - Product metadata
- DRM Packager
  - Packages content with metadata
  - Encrypts



# License Server

- Encryption key repository
- User identity database
  - Usernames
  - Machine IDs
- DRM License Generator



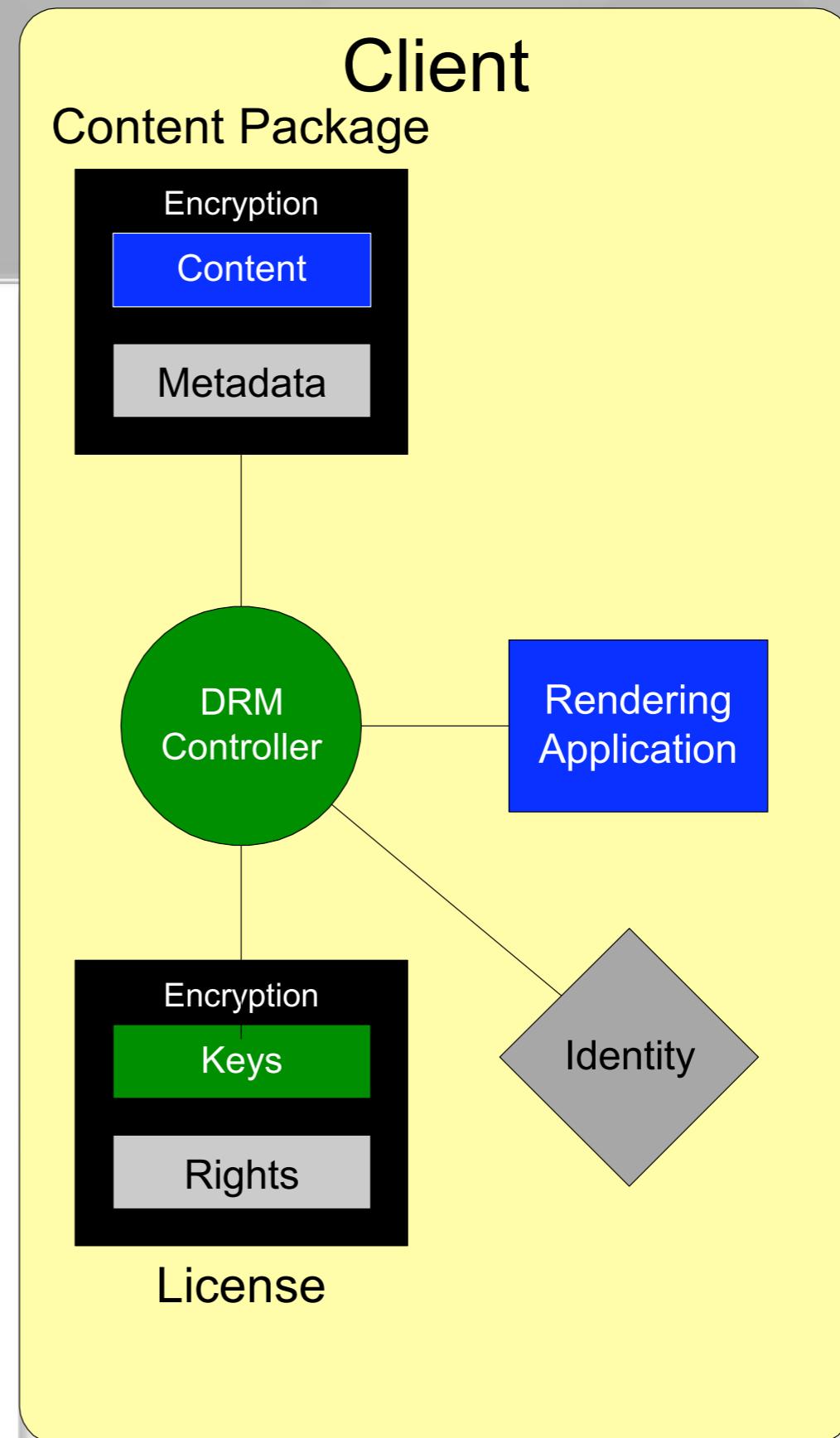
LICENSE SERVER

key  
repository

identities

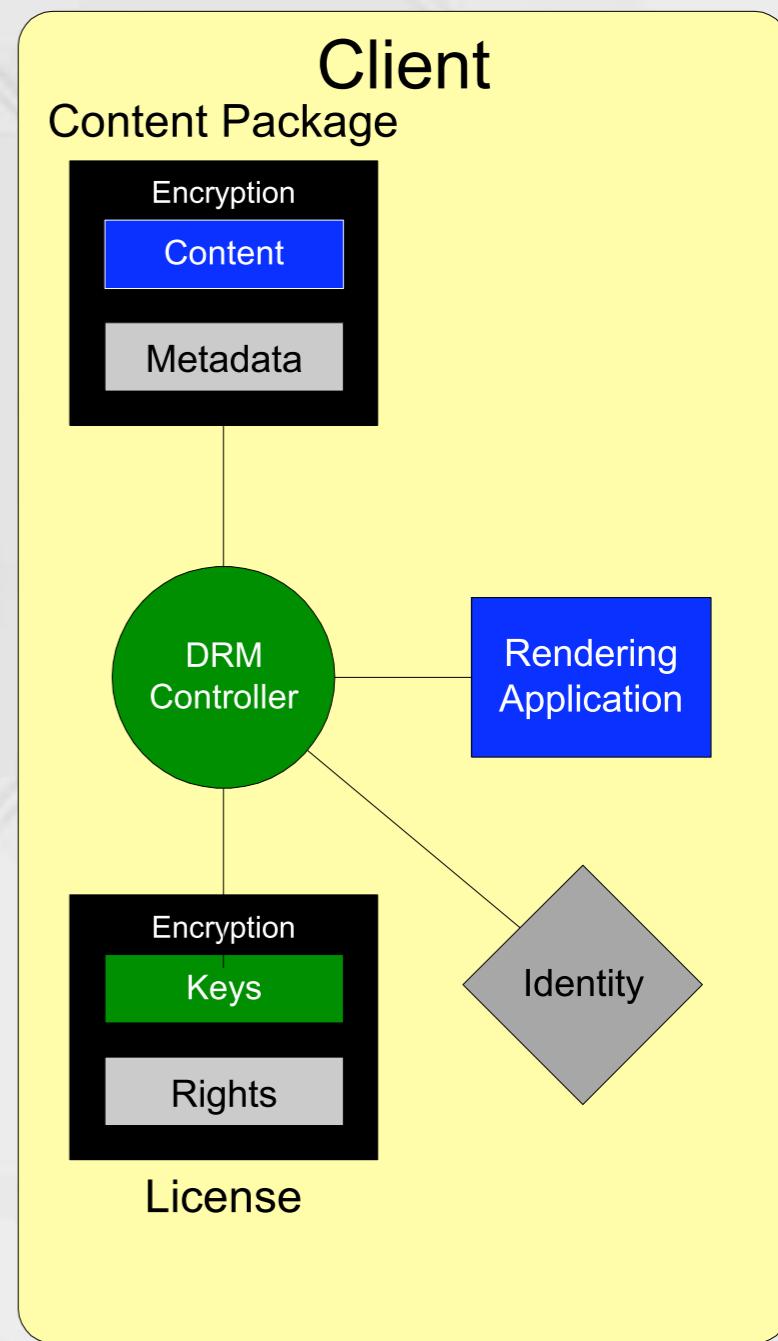
# Client

- DRM Controller
  - Nerve center of process
- Rendering application
- Content packages
- Licenses
- Identity



