Knowledge Management and Protection Systems (KMaPS)
Corso di Laurea in Ingegneria

Part 1b – **sistemi di protezione e distribuzione**

Prof. Paolo Nesi

DISIT Lab http://www.disit.dinfo.unifi.it/

Department of Information Engineering, DINFO

University of Florence
Via S. Marta 3, 50139, Firenze, Italy
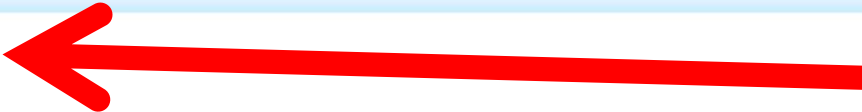tel: +39-055-2758515,   fax: +39-055-2758570

paolo.nesi@unifi.it, http://www.disit.dinfo.unifi.it/nesi

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Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM ⟵
- ¿ Definizioni
    - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- ¿ Architettura AXMEDIS overview
- ¿ Package MPEG-21 e AXMEDIS
    - ♣ AXMEDIS, NewsML, MXF
    - ♣ Intelligent content, Behavior e annotazioni
- ¿ Player AXMEDIS e DirectX
- ¿ Aspetti di DRM avanzati
- ¿ AXMEDIS Major Tools
    - ♣ AXMEDIS player multipiattaforma
    - ♣ Content Production and workflow
- ¿ Distribuzione dei contenuti
    - ♣ Controlled P2P content Distribution
    - ♣ Content Distribution via Kiosks
    - ♣ Satellite broadcasting, Terrestrial Broadcasting
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    - ♣ Interoperabilita' nel Backoffice
    - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

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As it was: i-Tunes of Apple, iTMS, I-Tunes Music Store

¿ MP4 package with AAC 128 Kbit, comparable with 160Kbit MP3,

¿ 70 Millions of Files in the first year of work

¿ > 500.000 traces

¿ Very easy

¿ No subscription costs

¿ Pay per download (0.99$ per file, 9.99$ per collection)

¿ Tools: download, player, burning, play lists, etc.

¿ DRM proprietary, "FairPlay", cracked in April 2004

¿ Continue to work even if cracked

I-Tune and early DRM limits

¿ Transfer of a trace to at most

♣ 7 CDs, burning

♣ 3 authorized computers

¿ Authorized transfer on a non limited number of i-POD

♣ Market and money on iPods

¿ Content is bought forever

¿ Authorized transfer on any computer but they can be played only on those that are authorized

Apple iTunes: iPhone-iPod

- ¿ iTunes uses contract and/or copyright law to govern the actions consumers may take
  - ♣ control copyright through contract?
    - ➔ Protect DRM
    - ➔ Price efficiently
    - ➔ Encourage vendors
- ¿ iTunes attempts to contract out of resale rights, reverse-engineering, certain (other) fair uses
- ¿ Digital Rights Management
  - ♣ FairPlay to prevent piracy and, foremost, limit interoperability (controlling secondary markets)
  - ♣ Prevents users from certain "fair" uses
  - ♣ Not interoperable with other technologies

FairPlay DRM

- ¿ Codifica in AAC, encryption
  - ♣ MPEG-4 con un audio AAC codificato encrypted with a master key
    - ➜ Codifica AES dell'audio e firma MD5
    - ➜ La master key è encrypted nel file stesso, e viene decrypt tramite una User key
- ¿ La UserKey viene prodotta in modo random
  - ♣ generata per ogni vendita per criptare la master key
  - ♣ ogni contenuto O(CxU), milione di chiavi per milioni di utenti, bilioni di transazioni
  - ♣ Le KxU info sono memorizzate su server e anche sul player, su iTune in un encrypted file (key repository)
  - ♣ iTune, ha UK, per ogni content ottiene la Master key e da questo accede al file
- ¿ iTune ha un Hardware ID univoco per ogni computer-device
  - ♣ Ad ogni nuovo HWID viene inviata la serie delle chiavi collegate
  - ♣ Un numero limitato di HWID sono concessi per ogni persona.

