Knowledge Management and Protection Systems (KMaPS)

Corso di Laurea in Ingegneria

Part 1a – ***sistemi di protezione***

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Part 1a: sistemi di protezione

- Distribution models
- Terminologies
- Business Models & Value Chain
- Copy protection
- Conditional Access Systems
- Digital Rights Management
- Content Modeling and Packaging
- Licensing and content distribution
- Creative Commons Licensing
- Composition of Licenses, data aggregation

Content Services Aspects

- **Scalability**:
  - From few to millions of transactions per hours
  - From few to millions of subscribed users
  - From few to millions of different content items
- **Availability and**
  - High reliability of the service, no or few interruptions
- **Accessibility:**
  - Accessibility of the service, broadcast/cellular coverage
  - User accessibility aspects
- ***Other aspects discussed in the course***
  - ***Privacy of the customers***
  - ***Intellectually property management and protection, IPMP***
  - ***Multichannel distribution***
  - ***Interoperability of content on devices***

Architectures

A. Content/good *distribution*

B. Content/good *production and management*

C. Content/good *Protection and Security*

D. Content/good *Modeling and Processing*

A) Content distribution models

- **Download, P2P download, …:**
  - 1:N: one sender N receivers/users
  - N copies, propagation of seeding/sources sites
  - Network costs from O(N) → O(1)
- **Broadcast Streaming (e.g., MPEG2-TS)**:
  - 1:N: one sender N receivers/users
  - N users that play the same content at the same time
  - Network costs O(1)
  - DVB-T, DVB-S, DVB-H, DVB-SH
- **VOD, progressive download, P2P streaming/progressive:**
  - 1:1 stream processes, one sender process for each receiver/user, that play the same content a different time
  - Network costs O(N) -→ may be going to O(1) if ….

B) Content production and management

- Content Processing:
  - adaptation,
  - production,
  - formatting,
  - packing, etc.

- Scalability GRID for content processing:
  - UGC management
  - Indexing for search,
  - production on demand,
  - massive production
  - transcoding

C) Content Protection and Security, aspects

- CP: Copy Protection
- CAS: Conditional Access Systems
- DRM: Digital Rights Management
- Based on technologies such as
  - **Certification** of: content, users, devices, etc.
  - **Authentication** of: users, actors, devices, etc.
  - **Signature** of: content, DLL, EXE, ..
  - **Identification** of: content, users, devices, etc.
  - **Watermark** and **fingerprint** of: content, descriptors, ...any....
  - **Coding** and Encryption of: .....everything.....

D) Content Modeling and Processing

- **The content model impacts on:**
  - **Format: XML, binary**
  - **Content gathering and ingestion**
  - **Production and production-process definition**
    - Workflow Management systems
    - Cooperative work
  - **CMS, DMS, Content/Media Management Systems**
    - Database management systems
    - query support, distributed queries, etc.
  - **Content description for**
    - Search, classification/indexing, retrieval
  - **Content protection for enforcing respect of**
    - IPR: CAS, DRM, ...
  - **programme/guide production**
    - EPG, GuidePlus, ShowView, TVAnytime, etc.

Acronyms and Definitions

- IPR: Intellectually Property Right
- CA: Certification Authority, chain of certificates
- TPM: Technological Protection Model
- FTA: Fault Tolerance Architectures
- VOD: video on demand
- PPP: pay per play
- PPV: pay per view
- VOIP: voice over IP
- TS: Transport Stream
- EPG: electronic program guide
- Etc.

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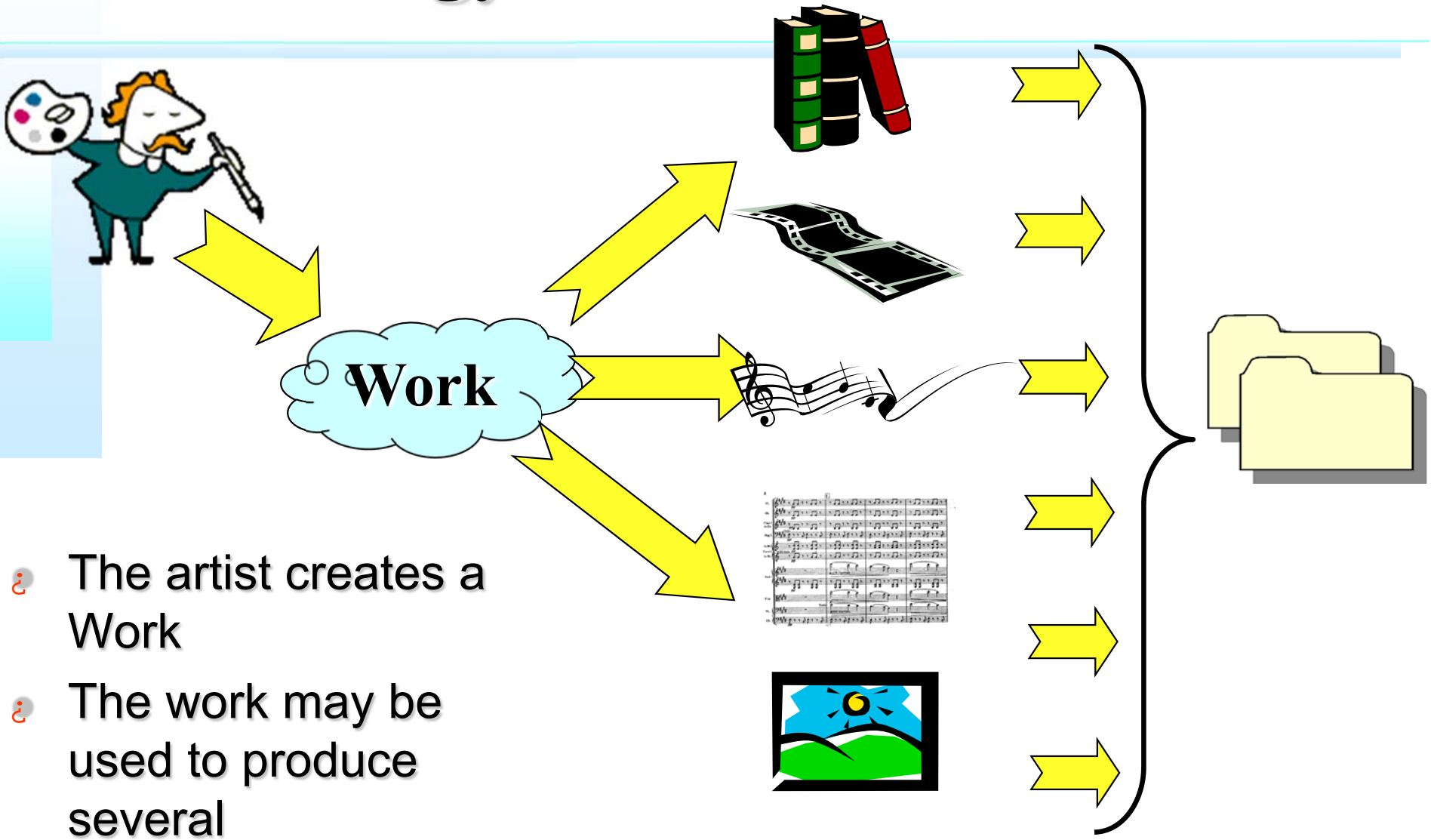
Terminology



- The artist creates a Work
- The work may be used to produce several manifestations

Some Actors of the value chain, “definitions”

- **Right/Content Owners**, artists, etc.
  - who has the rights on the initial work, non digital
- **Content Producers**, Publishers
  - Who is producing the manifestations of the work, define its rights, may produce the digital resources or not, etc.
- **Content Integrators**, aggregators
  - Who is Integration/aggregation: resources + metadata ++ , added value, etc., may be add other rights, etc.
- **Content Distributors**,
  - Who is distributing digital content
- **Final Users**,
  - Who is using (or should use) the digital content on behalf of the rights obtained
- **Users**, in general
  - All the above actors that use in some way content on the basis of the rights obtained

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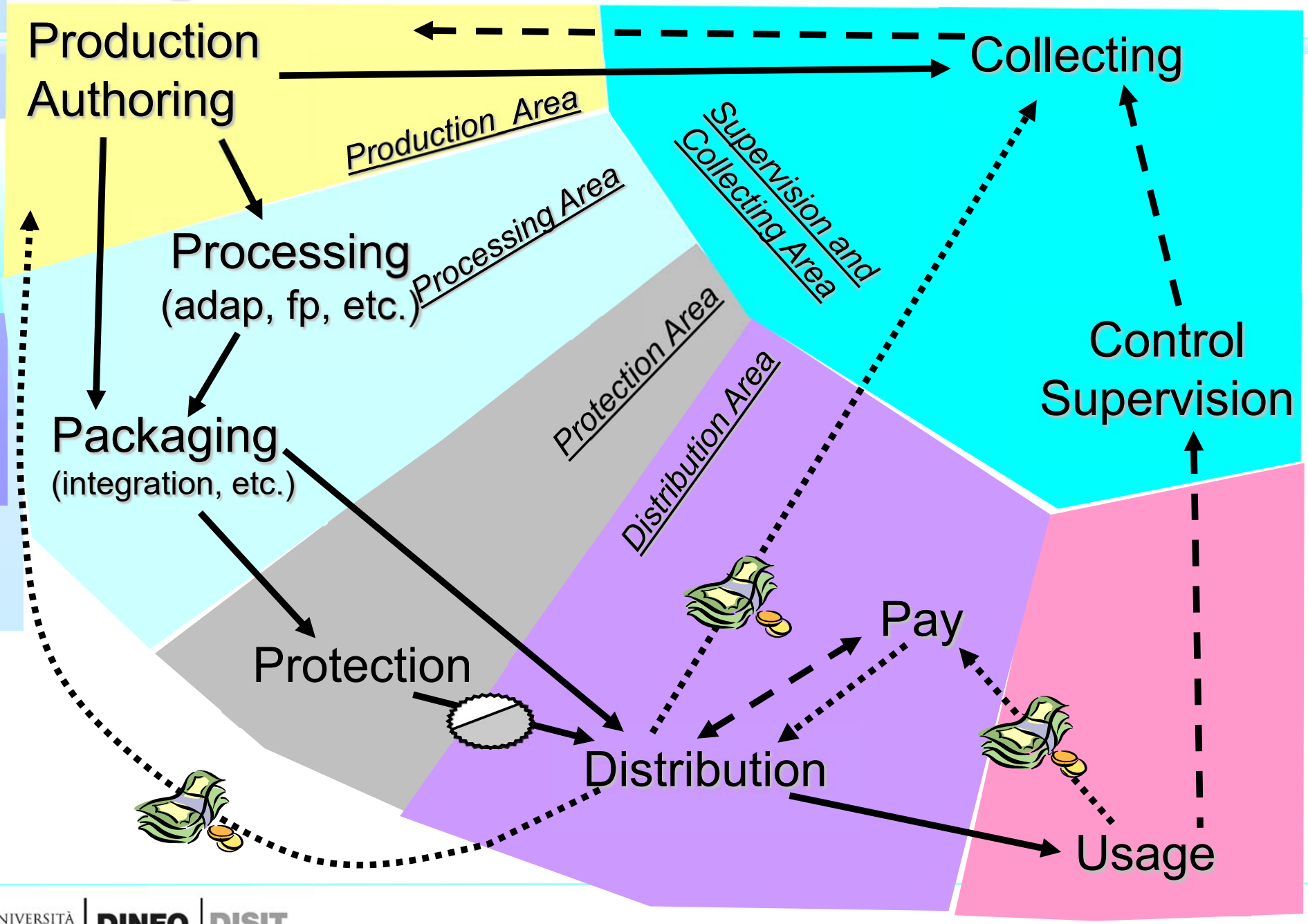
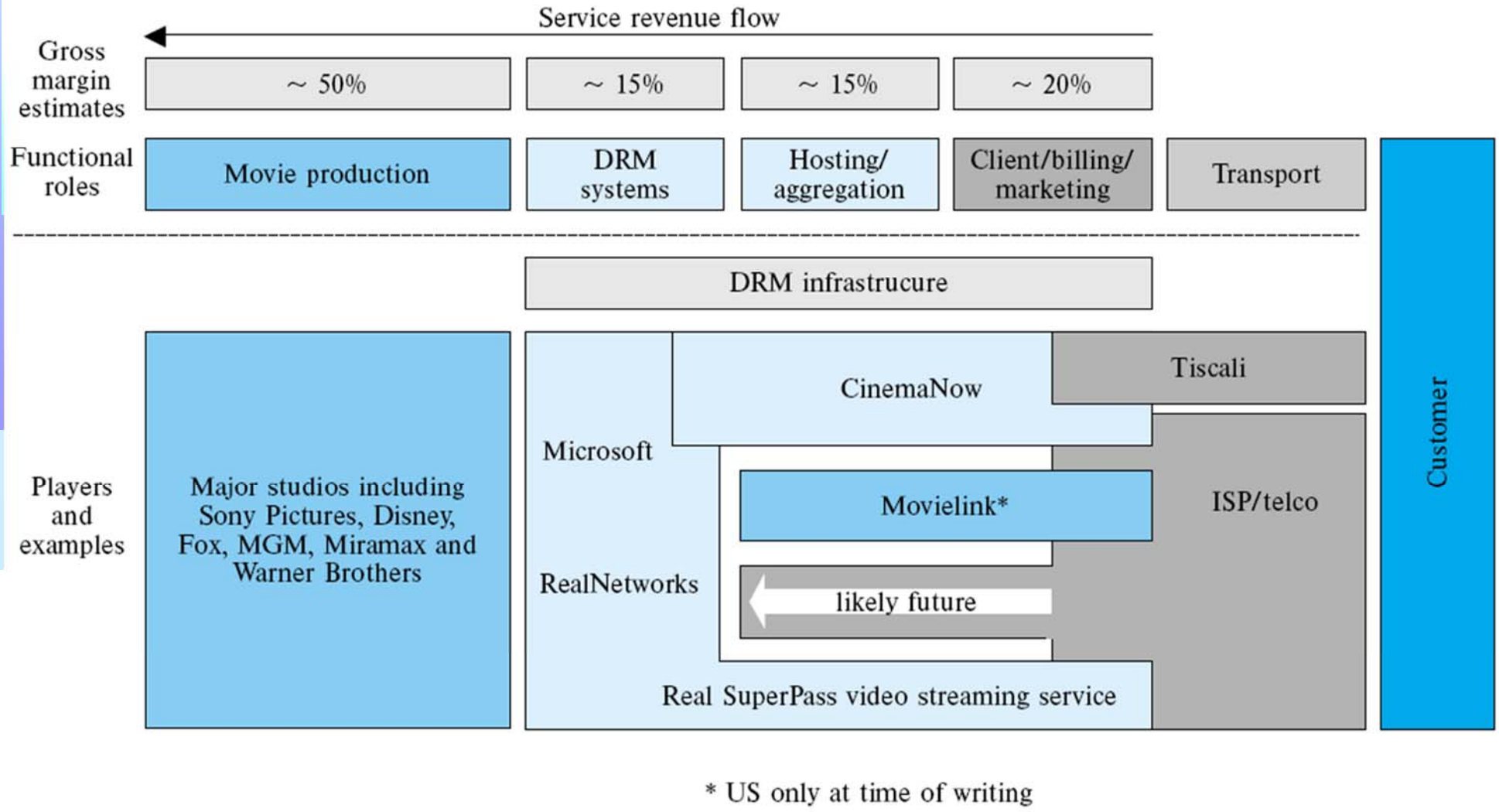
Simplified Traditional value chain



Classification of Transaction Models

- **B2B:** Business to Business
  - Among digital good: producer, publishers, integrator, resellers, distributors, etc.
  - Each of them add a value and thus charge to final prince of the digital good, …
- **B2C:** Business to Consumer
  - From distributors to consumers
  - The final part of the value chain
- **C2C:** Consumer to Consumer
  - File and good sharing
  - UGC (User Generated Content) sharing
  - Recently IPR management
- **B2B2C**
  - Integrated B2B to B2C

Ex: Broadband VOD value chain



Source EITO2005

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Copy Protection solution

- **Naturally digital items can be freely copied**
  - The copy is a feature of the operating system, file system
  - The operating system cannot be typically controlled
  - Microsoft is going to enforce more control on the Operating System

- **CP Solution**: prevents the Copy of digital content
  - Programs: hardware key
  - Holes in FD
  - Special formatting in CDs/DVDs
  - Etc.