# Processes - User Initiation

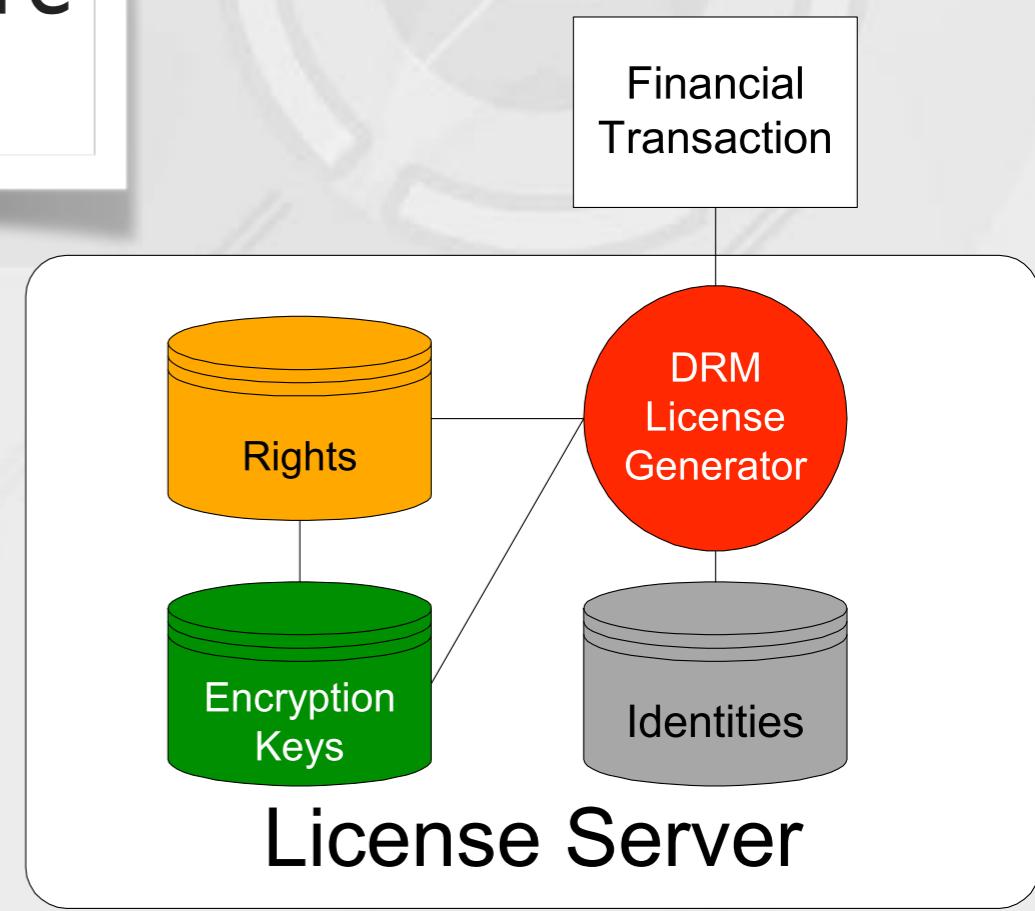
- User obtains content package
- User requests operation
  - view, play
- DRM controller collects info
  - Content
  - Identity
  - Requested rights
- DRM controller:
  - license generator



# Processes - License Generation

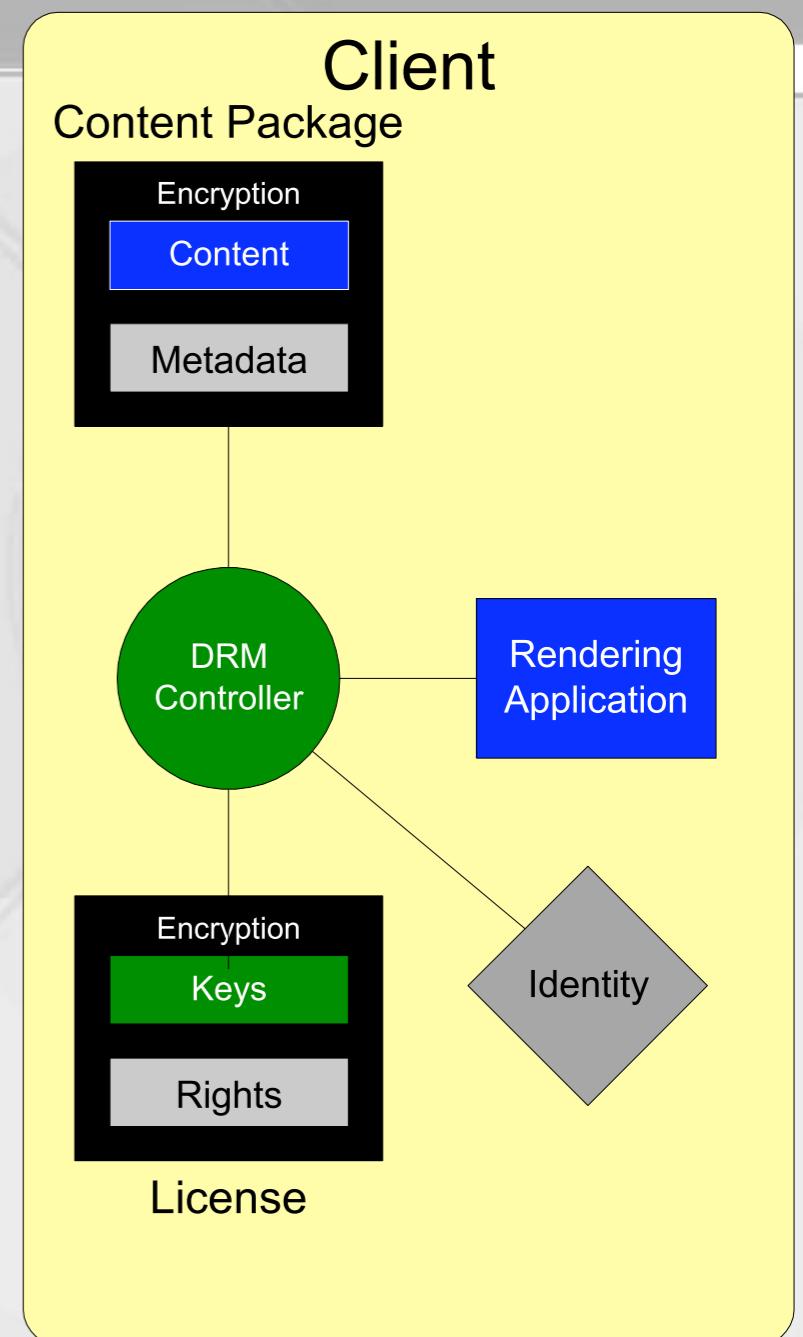
## DRM License Generator...