FairPlay DRM

¿ Ogni traccia protetta può

- ♣ andare su un numero non limitato di iPod
- ♣ andare su Max 5 PC
- ♣ essere masterizzata su CD senza limitazioni di numero. Il CD audio non ha tracce protette. Ovviamente «rippare» tale CD e' una violazione come rippare quegli originali.
- ♣ essere eseguita solo su Ipod, iPhone, iPad e alcuni Motorola

¿ Una play list con una traccia protetta può

- ♣ essere usata per fare un CD al max 7 volte

FairPlay DRM

- **E' da molto tempo possibile aggirare ed eliminare il DRM**
    - ♣ Vi sono Tool che accedono alle chiavi dai server Apple e decriptano i file audio, salvandolo in chiaro.
    - ♣ Nel 2006 e' stata prodotta la versione iTune 7.0 risulta robusta a tali attacchi.
    - ♣ Nel 2008 vi sono stati altri tool per violare e
        - → La versione iTune 8 per bloccarli, etc.
    - ♣ Nel 2009 Apple ha contrattato con i produttori di distribuire audio senza DRM, mentre video, book e TV prog sono ancora con DRM
- **Altri Metodi semplici:**
    - ♣ Masterizzare un CD e ripparlo
    - ♣ Usare un software di registrazione tramite:
        - → il cosi' detto "analogHole"

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Analog Hole

¿ **Comunque uno protegga** un certo contenuto audio video quando questo viene riprodotto nel ***dominio analogico dei sensi***:

- ♣ la riproduzione finisce per produrre effetti nel mondo analogico:
  - → Il suono percepito dal sistema uditivo umano
  - → Le immagini percepite dalla vista

¿ **Questo implica** che:

- ♣ tramite sistemi di registrazioni del: Suono o delle immagini come registratori si puo' sempre effettuare una copia privata di tale materiale ***registrando nel dominio analogico***
- ♣ la copia da analogico puo' avere una qualita' inferiore dell'orginale dipendentemente dall'originale stesso

¿ **Dal punto di vista legale**:

- ♣ Puo' essere una violazione dipendentemente da chi fa questa operazione, se non ha il diritto di Copy etc.
- ♣ Chi ha comprato un certo materiale ha il diritto di copia privata

Triple Play definition

- ¿ Definizione derivata dal mondo delle telecomunicazioni e degli ISP (internet service provider) via telefono o TV via cavo

- ¿ Consiste in **Tre modi di fare play** sulla stessa rete / infrastruttura, magari supportata da un BOX con xDSL

- ¿ Per offrire servizi integrati, o meno, di:
    - ♣ High speed internet access, broadband connection
    - ♣ IPTV/WebTV: IP television
    - ♣ VOIP: telefono su IP, voice over IP

- ¿ Il triple play e' più legato all'offerta commerciale che alla soluzione di un problema tecnico per la fornitura di servizi integrati.

Quadruple Play definition

- ¿ Definizione derivata dal mondo delle telecomunicazioni e dai provider:

- ¿ **4 modi di fare play sulla stessa rete/infrastruttura**, e pertanto di offrire servizi integrati di:

  - ♣ High speed internet access, broadband connection
  - ♣ IP television, IPTV
  - ♣ VOIP, telefono su IP
  - ♣ Mobile connection:
    - ➔ dual mode: GSM and WiFi (per pasare a tariffa flat via IP, VOIP quando entra in area triple play, a casa)

- ¿ Il quadruple play e' legato all'offerta commerciale e alla soluzione tecnica per la fornitura di servizi integrati.

Comments on: concept of Super Distribution

¿ What is intended as superdistribution ??