Utilizzo della crittografia

- Encryption è il processo che codifica un messaggio in modo da nasconderne il contenuto
- Si basano sull'uso di parametri segreti chiamati *chiavi*
- Si dividono in due classi fondamentali
  - Chiavi segrete condivise *(secret-key)*
  - Coppie di chiavi pubblica/privata *(public-key)*
- Segretezza e integrità
- Autenticazione
- Firma digitale

Algortimi di crittografia

- Un messaggio si dice criptato quando il mittente applica alcune regole per trasformare il testo originale (*plaintext*) in un altro testo (*ciphertext*)

$$E(K_1, M) = \{M\}_K$$

- Il ricevente deve conoscere la trasformazione inversa per ritrasformare il *ciphertext* nel messaggio originale

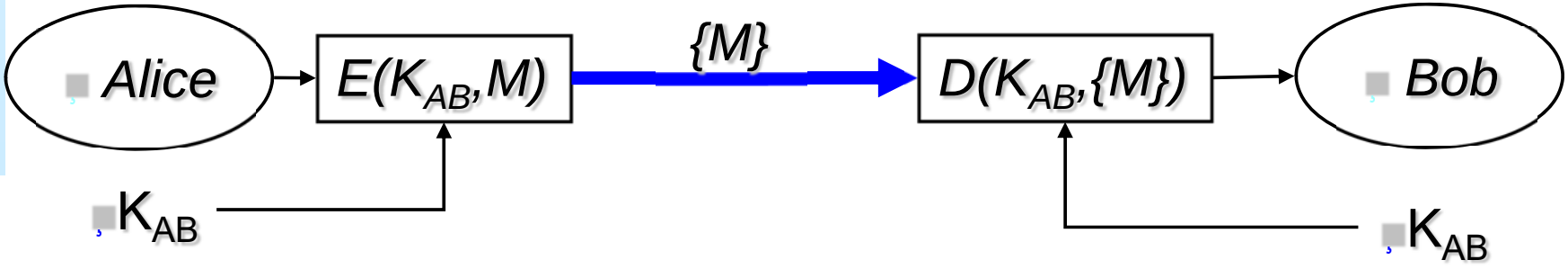
$$D(K_2, \{M\}_K) = M$$

$K_1 = K_2$ **simmetrico**

$K_1 != K_2$ **asimmetrico**

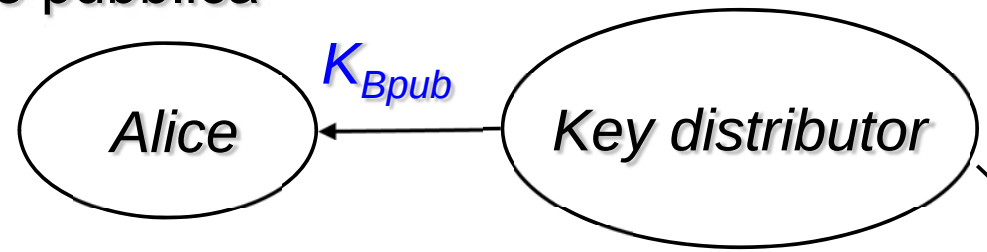
Scenario 1: secret communication

- Alice vuole inviare alcune informazioni segretamente a Bob
  - $\{M\}=E(K_{AB},M)$
- Alice e Bob conoscono entrambi la chiave segreta K_{AB}
- La comunicazione è segreta finchè K_{AB} non è compromessa

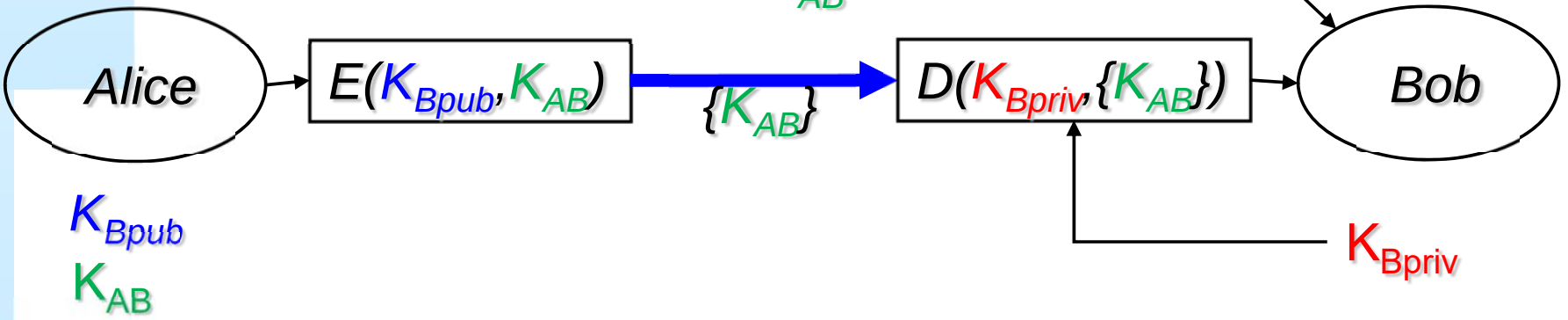


Scenario 3: authenticated with public-key

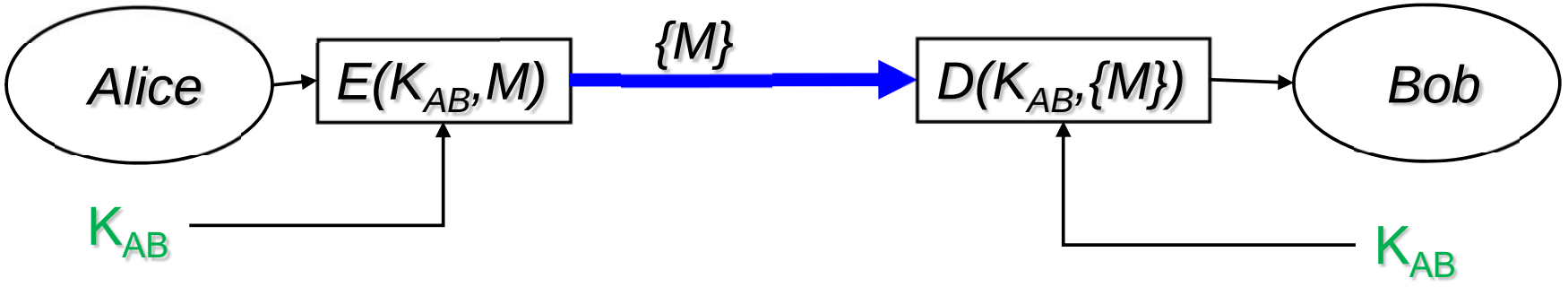
- Richiesta chiave pubblica



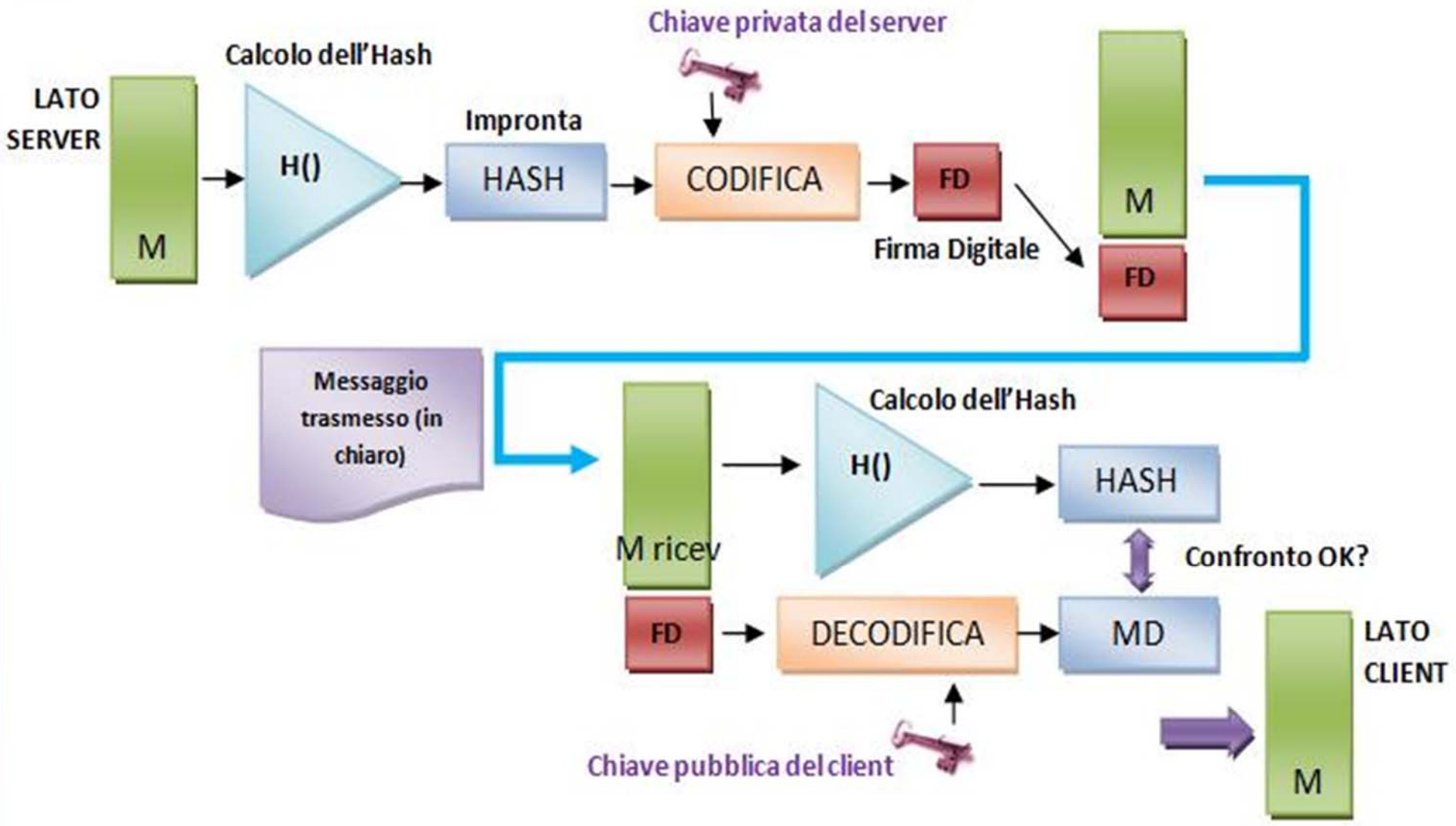
- Determinazione chiave di sessione K_{AB}



- Cumunicazione sicura



Digital Signature



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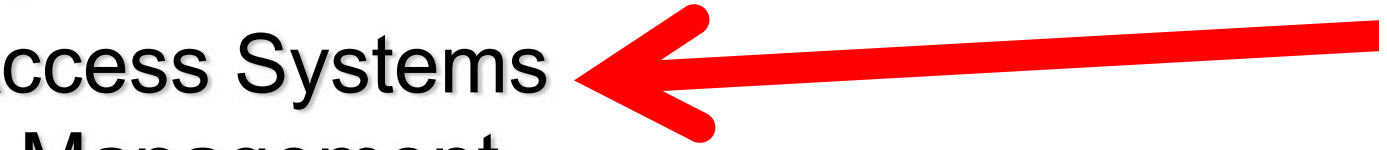


CAS: Conditional Access Systems

- **Systems that controls the access to the content**
  - Typically used on streaming towards STB/Decoders
  - Copy is assumed not possible since the content is not stored locally and neither accessible to the final user.

- **For PC:**
  - Partially suitable for open platforms such as PC
    - ➔On PC: SSL, HTTPS, etc.
  - Temporary storage of smaller content on the disk, may be encrypted
- **For STB:**
  - The most interesting and diffuse solution

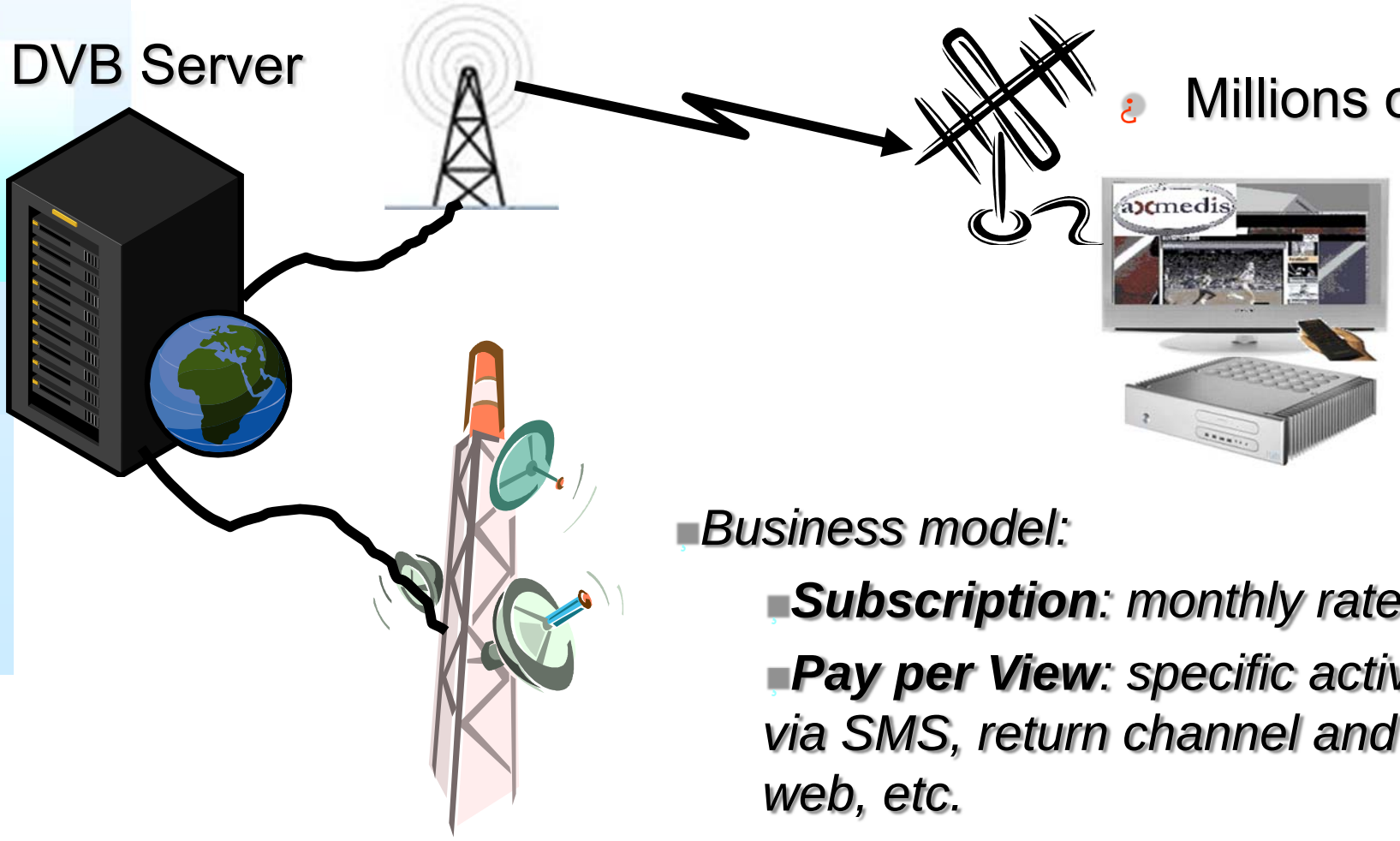
CAS: Conditional Access Systems

- **Systems that controls the access to the content for STB**
  - Streaming towards STB/Decoders
    - DVB-T, DVB-S, DVB standards for CAS
  - Copy is assumed not possible since the content is not locally stored and accessible to the final user. Recently can be temporary stored, see MySky.

- **Protection and solution**
  - Streaming in broadcast
  - Adoption of MPEG-2 TS (other models such as RTSP)
  - *For example*: Irdeto, Nagravision, NDS
  - Key distributed into the stream, accessible with another key
  - Adoption of SmartCard for some business models
  - Adoption of the Return Channel for some business models

DVB-T/DVB-S

- DVB Server
- Millions of STBs



- *Business model:*
  - ***Subscription**: monthly rate*
  - ***Pay per View**: specific activation via SMS, return channel and GUI, web, etc.*

Il sistema DVB terrestre (DVB-T)....

Set Top Box (STB)

La Multimedia Home Platform (MHP)…

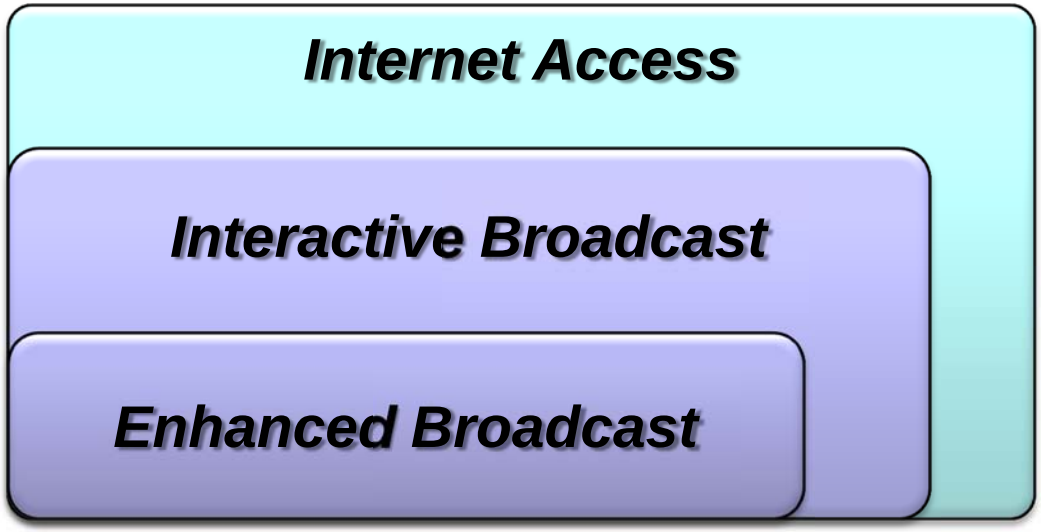
La piattaforma DVB-MHP

MHP 1.0 nel luglio 2000, MPH 1.1 nel giugno 2003

Indipendenza dall'ambiente HW e SW

Approccio a livelli per le API MHP

I Profili

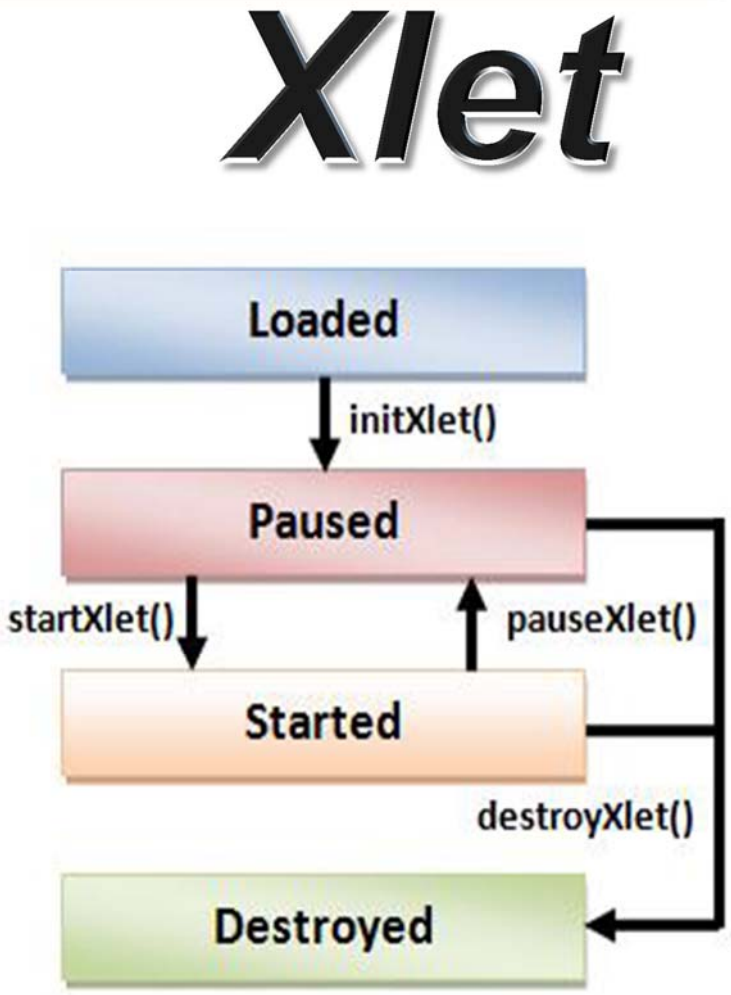


Il digitale terrestre e Java....