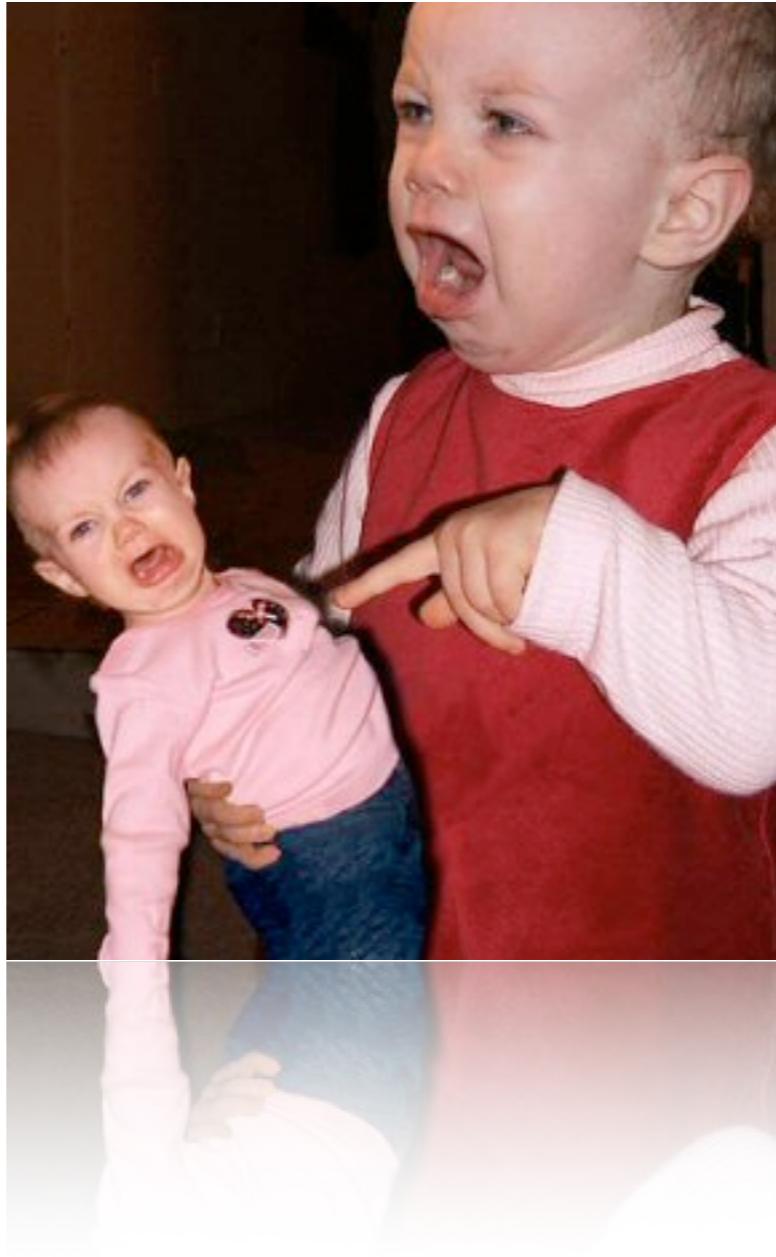
- Checks content & identity
- Obtains keys from key repository
- Creates & sends license to client
- Generates financial transaction, where necessary



# Processes - User Completion

- DRM Controller...
  - Receives license
  - Extracts keys from license
  - Decrypts content
  - Generates financial transaction, where necessary
  - Hands content to rendering application
- Rendering application plays content





**What were the results of  
Sony's attempt at DRM?**

# Results of Sony's DRM Project:

- The rootkit was uninstallable
- Installing software without permission is illegal in many countries
- Rootkit left backdoors that could be exploited by viruses
- Sony under class action lawsuit



# Public Outcry

- The head of Sony BMG's global digital business, Thomas Hesse, told National Public Radio

"Most people, I think, don't even know what a rootkit is, so why should they care about it?"

- Turns out people did care
  - Class action lawsuit in place against Sony
  - Uninstaller finally released for the rootkit

## Discussion:

★ What is the fine line between acceptable restrictions on Digital Rights?