Le applicazioni MHP

- Java Virtual Machine (JVM)
- API Java Media Framework (JMF)
- API JavaTV
- Astrazione dalle specifiche HW
- Nessun vincolo con lo standard DVB
- Xlet vs Applet
- L'interfaccia **Xlet**
- La classe **java.tv.XletContext**
- L'interfaccia grafica

Java.awt.* **java.havi.ui.*** **org.dvb.ui.*** **org.dvb.event**

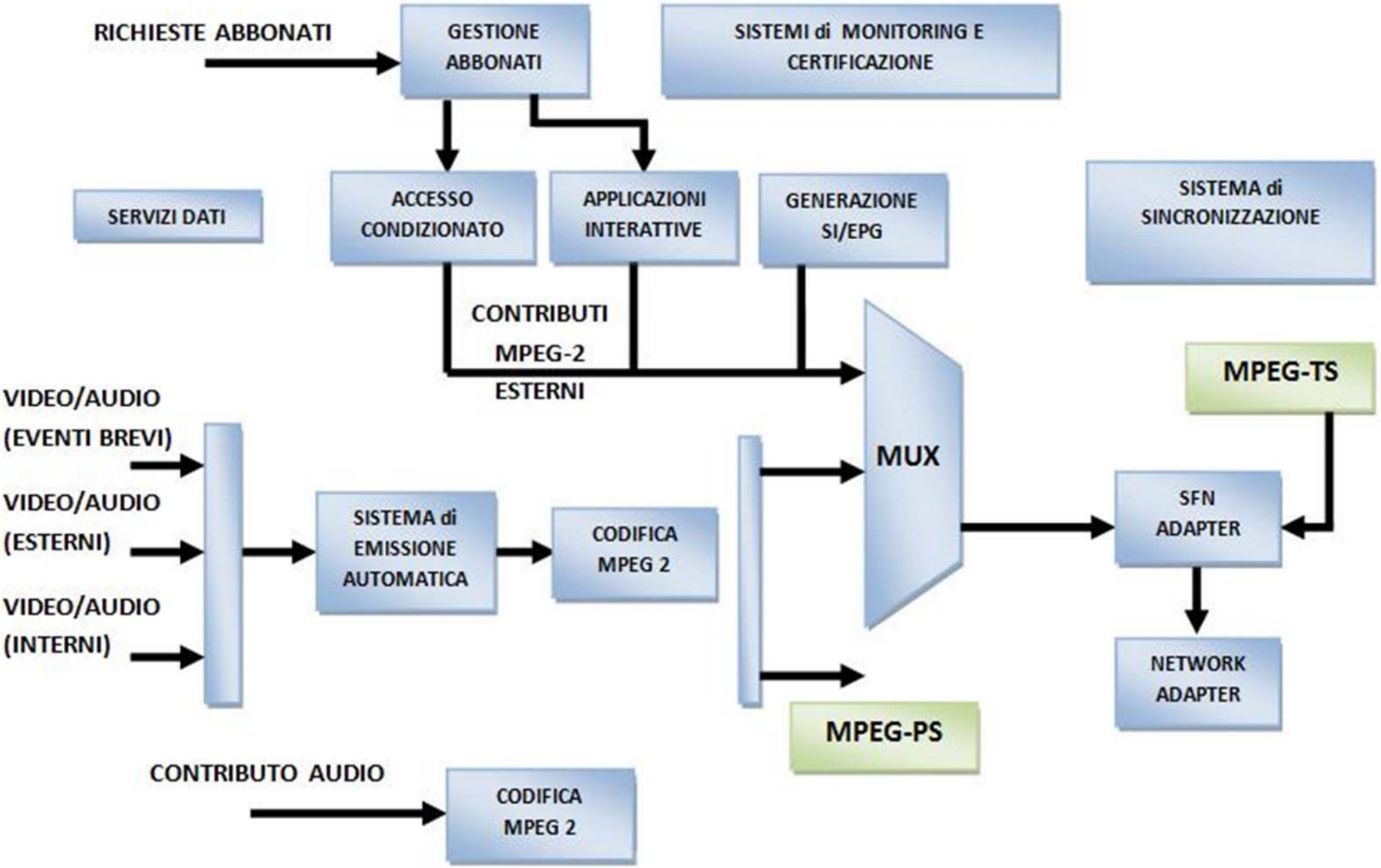


I meccanismi di trasmissione…

MPEG2-DVB System

- Il Program Stream (PS)
- Il Transport Stream (TS)
- La Program Service Information (PSI)
  - Program Association Table (PAT)
  - Program Map Table (PMT)
  - Conditional Access Table (CAT)
  - Newtork Information Table (NIT)

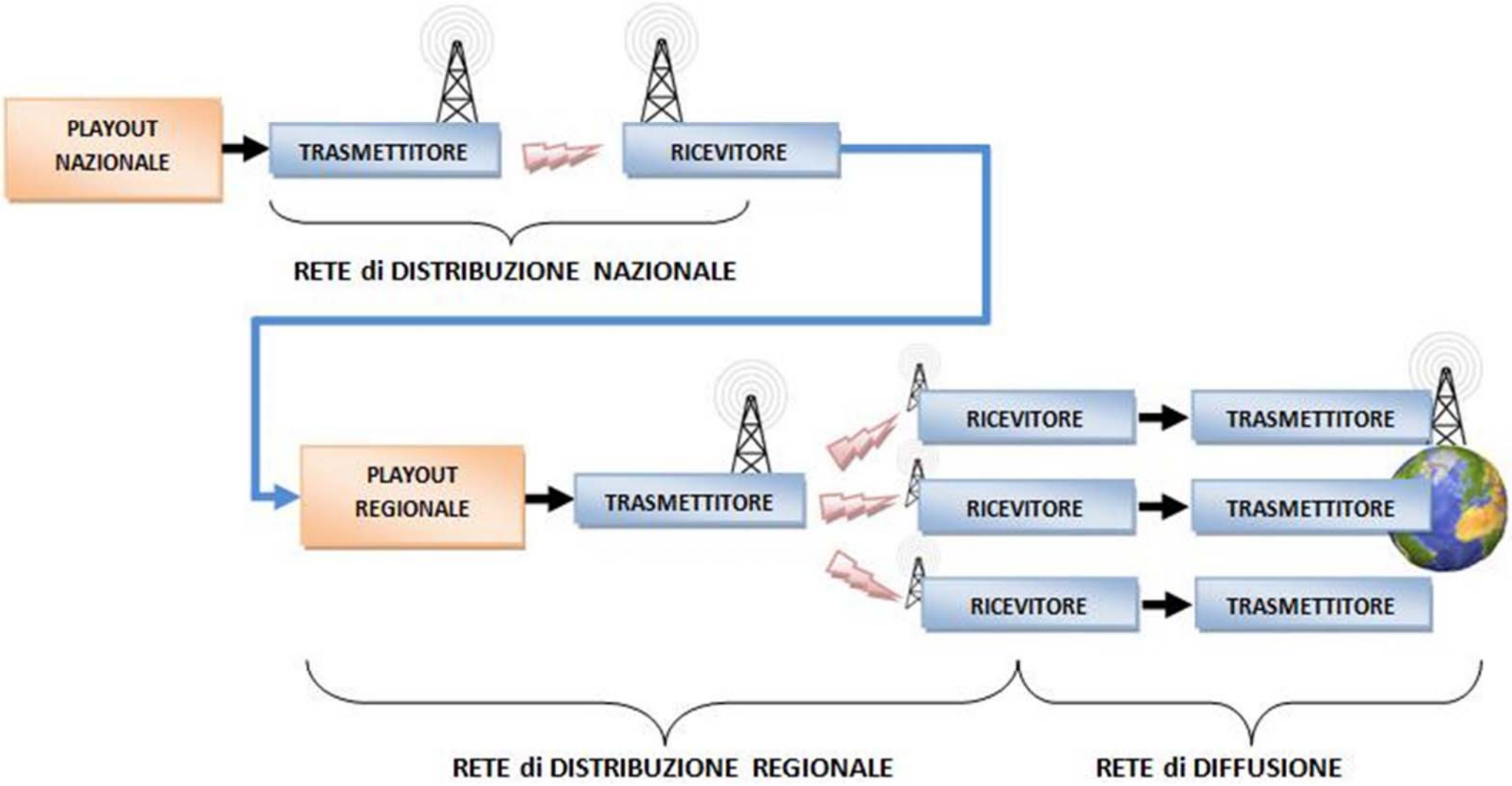
DVB-T Server Side



MPEG2-TS e DVB-T

- Il Program Stream, PS, integra nel tempo I vari programmi producendo uno stream integrato
- Il MUX di program integra contenuti di vario tipo nello stesso Stream producendo un TS
  - Program stream, info di CAS, XLET application, EPG
  - Questo puo' essere integrato con quello di altri canali:
  - Ogni TS puo' avere vari PS, cioe' vari canali al suo interno
- Il MUX viene trasmesso su una sola frequenza e puo' pertanto essere ricevuto tutto insieme dal tuner.
  - MUX Canale satellitare: 34-38 Mb/s ≈ 8 programmi
  - MUX Canale terrestre: 20-24 Mb/s ≈ 4 programmi
- La selezione del singolo canale avviene tramite una demux che seleziona I pacchetti del canale dal PS.

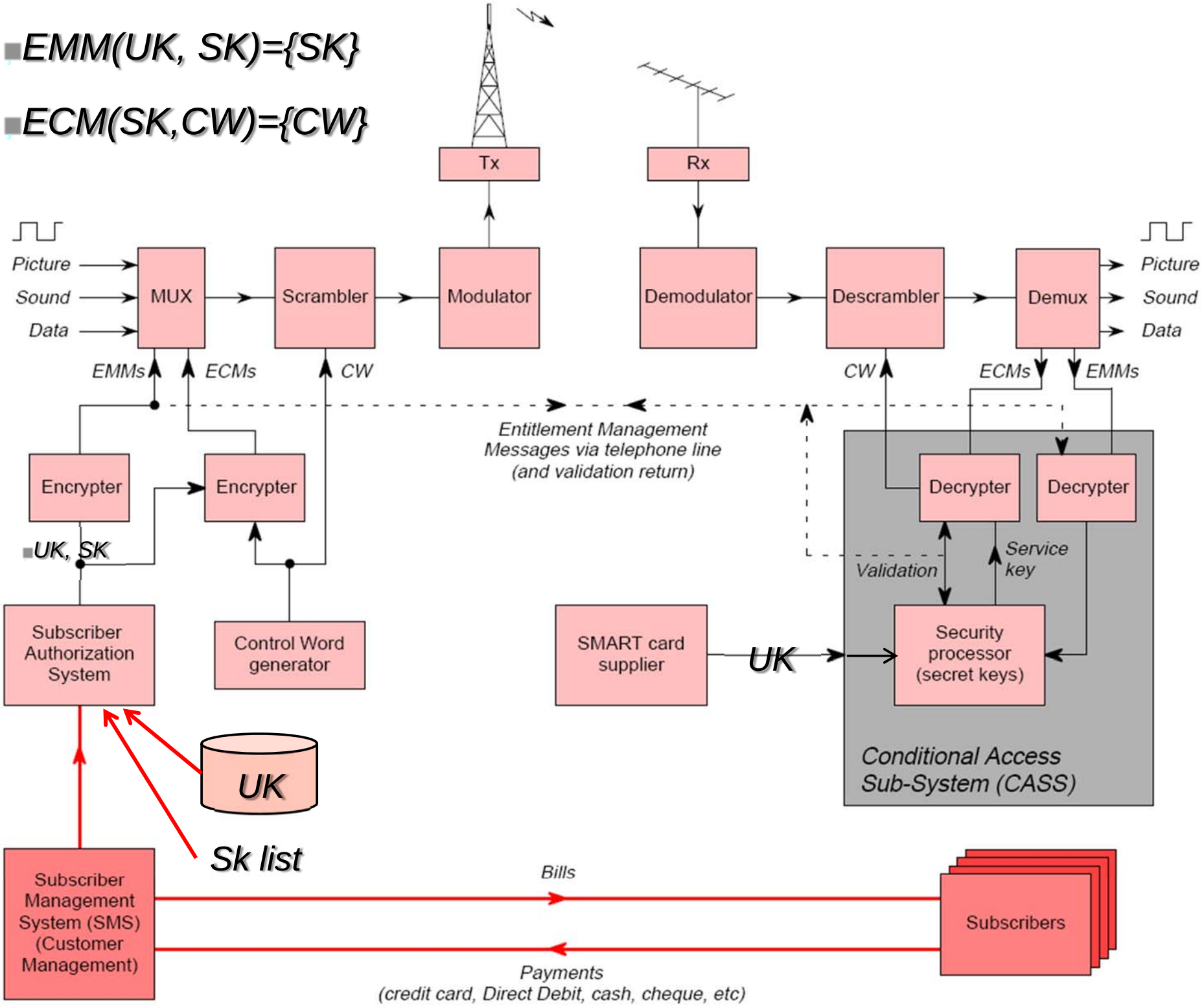
Distribuzione



CAS protezione

- Cifrare il TS da lato Server per poi abilitare lato client solo quelli che stipulano un contratto,
  - E pertanto solo questi ottengono una licenza
- La cifratura avviene tipicamente con algoritmi standard (scrambling) e vengono cambiate le chiavi molto spesso.
- Oltre a questo, nel TS vengono anche inviate alcune info che possono essere usate per recuperare la chiave di decifratura.
- La chiave non viene inviata in chiaro per ovvi motivi.

- EMM(UK, SK)={SK}
- ECM(SK,CW)={CW}



Sistema di Chiavi

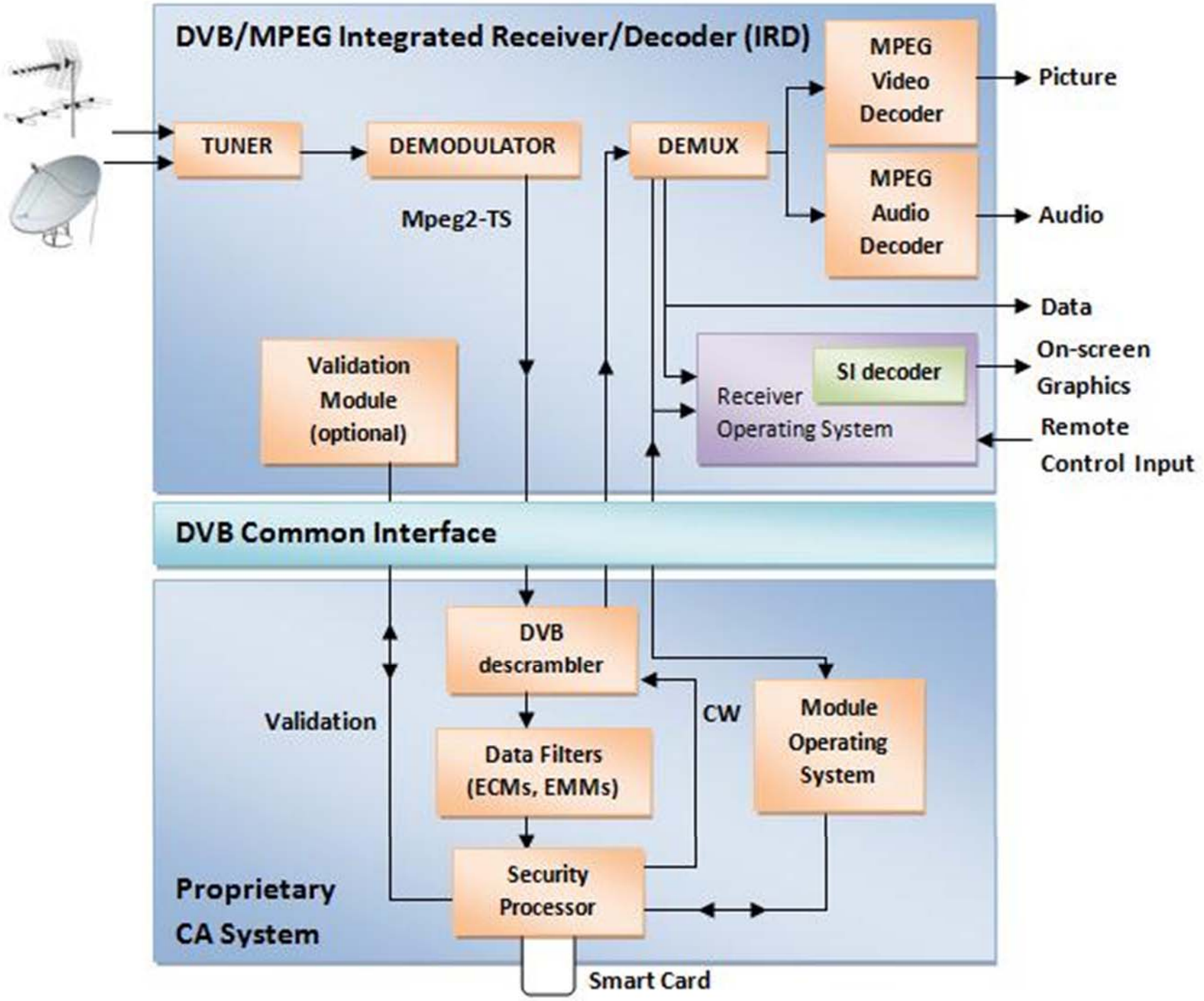
- **CW: Control word**, chiave utilizzata per cifrare il flusso digitale
- **SK: Service Key**, serie di chiavi,
  - una per ogni servizio/canale contenuto nello stream,
  - Per ogni SK viene creato un oggetto cifrato **chiamanto ECM**
- **UK, User key**, permette all'utente di ottenere la SK, decrypt.
  - Ogni utente ha un UK diversa
  - Per esempio nascosta in una SMARTCARD
- **ECM: Entitlement Control Message**, ECM(SK,CW)={CW}
  - viene inviata in broadcast
  - contiene la CW cryptata tramite la SK
- **EMM, Entitled Management Message**, EMM(UK, SK)={SK}
  - viene inviato in broadcast
  - contiene una SK encrypted che puo' essere decifrata solo con una UK (come quella usata per encription)

- **Client side:**
  1. arriva un EMM per un certo servizio i, dallo stream che viene passato al SecProcessor che ha la UK (user key)
  2. Il SecProcessor produce la SK(i) (service key) usando la sua UK se possibile, cioe' se abbonato al servizio
  3. Questa SK(i) (ve ne sono n, una per ogni servizio/canale) viene usata per estrarre la CW (i) da ECM (i)
  4. CW(i) viene usato per decriptare il ProgStream/servizio (i)
- **Server side**:
  1. Le CW per ogni servizio i sono generate in modo periodico
  2. SK(i) (n elementi) sono generate per ogni servizio i degli n
  3. SK(i) viene usata per codificare CW(i) into ECM(i) del servizio i
  4. La User List viene usata per codificare le n SK(i) into m EMM (I,u), un EMM per ogni servizio e per ogni utente, u.

- **ECMn** = { per ogni servizio i si ha SKi, ECM i = Encrip (CWt, SKi) }
  - Con: i di *n; d*ove: *n* e' il numero di oggetti/servizi
  - CW t cambia nel tempo
  - n ECM, uno per ogni SK
  - complessita' O(n)
  - Invio ogni 2 secondi, in anticipo
  - I servizi possono essere canali diversi, PS diversi

- **EMMm** = { per ogni utente j di m: EMM j,i = Encrip (SKi, UKj) }
  - Con: j di m; dove: m e' il numero di utenti
  - Con: i di n; dove: *n* e' il numero di oggetti/servizi
  - m EMM, uno per ogni servizio i-esimo SK (Service Key si trova dentro la EMM e viene decripted tramite la UK)
  - complessita' O(mn)
  - Invio ogni 10 secondi, in anticipo

The Decoder


DVB/MPEG Integrated Receiver/Decoder (IRD)
TUNER
DEMODULATOR
DEMUX
MPEG Video Decoder
MPEG Audio Decoder
Picture
Audio
Mpeg2-TS
Data
Validation Module (optional)
SI decoder
Receiver Operating System
On-screen Graphics
Remote Control Input
DVB Common Interface
DVB descrambler
Validation
CW
Module Operating System
Data Filters (ECMs, EMMs)
Security Processor
Proprietary CA System
Smart Card

Effectiveness of Protection, and example

- The cards have to be very hard to be cloned, but they are standards. So that additional features are added to make them different from the standard one.
- The keys are periodically changed, period is very short.

- **Attack**:
  - Substitute the smartCARD with one capable to extract the key and make it accessible to other decoders in the same house or via internet (on internet other users may use this key in their ad hoc smart card).
- **Defense**:
  - Detection of non correct cards measuring several aspects: patterns, temperature as a function of workload, identification of the electronic circuit contained, etc.

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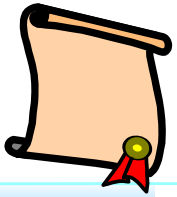
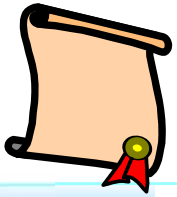
Rights Management



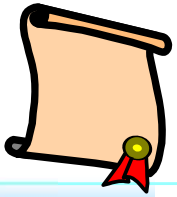
- **DRM**: Digital Rights Management
  - general term many times abused, confused, ...
- Management of Digital Rights
  - Limited to the management of rights of digital content ? → NO!!!
- **Digital Management of Rights → YES!!!**
  - More correct and reasonable
  - Management of both rights for original *works* and related *manifestations*, digital *resources*, etc.
  - in many solutions DRM is not intended in this way

Aim of …… Digital Rights Management



- To allow exploiting digital content functionalities (rights) in a controlled manner
  - To who has been **authenticated/certified**
  - To do what (are the rights) is defined in a formal **license**
  - **Verifying/Control/Supervise** if the above conditions and others are respected
  - By using technologies to **protect content** (e.g., encryption, fingerprint, watermark, etc.)
- Cons:
  - Registration of users (in some case can be relaxed)
  - Authentic. of users and/or tools/terminal/devices
  - Control of users
- *It has to be supported by a set of additional technical solutions*

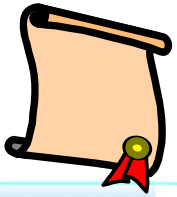
Motivations for Digital Rights Management



- Prevent the rights exploitation to who has not acquired the rights
  - from some rights owner or authorized reseller
- Verifying/Control if the allowed rights are respected:
  - In the whole value chain or at least at the end users
- Support/adoption of protection solution to
  - Enforce the rights control on the players and tools by which the users are accessing to the content.

- **Recently**, strongly rejected by the final users since most the DRM solutions also enforce some limitations with respect to the TRU (traditional rights usages):
  - Cracking the DRM solutions
  - Redistributing the content violating the IPR via P2P, Social Network, direct contacts, etc.

Motivations for Digital Rights Management

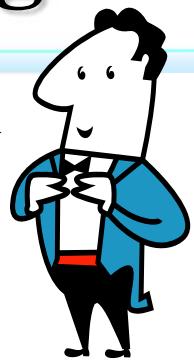


- The **collection of money/revenues (creation of revenue streams)** related to the exploitation of rights is traditionally/partially covered by Collecting Societies (clearing houses)

- **Collecting Societies**
  - Are Focussed on one or more rights types
    - thus, one or more for each Country/area
  - Guarantee/protect the interests of the content/rights owners
  - Are territorially distributed, while in Europe some liberalisation has been performed, permitting in some measure the competitions among different European CS

- They are some common agreement among the majors Collecting Societies in Europe: SIAE, SGAE, SAGEMA, etc.

Simple protection with Key sending



Selling Server

License Production

License distribution and player/device verification and supervision

Ask for the License

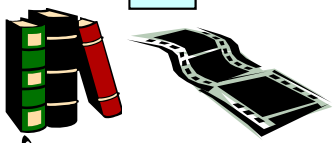
Content deprotection and rights exploitation

Get the content

Content Packaging, Protection

content

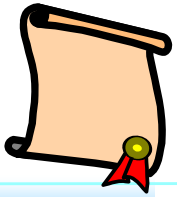
Distribution Server



Production and distribution

Player device

What Should be the DRM



- To allow exploiting the (digital) content functionalities (rights) in a controlled/supervised manner
  - To who has been **authenticated/certified**
  - To do what (are the rights) is defined in a formal **license**
  - By using technologies to **protect content** (e.g., encryption, fingerprint, watermark, etc.)
  - **Verifying/Control/Supervise** if the above conditions and other issues are respected,
    - including the *possibility of keep trace of the activity performed by the users and reporting/using them to the distributors* (this part is disputable since for the privacy)

Technical issues behind the DRM

- **Digital Encryption/decryption**
  - DRM may use strong encryption (# bits) never been cracked
- **Digital signatures**
  - content may be digitally signed to prevent tampering
  - license has to be digitally signed, etc.
  - event reporting has to be digitally signed, etc.
- **Unique identification of elements:**
  - Users, Content Objects, devices/players, ...
  - Distributors and rights, ...
- **Authentication and certification of users and devices**
  - To prevent compromised players or non trusting users to receive or distribute other content, ….
  - Black list of devices, licenses, users, etc.

Technical issues behind the DRM

- **Separation of licenses from content**
  - licenses should be kept separate from content
  - The license formalises what can be done by a given user on a given content
  - thus content can be protected once for all and widely distributed via any kind of channel including P2P
- **Revocation of User, User ID**
  - The user that has violated the solution is black listed, banned.
  - He cannot exploit any right on content !!, may be too strong..
- **Revocation of licenses, via License ID**
  - Revocation of rights authorization, for that content-right
  - various ways to prevent players from exploiting content
- **Revocation of Content, via Content ID**
  - Content with the listed IDs cannot be played on players.
- **Revocation of Player, Player ID**
  - Players with the listed IDs cannot be used to open protected content, lost of certification.

Part 1a: sistemi di protezione

- Distribution models
- Terminologies
- Business Models & Value Chain
- Copy protection
- Conditional Access Systems
- Digital Rights Management
- Content Modeling and Packaging
- Licensing and content distribution
- Creative Commons Licensing
- Composition of Licenses, data aggregation

Content Elements

- **Content Packaging to contain the following information**
  - Metadata + semantic descriptors ……
  - Digital Resources: items, digital essences, ……
  - Protection Information: (how to prot/deprot the content)…..
  - License: ……..who can use, when, how, etc...
- **The Package should allow to be**
  - Protected
  - Streamed (so called real-time) and/or downloaded, ….
  - Shared on P2P, etc..
  - Ported on physical supports,
  - Adapted, etc..
  - Coded in binary and/or XML, etc.
  - etc.

Content Elements of the package

- **Metadata:** *Metadata*
  - Identification information, unique ID, distributor ID, etc.
  - Classification information also for indexing: Dublin core, etc.
  - Semantic Descriptors, MPEG-7, for indexing, etc.
  - References to Owner, to distributor, etc.
  - Etc.
- **Digital Resources:** *Resource*
  - Any digital information: images, doc, txt, video, game, application, file, audio, etc.
  - Hierarchy of digital resources
- **Protection Information:** *Prot-Info Model* → P
  - What has to be done to access at a given information/resource
  - Tools used, their parameters, etc.
- **License:** *License Model* → License Contract
  - Which rights are provided, who is the recipient, conditions, etc.

Packing Content vs other aspects

- The **package** may contains several information: metadata, info, several files, etc. →
  - Cross media content
  - hierarchical content and structure
- The **package** to be protected has to encoded in some file and format. For example to be encrypted with some algorithm
  - Protection by ignorance (algorithm and key)
  - Protection by complexity
- The **key** has to reach the player only via specific protected channels
  - If the key is reached and the algorithm is known the protection is violated
- The **player** has to **enforce** the protection and has to provide a precise semantics for the rights
- The **license** is a description of the conditions under which the key can be taken, passed, used to/by the player

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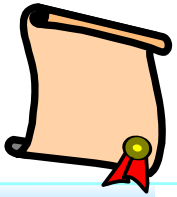
License formal language

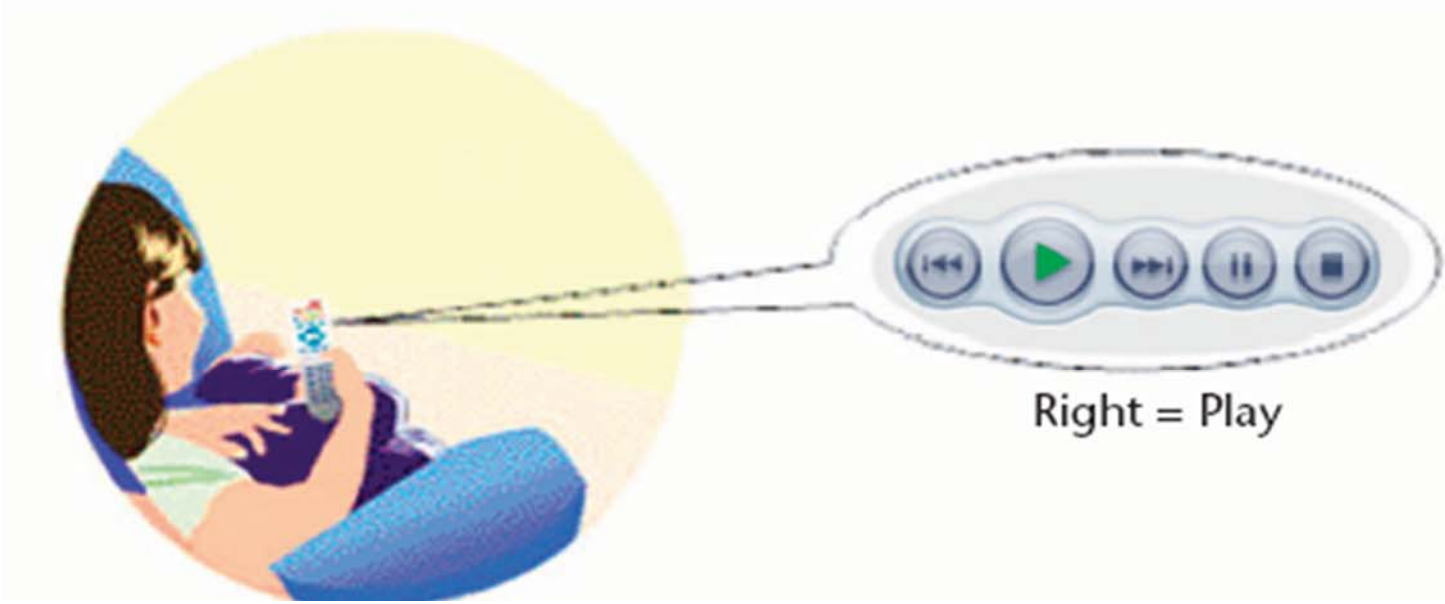


- **XrML 2.0:** eXtensible rights Markup Langua
  - http://www.xrml.org/
  - General purpose
  - ContentGuard, Nov. 2001, Microsoft
  - Derived from DPRL
  - Usato come base per MPEG-21
- **Windows Media DRM**
  - Derived from XrML
- **MPEG-21:**
  - REL: Rights Expression Language
    - ➔Derived from XrML
  - RDD: Rights Data Dictionary
- **OMA ODRL:** Open Digital Rights Management
  - Expression language for mobiles
  - In some way simpler than MPEG-21 REL

An example of statement

Condition = November 2003

Resource = Ocean Wilds



Right = Play

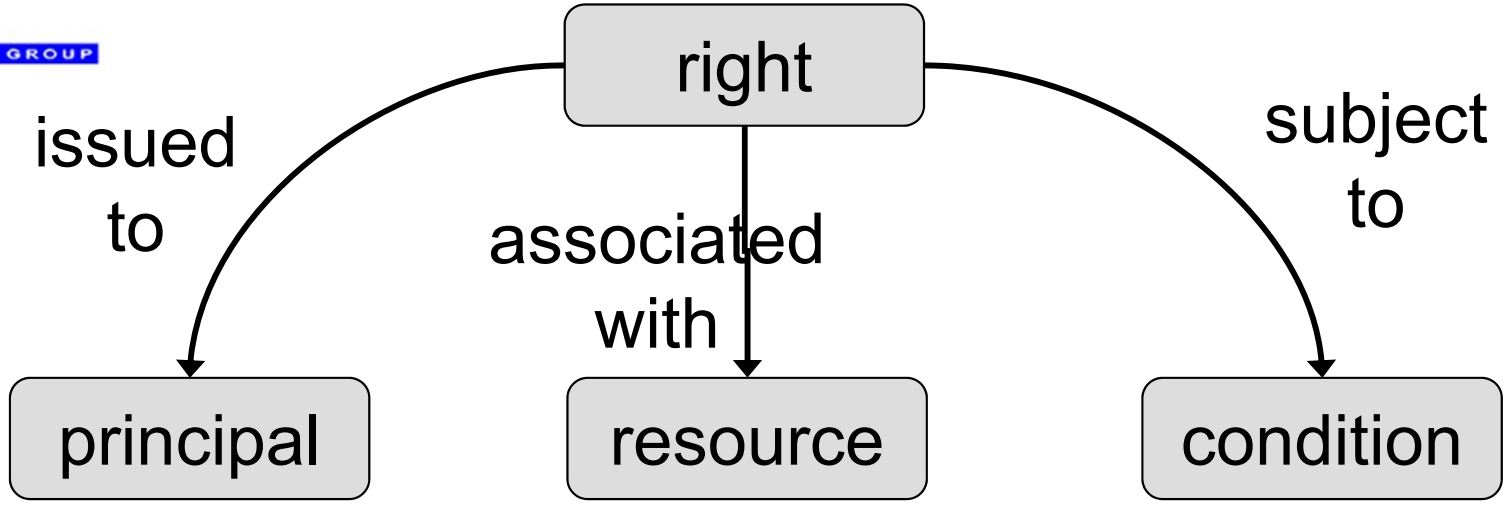
- Rosy can Play 3 times the Ocean Wilds in November 2003.

MPEG-21 — REL, Rights Expression Language

ISO/IEC JTC1/SC29 WG11 MPEG MOVING PICTURE EXPERTS GROUP

- **REL is** a machine-readable language, XML
  - to declare rights and permissions
  - uses terms defined in the Rights Data Dictionary, RDD
- **REL allows to define licenses** that give specific permissions to Users to perform certain actions on certain resources, given that certain conditions are met
  - Grants can also allow Users to delegate authority to others
- **Systems and device have to**
  - parse and validate the REL formalizations
  - check permissions before any further action is done
- **REL licenses** are wrapped into MPEG-21 Digital Items when the object is governed
- **MPEG-21 DID parser** is responsible for discovering and identifying where to gather licenses

REL data model



- REL grant formalization consists of
  - principal to whom grant is issued
  - rights the grant specifies
  - resource to which right in grant applies
  - condition to be met before grant can be exercised

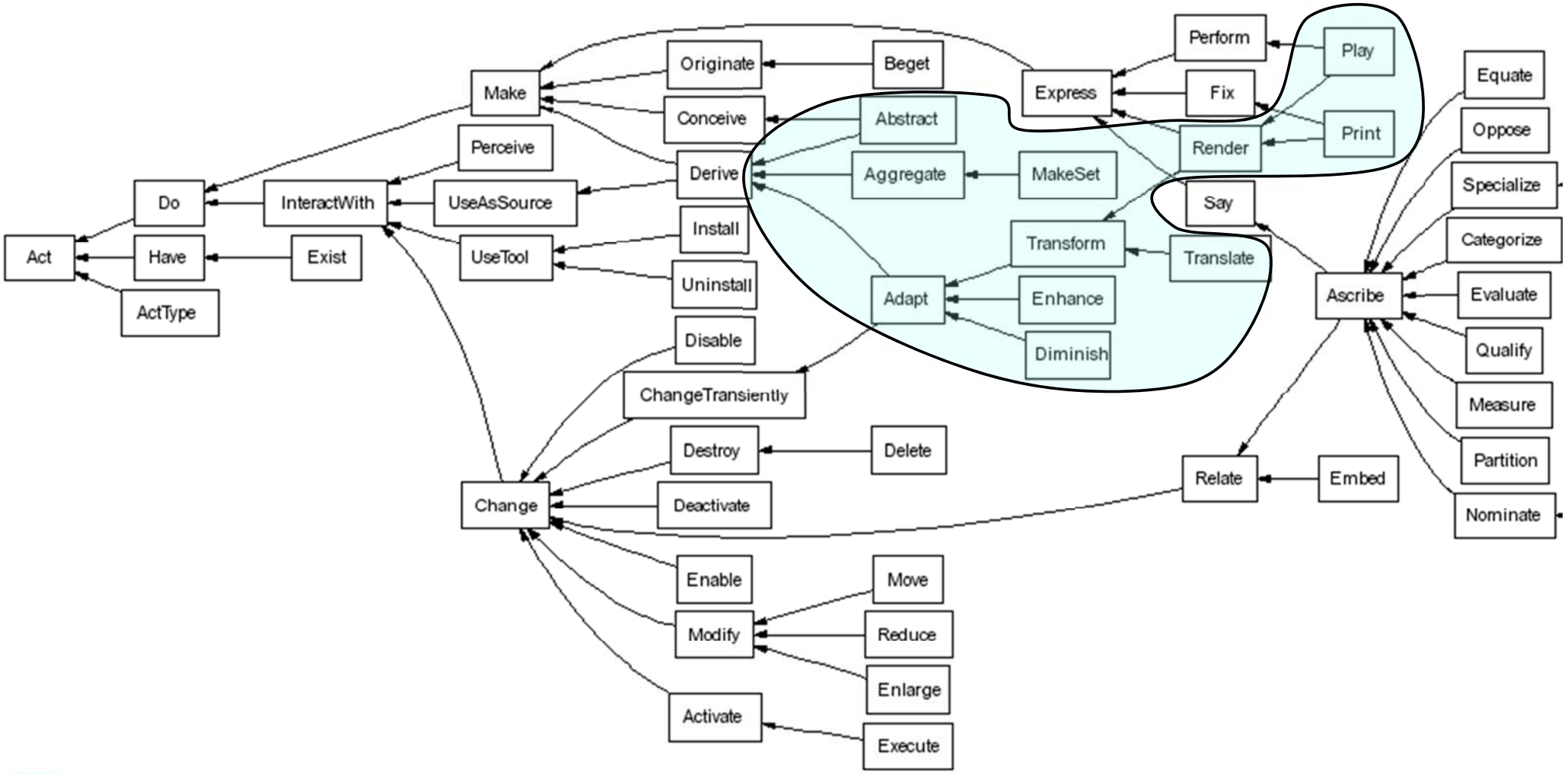
REL – Principal and Rights

- **Principal**: Party to whom a grant conveys usage rights.
  - authentication mechanism by which the principal can prove its identity.
  - a principal that must present multiple credentials, all of them must be simultaneously valid, to be authenticated.
- **Right**:
  - Action or activity that a principal may perform using a resource under some condition.
- **Resource**:
  - Object/content to which the principal can be granted a right.
- **Condition**:
  - Terms under which rights can be exercised.

- **MPEG REL provides** a right element to encapsulate information about rights and provides a set of commonly used, specific rights, notably rights relating to other rights, such as issue, revoke and obtain.
  - Extensions to MPEG REL could define rights appropriate to using specific types of resource.
  - For instance, the MPEG REL content extension defines rights appropriate to using digital works (e.g., play and print)

RDDOnto (Garcia, Delgado, 2007)

- Example: *Act* hierarchy.



Possible values for terms

- **Principal**
  - AllPrincipals and KeyHolder
- **Rights**
  - Issue, Obtain, PossesProperty and Revoke
- **Resources**
  - DigitalResource, Revocable and ServiceReference
- **Conditions**
  - AllConditions, ExerciseMechanism, ExistsRight, Fullfiler, PrerequisiteRight, RevocationFreshness, ValidityInterval
    - CallForCondition
    - ExerciseLimit
    - FeeFlat
    - FeeMetered
    - FeePerInterval
    - FeePerUse
    - FeePerUsePrePay
    - SeekAproval
    - Territory
    - TrackQuery
    - TrackReport
    - TransferControl
    - ValidityIntervalFloating
    - ValidityIntervalStartsNow
    - ValidityTimeMetered
    - ValidityTimePeriodic

- Examples of Rights
  - Adapt
  - Delete
  - Diminish
  - Embed
  - Enhance
  - Enlarge
  - Execute
  - Install
  - Modify
  - Move
  - Play
  - Print
  - Reduce
  - Uninstall

Esempi di Licenze: creator to distrib

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<!-- License model for giving right adapt to the distributor -->
<r:license xmlns:dsig="http://www.w3.org/2000/09/xmldsig#" xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-
    MX-NS" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS" xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-
    SX-NS" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:mpeg:mpeg21:2003:01-REL-R-NS ../schemas/rel-r.xsd
    urn:mpeg:mpeg21:2003:01-REL-SX-NS ../schemas/rel-sx.xsd urn:mpeg:mpeg21:2003:01-REL-MX-NS
    ../schemas/rel-mx.xsd">
    <r:grantGroup>
    <r:grant>  <r:keyHolder>  <r:info><dsig:KeyName>AXDID:Distributor</dsig:KeyName> </r:info>
               </r:keyHolder>
               <mx:adapt/>
                <mx:diReference><mx:identifier>AXOID:Identifier</mx:identifier> </mx:diReference>
          </r:grant>
    </r:grantGroup>
    <!--The license is issued by the creator.-->
    <r:issuer> <r:keyHolder> <r:info> <dsig:KeyName>AXCID:Creator</dsig:KeyName></r:info>
          </r:keyHolder>
    </r:issuer>
</r:license>
```

```
<r:grantGroup>
        <r:grant><r:keyHolder><r:info><dsig:KeyName>AXDID:Distributor</dsig:KeyName></r:info>
                </r:keyHolder>
                <r:issue/>
        <r:grantGroup>
                <r:grant>
                <mx:play/>
                <mx:diReference>      <mx:identifier>AXOID:Identifier</mx:identifier>
                </mx:diReference>
                <sx:feePerUse  xmlns:iso="urn:mpeg21:2003:01-REL-SX-NS:2003:currency">
                        <sx:rate>   <sx:amount>1.00</sx:amount>
                                <sx:currency>iso:EUR</sx:currency>
                        </sx:rate>
                </sx:feePerUse>
                </r:grant>
        </r:grantGroup>
        </r:grant>
</r:grantGroup>
<!--The license is issued by the Creator-->
<r:issuer><r:keyHolder>
        <r:info><dsig:KeyName>AXCID:Creator</dsig:KeyName></r:info></r:keyHolder>
</r:issuer>
```

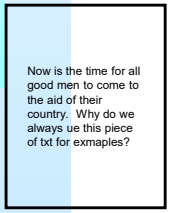
Riferimenti

- **CAS**
  - Irdeto: http://www.irdeto.com/
  - Nagravision: http://www.nagravision.com/
  - NDS: http://www.nds.com/
- **DRM**
  - MPEG-21: http://www.dsi.unifi.it/~nesi/DISIT-Introduction-to-MPEG-21-v1-0.pdf
  - AXMEDIS DRM for dummies: a full round into the content protection, production of licenses, etc.
  - http://www.axmedis.org
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3964

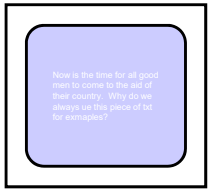
Rights Models: Types of Rights

Render Rights

Print



View

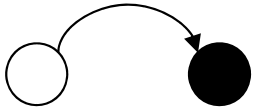


Play

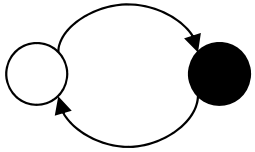
Transport Rights

Copy

Move

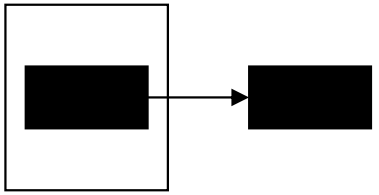


Loan

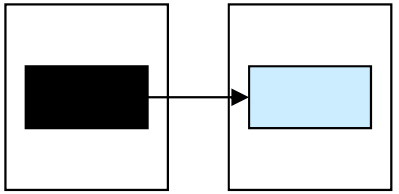


Derivative Work Rights

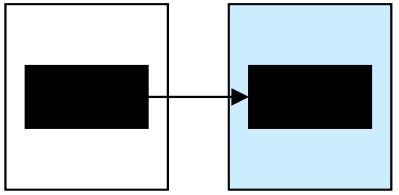
Extract



Edit

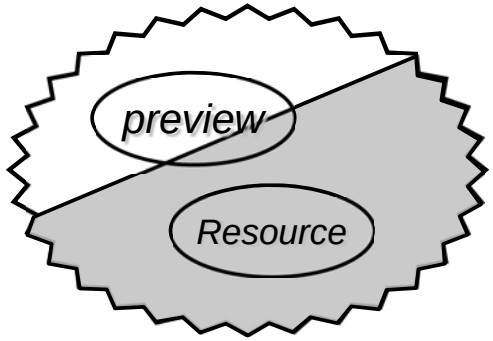


Embed



Business Rules, a way to formalize allowed rights

- Exploitation Models (contracts from the consumers to the provider are aligned to the exploitation model):
  - Subscription to a collection or service, per months, per year, etc.
    - All you can eat, per month, etc.
    - Pay per minute all you can eat
  - Pay per
    - rent, use, play, print, etc.
    - stream, download, etc…
    - burning the CD
    - copy the object
    - moving the object
    - passing the object to a different device/friend
    - building a collection
  - Preview without paying
  - Try and buy, e.g., 30 gg try, …
- Etc.



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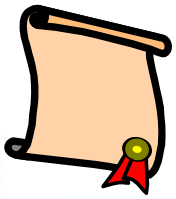
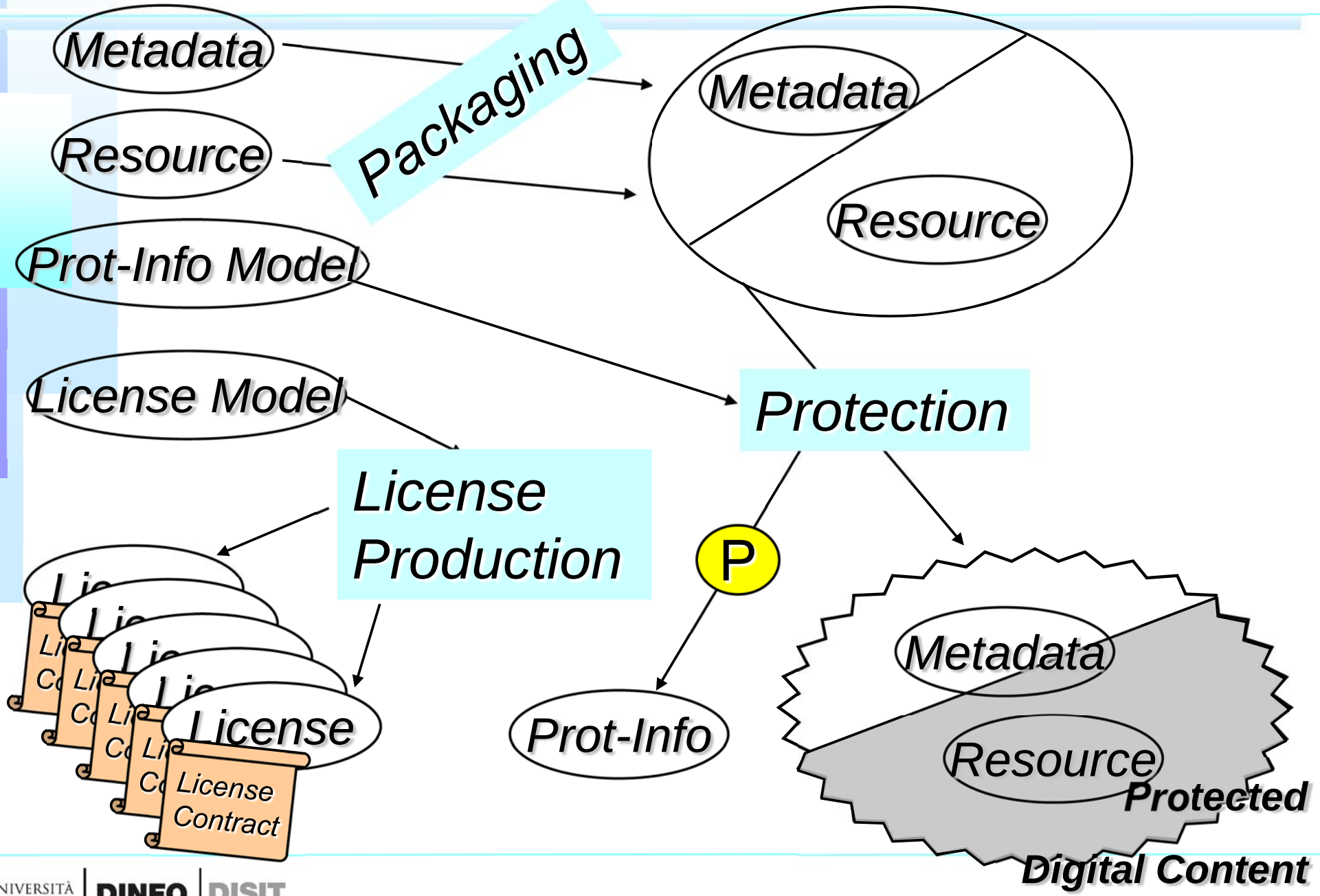
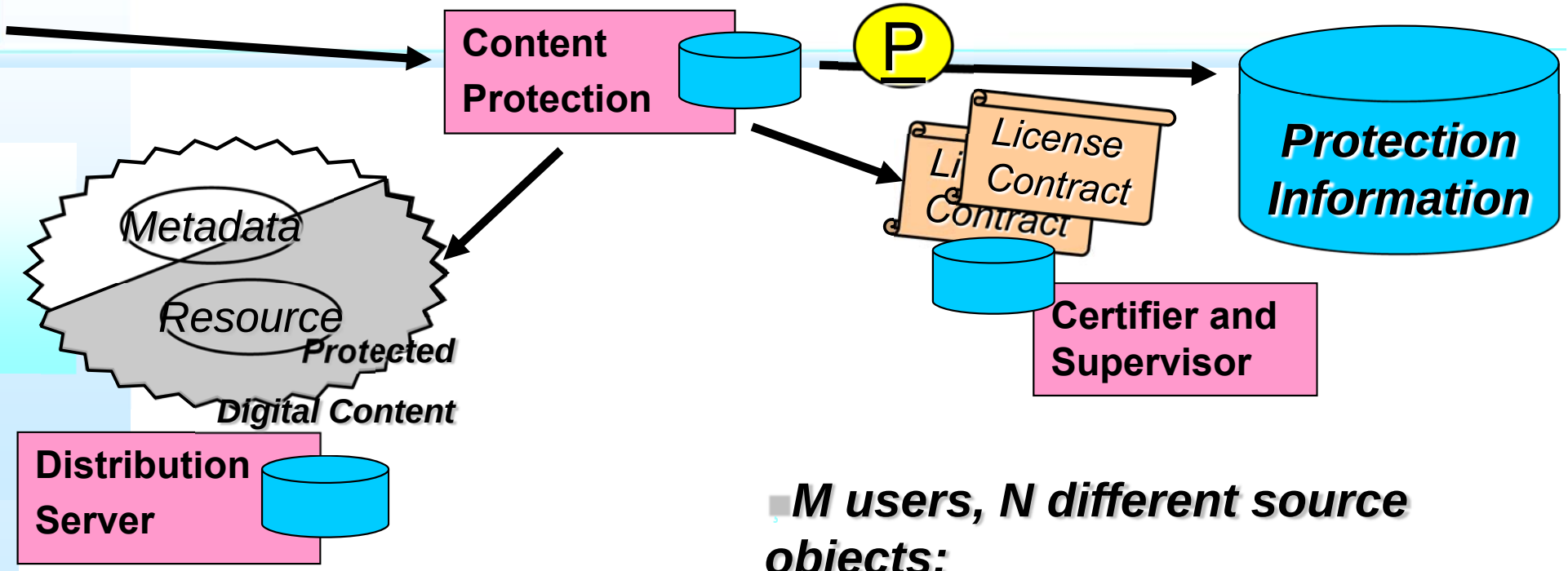


- It may be based on limiting
  - Number of times you can do an action, and usage
  - in a temporal window for the exploitation of any rights
    - renting
  - in a space
    - regional area or
    - domain (set of computers, etc.)
  - The usage according to the user profile:
    - impaired,
    - student,
    - Archival
    - etc.

Packaging and Protection, Open Model



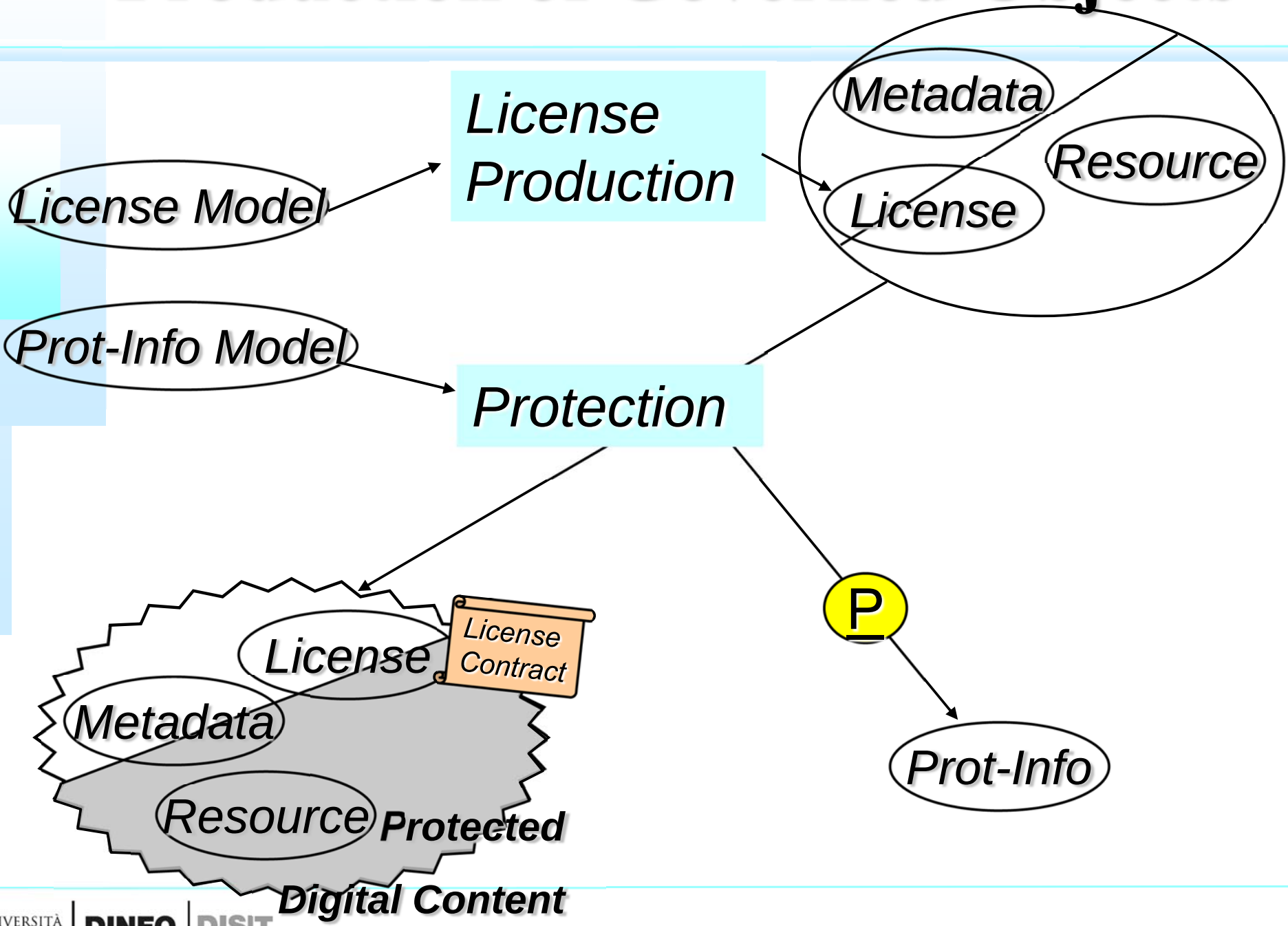
General Architecture of content business



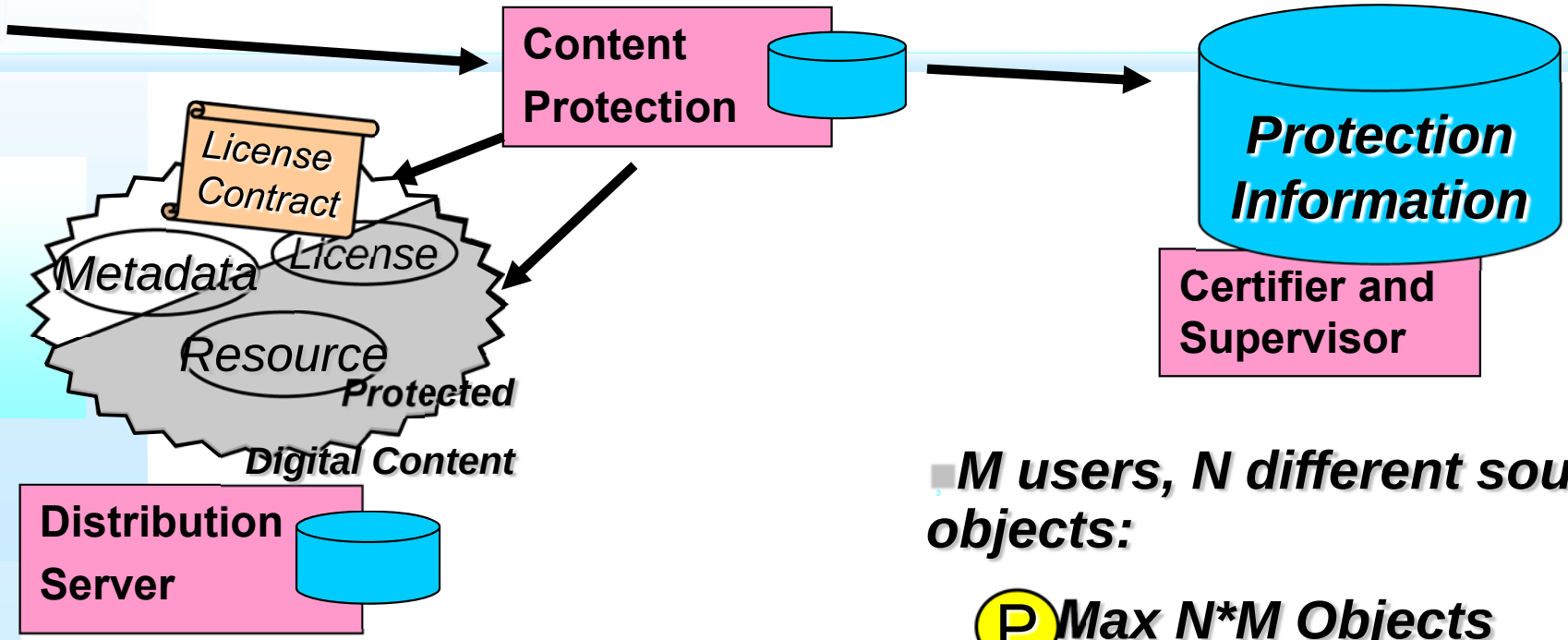
- **Pros:**
  - **Simple distribution**
  - **P2P supported**
- **Cons:**
  - **3 servers**
  - **Many Licenses**

- **M users, N different source objects:**
  - **N Objects protected only once**
  - **N protection info**
  - **M*N licenses maximum since each of them may be interested to have all objects**

Production of Governed Objects



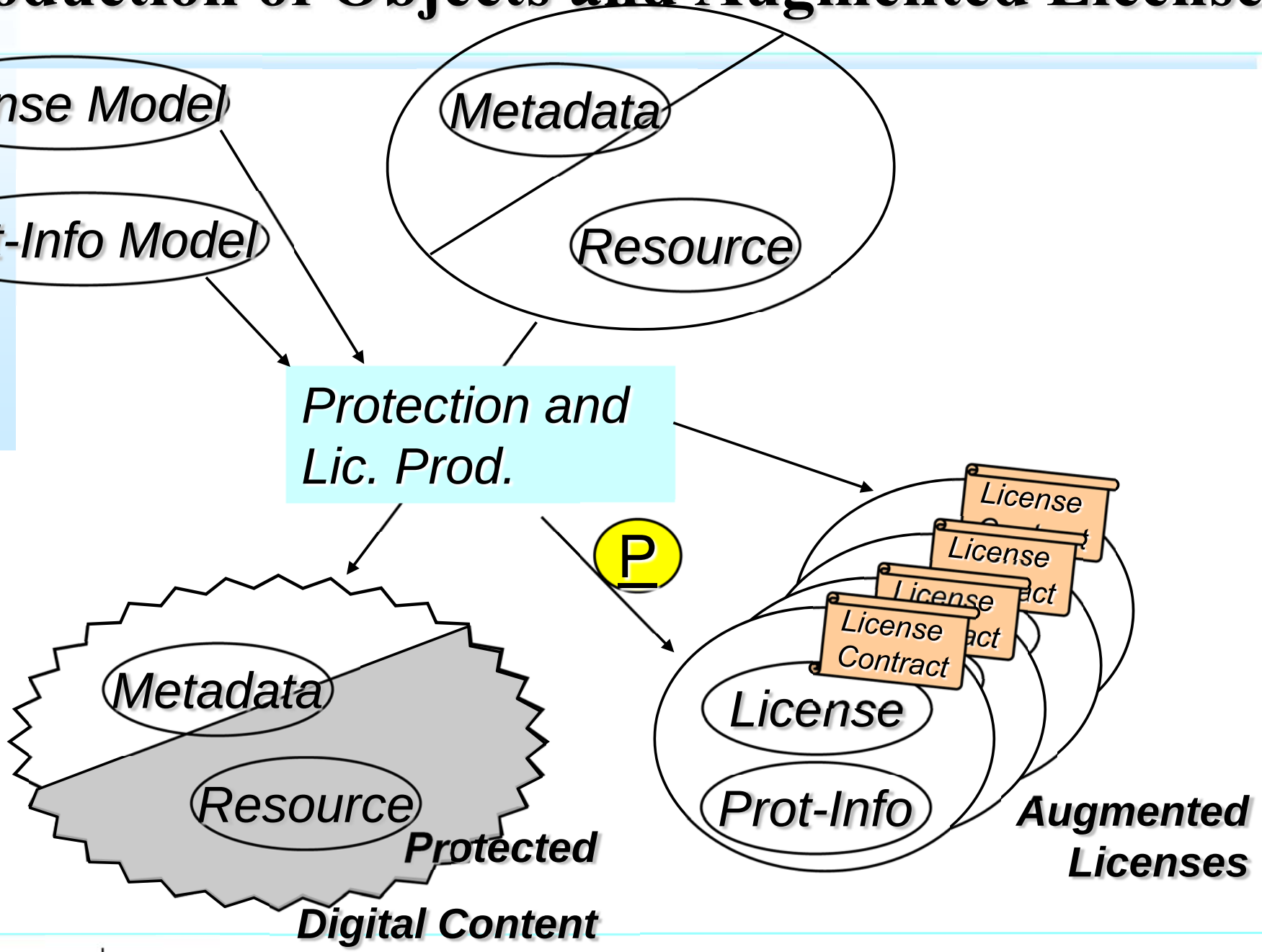
General Architecture of content business



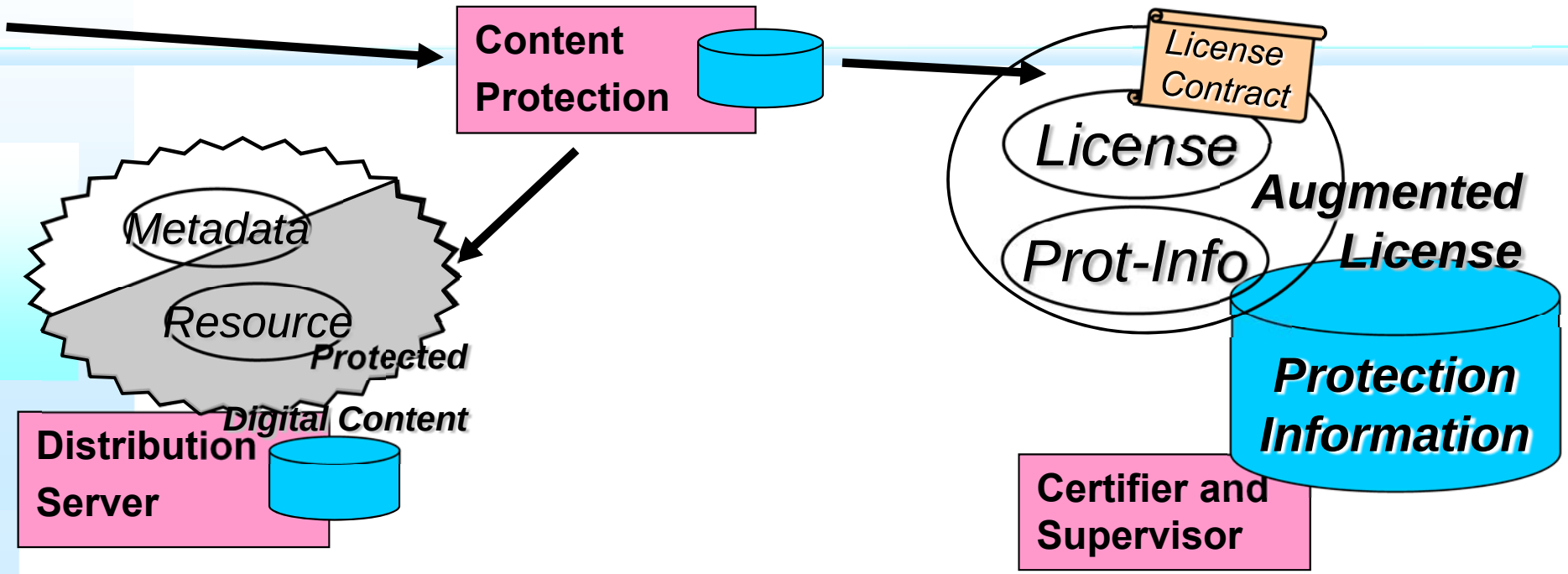
- *Pros:*
  - *Simple distribution, 2 servers*
- *Cons:*
  - *P2P non supported*
  - *Too many different objects, too much space*

- *M users, N different source objects:*
  - P *Max N*M Objects protected, that is for all the N Objects M different protected-licensed versions have to be produced*
  - P *N*M protection info*

Production of Objects and Augmented License



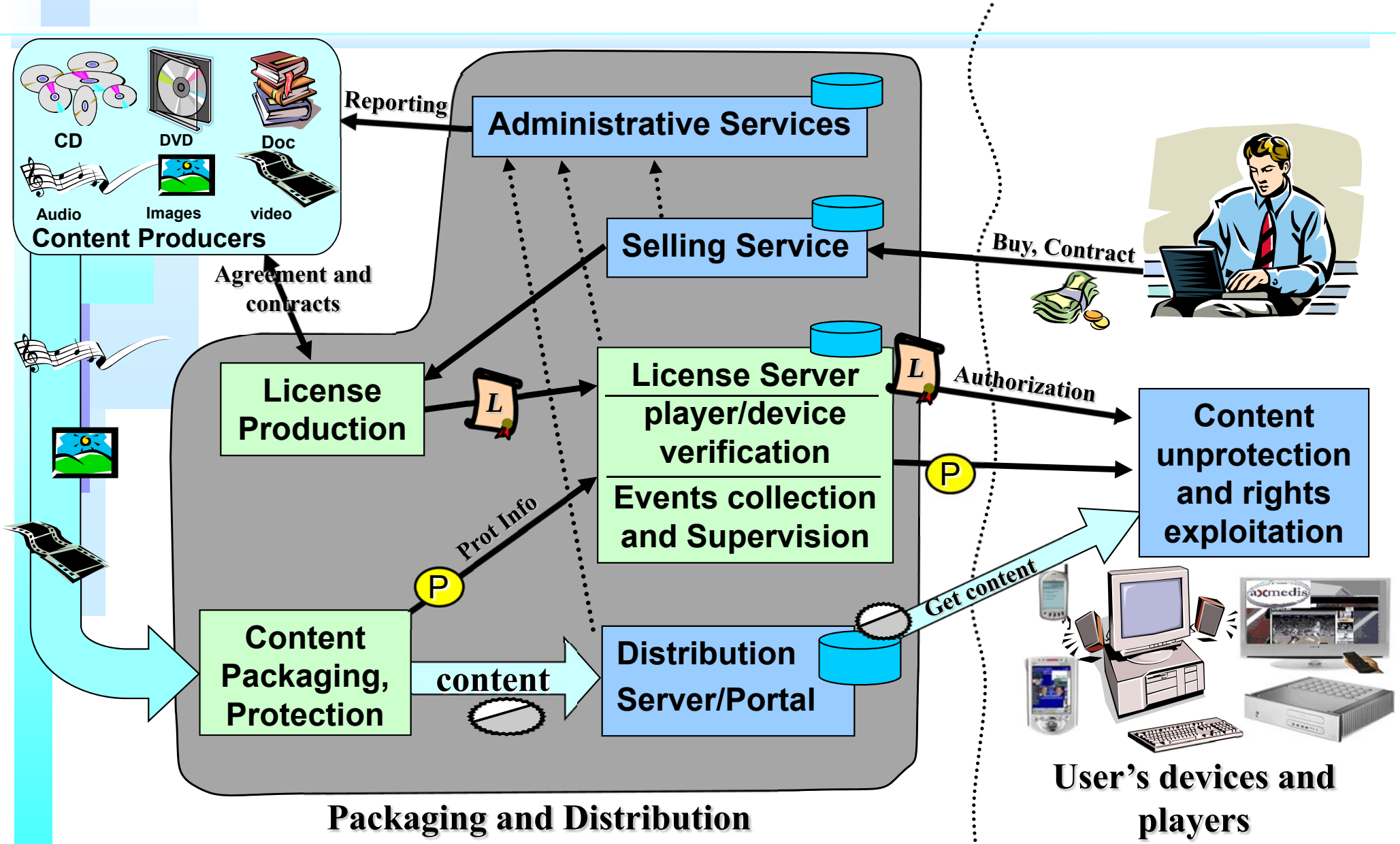
General Architecture of content business



- Pros:
  - Simple distribution, 2 servers
  - P2P supported
- Cons:
  - Many information outside
  - Diff users have the same protection inform

- M users, N different source objects:
  - N Objects protected
  - N protection information
  - N*M protection info included into licenses

Based model for DRM



Different kinds of Packages

	Package	Protection	Which Files	Distribution models	Annotations	Metadata custom + descriptors
MPEG-21	Xml	Yes/DRM	any	Yes/DIS	(Yes)	Yes
MPEG-4	Yes (xml/bin)	Yes/CAS	Audio video	Yes/Stream	No	No
MXF	Yes (xml/bin)	No	Audio video	Download	No	Yes/No
SCORM/IMS	Yes (xml/bin)	Yes /CAS	any	Download	No	Yes
AXMEDIS	Yes (xml/bin)	Yes /DRM	any	Yes all	(Yes)	Yes
ZIP	Bin	Yes (pwd, CAS)	any	Download	No	No
NewsML	Yes (xml/bin)	Yes (Zip, Pwd, cas)	any	Download	No	Yes

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Creative Commons, CC

- Nel commercio elettronico e' necessario includere anche alcune slide relative alle licenze CC.
- Fino ad ora abbiamo visto tecnologia al servizio della protezione della proprieta' intellettuale
- CC mette a disposizione degli strumenti, dei formalismi legali che possono essere o meno adottati da chi pubblica i propri contenuti
- Questi sono license formalizzate:
  - **Struttura della Licenza CC:**
    - Legal Code: testo legale che la descrive
    - Commons Deed: short description della licenza
    - Digital Code: metadati da associare

    (see S. Aliprandi, 2005, 2006…)

http://www.copyleft-italia.it/cc/brochureCCv2.pdf

Creative Commons, CC

- ***Le licenze CC***
  - Nate in USA
  - Sono state adattate alla legislazione nazionale di diversi stati e anche a livello europeo
    - specialmente per contenuti generati dagli utenti e in ambito culturale
    - Questo permette in un certo qual modo di avere una trascodifica fra le questioni legali nazionali e quelle di altre nazioni, ma solo per certe questioni.
  - Licenze CC ipotizzano uno share, copyleft
- E' stato fatta una codifica delle licenze CC in MPEG-21 REL
  - Non e' vero l'opposto, tutte le licenze che si possono formalizzare in MPEG-21 non hanno una controparte in CC

Le tre forme delle licenze

Ogni licenza Creative Commons si manifesta sotto tre forme differenti. La licenza vera e propria è detta **Legal Code**: è un testo piuttosto denso di concetti giuridici, abbastanza lungo e tendenzialmente comprensibile a coloro che hanno una formazione di tipo giuridico. E' questa la licenza che verrà esaminata dal giudice qualora emergesse una controversia legale sull'uso dell'opera licenziata. Tuttavia, Creative Commons ha pensato anche di riassumere i concetti essenziali delle licenze in versioni sintetiche (i cosiddetti **Commons Deed**) facili da capire anche per i semplici utenti e contraddistinti da efficaci *visuals*. Inoltre, ogni licenza è convertibile in alcune righe di linguaggio informatico (il cosiddetto **Digital Code**) che fungono da *metadati*, ovvero da informazioni digitali che permettono ai motori di ricerca di individuare e riconoscere correttamente l'opera che li contiene.

Traduzione e adattamento

L'ente statunitense Creative Commons ha affidato ad alcuni gruppi di lavoro (dislocati nei vari paesi che hanno aderito al progetto) il compito di effettuare il ***porting*** delle licenze: cioè, non una semplice traduzione linguistica delle licenze, ma una traduzione ragionata, in modo che le licenze potessero esplicare gli stessi effetti anche in paesi con sistemi giuridici diversi da quello americano. L'autore quando sceglie la licenza, infatti, se vuole, può anche indicare una giurisdizione preferenziale, cioè il contesto giuridico a cui vuole fare riferimento. In questo modo, alla luce dei principi di diritto internazionale, si cerca di ovviare ad eventuali problemi di interpretazione e di scelta delle fonti normative applicabili al caso concreto.

Come applicare una licenza CC

Il concetto è semplicissimo: poiché il modello tradizionale e standardizzato è quello "tutti i diritti riservati", se vogliamo applicare un modello alternativo dobbiamo segnalarlo esplicitamente. Possiamo ad esempio utilizzare un disclaimer di copyright come quello che trovate nella pagina successiva di questa brochure, in cui indicare con chiarezza chi è il titolare dei diritti d'autore e quale licenza ha scelto per la sua opera. Nient'altro! Non sono necessarie particolari formalità di registazione o certificazione da parte di nessun ente.

Sul sito ufficiale Creative Commons sono poi disponibili informazioni più specifiche per l'inserimento della licenza in versione *digital code* nei file digitali con cui l'opera circolerà.

Come trovare opere sotto licenze CC

In generale è possibile utilizzare lo specifico motore di ricerca che si trova al sito **http://search.creativecommons.org** ;
oppure fare riferimento ad archivi on-line come:

- http://sciencecommons.org/ (letteratura scientifica);
- www.jamendo.com (musica);
- http://ccmixter.org/ (musica, suoni e campionature musicali);
- www.flickr.com/creativecommons (immagini);
- www.spinxpress.com/getmedia (video e contenuti multimediali);
- http://ocw.mit.edu/ (materiale didattico e manualistica);
- commons.wikimedia.org (opere varie).

Per saperne di più...

...oltre a navigare attentamente sui siti ufficiali di Creative Commons e a frequentare le mailing list pubbliche della community (www.creativecommons.it/Liste), potete leggere la voce "Creative Commons" su www.wikipedia.org e le voci ad essa correlate; navigare sul sito www.copyleft-italia.it/cc e leggere le pubblicazioni liberamente scaricabili dal sito www.copyleft-italia.it/pubblicazioni, fra cui si segnalano principalmente:

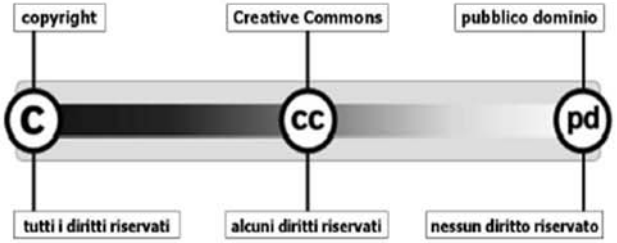
- Aliprandi, Copyleft & opencontent. L'altra faccia del copyright (ed. PrimaOra, 2005);
- Aliprandi (a cura di), Compendio di libertà informatica e cultura open (ed. PrimaOra, 2005);
- Aliprandi, Teoria e pratica del copyleft. Guida all'uso delle licenze opencontent (ed. NDA Press, 2006);
- Aliprandi, Capire il copyright. Percorso guidato nel diritto d'autore (ed. PrimaOra, 2007);
- Lessig, Cultura libera (ed. Apogeo, 2005).

Brochure a scopo divulgativo realizzata da Simone Aliprandi per il Progetto Copyleft-Italia.it nel gennaio 2008. Parte del materiale qui riportato è tratto dai siti ufficiali Creative Commons e dall'opera "Il copyleft in tasca. Vademecum con i concetti base del copyleft" (www.copyleft-italia.it/vademecum).

L'URL originario di questo documento è: www.copyleft-italia.it/cc .

creative commons

un copyright flessibile per opere creative



www.creativecommons.org
www.creativecommons.it

Brochure a scopo divulgativo a cura del Progetto Copyleft-Italia.it

c©pyleft-italia.it
www.copyleft-italia.it

NUOVI MODELLI PER IL DIRITTO D'AUTORE

info@copyleft-italia.it - myspace.com/copyleftitalia

Che cos'è Creative Commons (e cosa non è)

[tratto da www.creativecommons.it/cosa-fa-cc]

Le Creative Commons Public Licenses (CCPL) sono delle licenze di diritto d'autore che si basano sul principio de "alcuni diritti riservati". Le CCPL, infatti, rendono semplice, per il titolare dei diritti d'autore, segnalare in maniera chiara che la riproduzione, diffusione e circolazione della propria opera è esplicitamente permessa.

Il funzionamento delle CCPL è reso possibile dal fatto che la legge italiana sul diritto d'autore - così come, in generale, le corrispondenti normative nazionali e internazionali - riconosce al creatore di un'opera dell'ingegno una serie di diritti; allo stesso tempo, la legge permette al titolare di tali diritti di disporne liberamente.

Uno dei modi in cui ciò si può fare è il meccanismo contrattuale della licenza, tramite cui il titolare dei diritti (il cosiddetto "licenziante") concede o meno alcuni diritti alla controparte (il cosiddetto "licenziatario") ovvero qualsiasi fruitore dell'opera. E` importante sottolineare come le CCPL, e in generale tutte le licenze di diritto d'autore, non siano la fonte dei diritti in oggetto: è grazie alla legge che tali diritti sorgono. Le CCPL sono solo uno strumento tramite cui il titolare dei diritti concede determinati permessi ai licenziatari.

Tali permessi sono flessibili e possono essere vincolati ad alcune condizioni, a seconda del tipo di licenza scelta dall'autore.

Le CCPL sono state create negli Stati Uniti dall'associazione non-profit Creative Commons. Sono state quindi tradotte in italiano e adattate al nostro sistema giuridico da un gruppo di lavoro coordinato dal prof. Marco Ricolfi del Dipartimento di Scienze Giuridiche dell'Università di Torino. Dal gennaio 2005 il referente per Creative Commons Italia è il prof. Juan Carlos De Martin del Dipartimento di Automatica e Informatica del Politecnico di Torino, coadiuvato per le questioni di natura legale dal gruppo di giuristi che ha effettuato l'adattamento originario delle licenze.

Creative Commons Italia promuove l'uso delle licenze Creative Commons e la riflessione sulle motivazioni che hanno portato alla loro creazione, ma non svolge attività di consulenza legale, né di registrazione, archiviazione o catalogazione di opere dell'ingegno, siano esse rilasciate sotto una licenza Creative Commons o meno.

Le licenze Creative Commons

Caratteristiche

[tratto da www.creativecommons.it/Licenze/Spiegazione]

Ogni licenza richiede che il licenziatario:

- ottenga il tuo permesso per fare una qualsiasi delle cose che hai scelto di limitare, per esempio, usi commerciali, o creazione di un'opera derivata;
- mantenga l'indicazione di diritto d'autore intatta su tutte le copie del tuo lavoro;
- faccia un link alla tua licenza dalle copie dell'opera;
- non alteri i termini della licenza;
- non usi mezzi tecnologici per impedire ad altri licenziatari di esercitare uno qualsiasi degli usi consentiti dalla legge.

Ogni licenza permette che i licenziatari, a patto che rispettino le tue condizioni:

- copino l'opera;
- distribuiscano l'opera;
- comunichino al pubblico, rappresentino, eseguano, recitino o espongano l'opera in pubblico, ivi inclusa la trasmissione audio digitale dell'opera;
- cambino il formato dell'opera.

Struttura

Le licenze Creative Commons si strutturano idealmente in **due parti**: una prima parte in cui si indicano quali sono le **libertà** che l'autore vuole concedere sulla sua opera; e una seconda parte che chiarisce a quali **condizioni** è possibile utilizzare l'opera.

PRIMA PARTE - Le libertà per l'utente

Tutte le licenze consentono la copia e la distribuzione dell'opera:

Tu sei libero di riprodurre, distribuire, comunicare al pubblico, esporre in pubblico, rappresentare, eseguire e recitare quest'opera.

Alcune licenze consentono anche la modifica dell'opera:

Tu sei libero di modificare quest'opera.

SECONDA PARTE - Le condizioni per l'utilizzo dell'opera

Le licenze Creative Commons si articolano in **quattro clausole base**, che l'autore può scegliere e combinare a seconda delle sue esigenze.

Attribuzione *- Devi riconoscere la paternità dell'opera all'autore originario.* [1]

[1] Questa clausola è presente *di default* in tutte le licenze. Essa indica che, ogni volta che utilizziamo l'opera, dobbiamo segnalare in modo chiaro chi è l'autore.

Non commerciale *- Non puoi utilizzare quest'opera per scopi commerciali.* [2]

[2] Significa che, se distribuiamo copie dell'opera, non possiamo farlo in una maniera tale che sia prevalentemente intesa o diretta al perseguimento di un vantaggio commerciale o di un compenso monetario privato. Per farne tali usi, è necessario chiedere uno specifico permesso all'autore.

Non opere derivate *- Non puoi alterare, trasformare o sviluppare quest'opera.* [3]

[3] Quindi se vogliamo modificare, correggere, tradurre, remixare l'opera, dobbiamo chiedere uno specifico permesso all'autore originario.

Condividi allo stesso modo *- Se alteri, trasformi o sviluppi quest'opera, puoi distribuire l'opera risultante solo per mezzo di una licenza identica a questa.* [4]

[4] Questa clausola (un po' come succede nell'ambito del software libero) garantisce che le libertà concesse dall'autore si mantengano anche su opere derivate da essa (e su quelle derivate dalle derivate, con un effetto a cascata).

Le attuali sei licenze

Attribuzione
Attribuzione-NonOpereDerivate
Attribuzione-NonCommericale-NonOpereDerivate
Attribuzione-NonCommerciale
Attribuzione-NonCommerciale-CondividiAlloStessoModo
Attribuzione-CondividiAlloStessoModo

Ogni Licenza chiede che il Licensiatario

- Ottenga il tuo permesso per fare una qualsiasi delle cose che
  - hai scelto di limitare con la licenza,
  - for example: limitare gli usi commerciali o quelli di opera derivata
- Mantenga l'indicazione di diritto di autore intatta su tutte le copie del tuo lavoro
- Faccia un link alla tua licenza dalle copie dell'opera
- Non alteri i termini della licenza
- Non usi mezzi tecnologici per impedire ad altri licenziatari di esercitare uno qualsiasi degli usi consentiti dalla legge

Ogni licenza CC permette le seguenti azioni a patto che:

i licenziatari rispettino le condizioni della licenza CC assegnata:

- Possono
  - Copiare l'opera;
  - Distribuire l'opera;
  - Comunicare al pubblico, rappresentare, esegure, recitare o esporre l'opera in pubblico, ivi inclusa la trasmissione audio digitale dell'opera;
  - Cambiare il formato dell'opera.

Alcuni marker CC

Liberta' per l'utente

- Sei libero di distribuire, comunicare, rappresentare, eseguire, recitare o esporre l'opera in pubblico, ivi inclusa la trasmissione audio digitale dell'opera;

- Sei libero di modificare questa opera

Condizioni di uso

- Devi riconoscere la paternita' di questa opera
- Per esempio citando e riportanto un link alla sorgente

Licenze Creative Commons

- Offrono 6 diverse articolazioni
  - per artisti, giornalisti, docenti, istituzioni e, in genere, creatori che desiderino **condividere in maniera ampia** le proprie opere secondo il modello **"alcuni diritti riservati"**.

- **Altre condizioni d'uso, il detentore dei diritti puo'**

  - non autorizzare a priori **usi prevalentemente commerciali** dell'opera (opzione *Non commerciale*, acronimo inglese: *NC*)

  - non autorizzare la creazione di **opere derivate** (*Non opere derivate*, acronimo: *ND*); no extract, no aggregate, ..

  - Imporre di rilasciarle **con la stessa licenza dell'opera originaria** (*Condividi allo stesso modo*, acronimo: *SA*, da "Share-Alike").

Le combinazioni di queste scelte generano 6 licenze CC, disponibili anche in versione italiana, come descritto in seguito!

2 of the 6 CC licenses, 1/3

Attribution Non-commercial No Derivatives (by-nc-nd)

- The most restrictive of our six main licenses, allowing redistribution.
- This license is often called the “free advertising” license
- *it allows others to download your works and share them with others as long as they mention you and link back to you*,
- they can’t change them in any way or use them commercially

Attribution Non-commercial Share Alike (by-nc-sa)

- *Let others remix, tweak, and build upon your work non-commercially, as long as they credit you and license their new creations under the identical terms.*
- Others can download and redistribute your work just like the by-nc-nd license, but they can also translate, make remixes, and produce new stories based on your work.
- All new work based on yours will carry the same license, so any derivatives will also be non-commercial in nature.

2 of the 6 CC licenses, 2/3

- **Attribution Non-commercial (by-nc)**
  - Let others remix, tweak, and build upon your work non-commercially, and their new works must also acknowledge you and be non-commercial,
  - they don't have to license their derivative works on the same terms.

- **Attribution No Derivatives (by-nd)**
  - allows for redistribution, commercial and non-commercial,
  - as long as it is passed along unchanged and in whole, with credit to you

2 of the 6 CC licenses, 3/3

Attribution Share Alike (by-sa)

- *lets others remix, tweak, and build upon your work even for commercial reasons, as long as they credit you and license their new creations under the identical terms.*
- This license is often compared to open source software licenses.
- All new works based on yours will carry the same license, so any derivatives will also allow commercial use.

Attribution (by)

- *lets others distribute, remix, tweak, and build upon your work, even commercially, as long as they credit you for the original creation.*
- This is the most accommodating of licenses offered, in terms of what others can do with your works licensed under Attribution.

Part 1a: sistemi di protezione

- Distribution models
- Terminologies
- Business Models & Value Chain
- Copy protection
- Conditional Access Systems
- Digital Rights Management
- Content Modeling and Packaging
- Licensing and content distribution
- Creative Commons Licensing
- Composition of Licenses, data aggregation

Compatibility Chart

	PUBLIC DOMAIN	PUBLIC DOMAIN	BY	BY SA	BY NC	BY ND	BY NC SA	BY NC ND
PUBLIC DOMAIN	✓	✓	✓	✓	✓	✗	✓	✗
PUBLIC DOMAIN	✓	✓	✓	✓	✓	✗	✓	✗
BY	✓	✓	✓	✓	✓	✗	✓	✗
BY SA	✓	✓	✓	✓	✗	✗	✗	✗
BY NC	✓	✓	✓	✗	✓	✗	✓	✗
BY ND	✗	✗	✗	✗	✗	✗	✗	✗
BY NC SA	✓	✓	✓	✗	✓	✗	✓	✗
BY NC ND	✗	✗	✗	✗	✗	✗	✗	✗

Licenses and More..

- **Licenses**: MPEG-21, ODRL, XACML, Xrml, etc..
  - Suitable for media, Unsuitable for data
- **Data Licenses**: CC, ODC, OGL, IODL
  - Mainly open data and declinations
  - **Permissions**: derivative, commercialize, derivative...
  - **Restrictions/duties**: attribution, notice, ...
- **Getting Composing Data Set → Licences Composition is needed**
  - **See www.disit.org/6877 extension**
- Formal models to **grant rights**
- Techniques for **right enforcement/verification**
  - **Almost missing on RDF stores**

Confronto Fra Licenze

	Permissions			Requirements					Prohibitions
License	Reproduction	Distribution	Derivative Works	Notice	Attribution	Share Alike	Copyleft	Lesser Copyleft	Non-Commercial
CC0	X	X	X						
CC-PDM	X	X	X						
CC-BY-ND	X	X		X	X				
CC-BY-NC-ND	X	X		X	X				X
CC-BY	X	X	X	X	X				
CC-BY-SA	X	X	X	X	X	X			
CC-BY-NC	X	X	X	X	X				X
CC-BY-NC-SA	X	X	X	X	X	X			X
ODC-BY	X	X	X	X	X				
ODC-ODbL	X	X	X	X	X	X			
ODC-PDDL	X	X	X						
OGL 2.0	X	X	X	X	X				
OS OpenData	X	X	X	X	X	?			

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DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
http://www.disit.org

Composing Licenses

DISIT extension

	Second License												
First License	CC0	CC-PDM	CC-BY-ND	CC-BY-NC-ND	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	ODC-PDDL	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC0	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC-PDM	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC-BY-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY-NC-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY	CC-BY	CC-BY	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	CC-BY	CC-BY	ODC-ODbL	CC-BY	OS OpenData
CC-BY-SA	CC-BY-SA	CC-BY-SA	-	-	CC-BY-SA	CC-BY-SA	-	-	CC-BY-SA	CC-BY-SA	ODC-ODbL	CC-BY-SA	CC-BY-SA
CC-BY-NC	CC-BY-NC	CC-BY-NC	-	-	CC-BY-NC	-	CC-BY-NC	CC-BY-NC-SA	CC-BY-NC	CC-BY-NC	-	CC-BY-NC	--
CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	-	-	CC-BY-NC-SA	-	CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	-	CC-BY-NC-SA	--
ODC-PDDL	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
ODC-BY	ODC-BY	ODC-BY	-	-	ODC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	ODC-BY	ODC-BY	ODC-ODbL	ODC-BY	OS OpenData
ODC-ODbL	ODC-ODbL	ODC-ODbL	-	-	ODC-ODbL	ODC-ODbL	-	--	ODC-ODbL	ODC-ODbL	ODC-ODbL	ODC-ODbL	ODC-ODbL
OGL 2.0	OGL 2.0	OGL 2.0	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	OGL 2.0	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
OS OpenData	OS OpenData	OS OpenData	-	-	OS OpenData	CC-BY-SA	--	--	OS OpenData	OS OpenData	ODC-ODbL	OS OpenData	OS OpenData

RDF state of the art

- **Fuseky-Jena, GraphDB** support access control to the whole repository, not at level of data set/graph.
  - **Jena** provides API to write JAVA processes for filtering triples.
- **ORACLE** support access control to users at level of triple and model, not on graphs
- **Virtuoso and Stardog** allow to formalize simple licenses (as read/write permissions) at level of data set (RDF graph), and associate them to users.
  - an user performing a SPARQL query get back only triples for which is authorized **without any explanation** about filtered triples, and thus about potentially accessible data set with a different user profiles and licenses.

How is possible

- **SPARQL analyzer**
  - Read SPARQL query and rewrite to ask at the RDF store the Union of all the Graphs involved in the query
  - Several different constructs are addressed

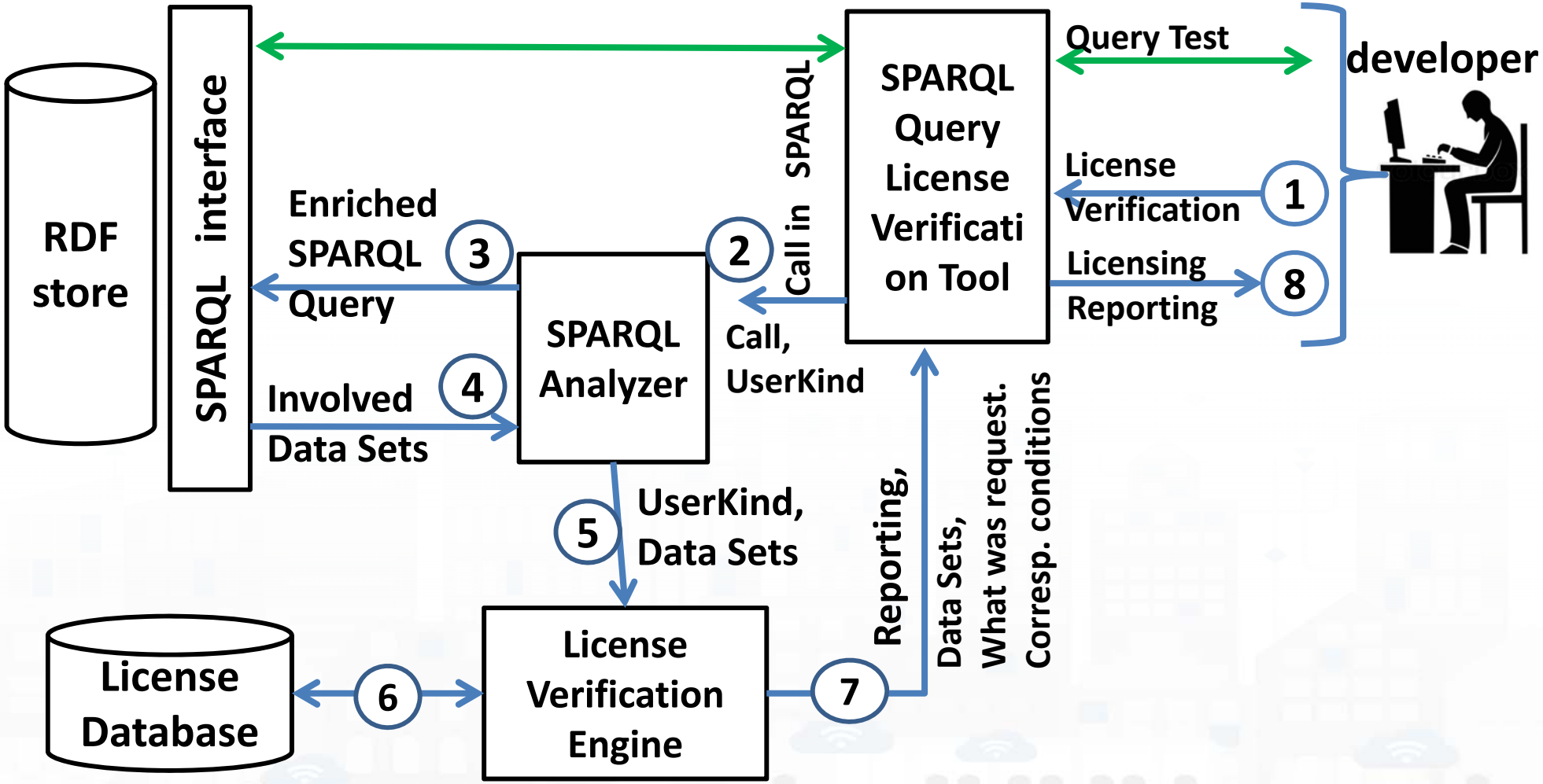
$$Graphs(Q) = \bigcup_{i=1}^{n} Graphs(Q.subQ_i) \cup G(Q)$$

- **License Verification Engine**
  - To compute the Duties and Permissions according to the category for which the query has been requested.

$$allow(Q,c,p) = \bigwedge_{g \in ResultGraphs(Q)} allow(g,c,p)$$

$$require(Q,c,d) = \bigvee_{g \in ResultGraphs(Q)} require(g,c,d)$$

SPARQL Query License Verification Tool



License Combination example

dataset/graph description	license	SD	Duties		permisions				user categories				
		sharealike	attribution	notice	derivative	commecialize	redistribute	reproduce	Citizen	Tourist	Police	Civil protection	Firefighters
DigitalLocation	CC-By-NC-SA	✔	✔	✔	✔	✘	✔	✔	✔	✔	✔	✔	✔
Eneergy Cabins	protected	✘	✘	✘	✘	✘	✘	✔	✘	✘	✔	✔	✔
Commercial firms	CC-By	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Graph street	CC-By	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Services on the city	CC-By-NC	✘	✔	✔	✔	✘	✔	✔	✔	✔	✔	✔	✔
Renting bikes	CC-By	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Taxi	CC-By	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Enogastronomy	CC-By	✘	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Two Main Cases

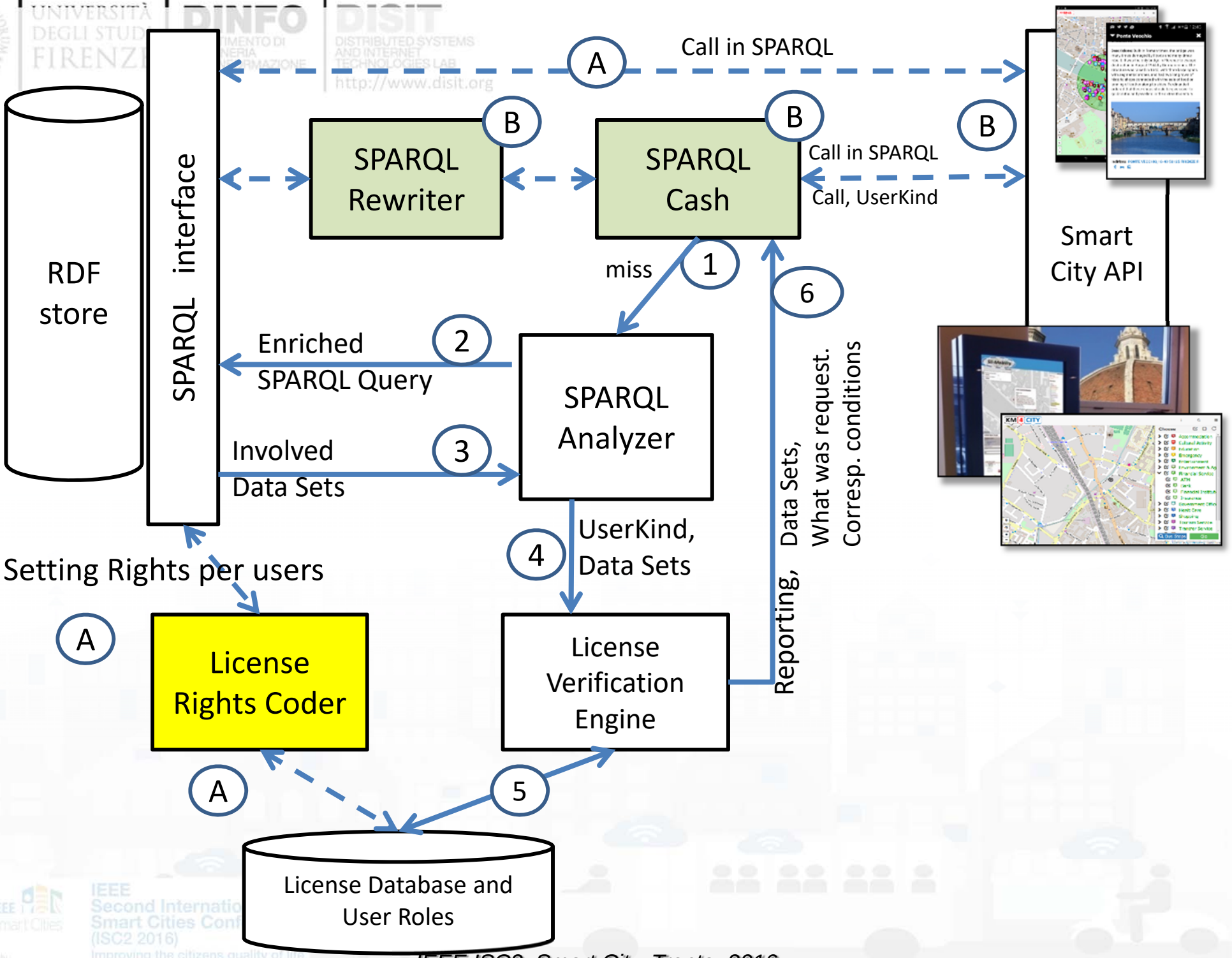
The solution allows:

- Developers to test and validate queries
- Cope with all kinds of RDF Stores

RDF Stores can be classified in two cases, those:

A. *provide* Triple filtering according to rights
   - Set up the correct rights into the RDF store via the **License Rights Coder**

B. *does not provide* triple filtering support,
   - provide support for **rights enforcement via query rewriting avoiding triple filtering**


A
Call in SPARQL
B
SPARQL Rewriter
B
SPARQL Cash
B
Call in SPARQL
Call, UserKind
RDF store
SPARQL interface
miss
1
6
Smart City API
Enriched SPARQL Query
2
SPARQL Analyzer
Involved Data Sets
3
UserKind, Data Sets
4
Reporting, Data Sets, What was request. Corresp. conditions
Setting Rights per users
A
License Rights Coder
License Verification Engine
A
5
License Database and User Roles

http://log.disit.org/spqlquery/

Flint SPARQL Editor 1.0.3

New Edit View Help

Dataset KM4CITY Mode SPARQL 1.1 Query Output SPARQL-XML Submit

Query 1

```
1  PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2  PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
3
4  SELECT * WHERE {
5     ?s ?p ?o
6  }
7  LIMIT 10
```

Samples SPARQL Properties Classes Prefixes

All municipalities

Select all municipalities names.

```
PREFIX km4cr: <http://www.disit.org/km4city/schema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT * WHERE {
   ?s a km4cr:Municipality;
      rdfs:label ?l.
} ORDER BY ?l
```

Bus stops near the Florence SMN train station

The bus stops within 100m of the Firenze SMN

```
PREFIX km4cr: <http://www.disit.org/km4city/schema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

Line: 1; Position: 1; Query is valid

Query Results — Visual Results Mode

#	s	p	o
1	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
2	http://www.w3.org/2000/01/rdf-schema#subPropertyOf	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
3	http://www.w3.org/2000/01/rdf-schema#subClassOf	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
4	http://www.w3.org/2000/01/rdf-schema#domain	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
5	http://www.w3.org/2000/01/rdf-schema#range	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
6	http://www.w3.org/2002/07/owl#equivalentProperty	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/1999/02/22-rdf-syntax-ns#Property

•END