- ♣ A distribution in which the users collaborate to the distribution of content C2C, such as in the P2P environments

- ♣ A DRM solution in which the content is separate from the license:
  - ➜ Open Model
  - ➜ Augmented License

- ♣ *A Solution (DRM or not) in which the Certifier and Supervisors and/or the devices are capable of detecting violations thus activating some recovering activity*

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Automating Production of Cross Media Content for Multichannel Distribution
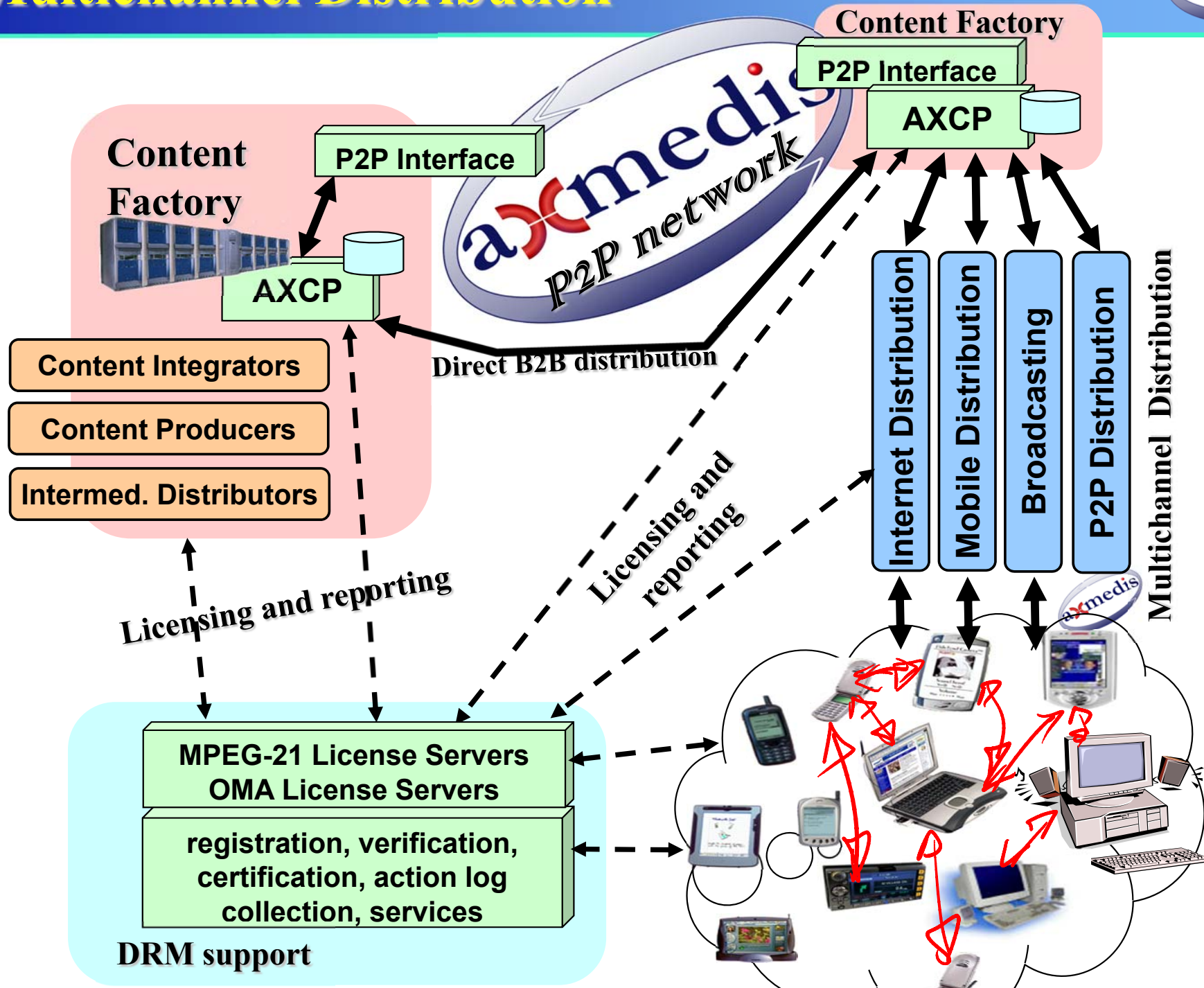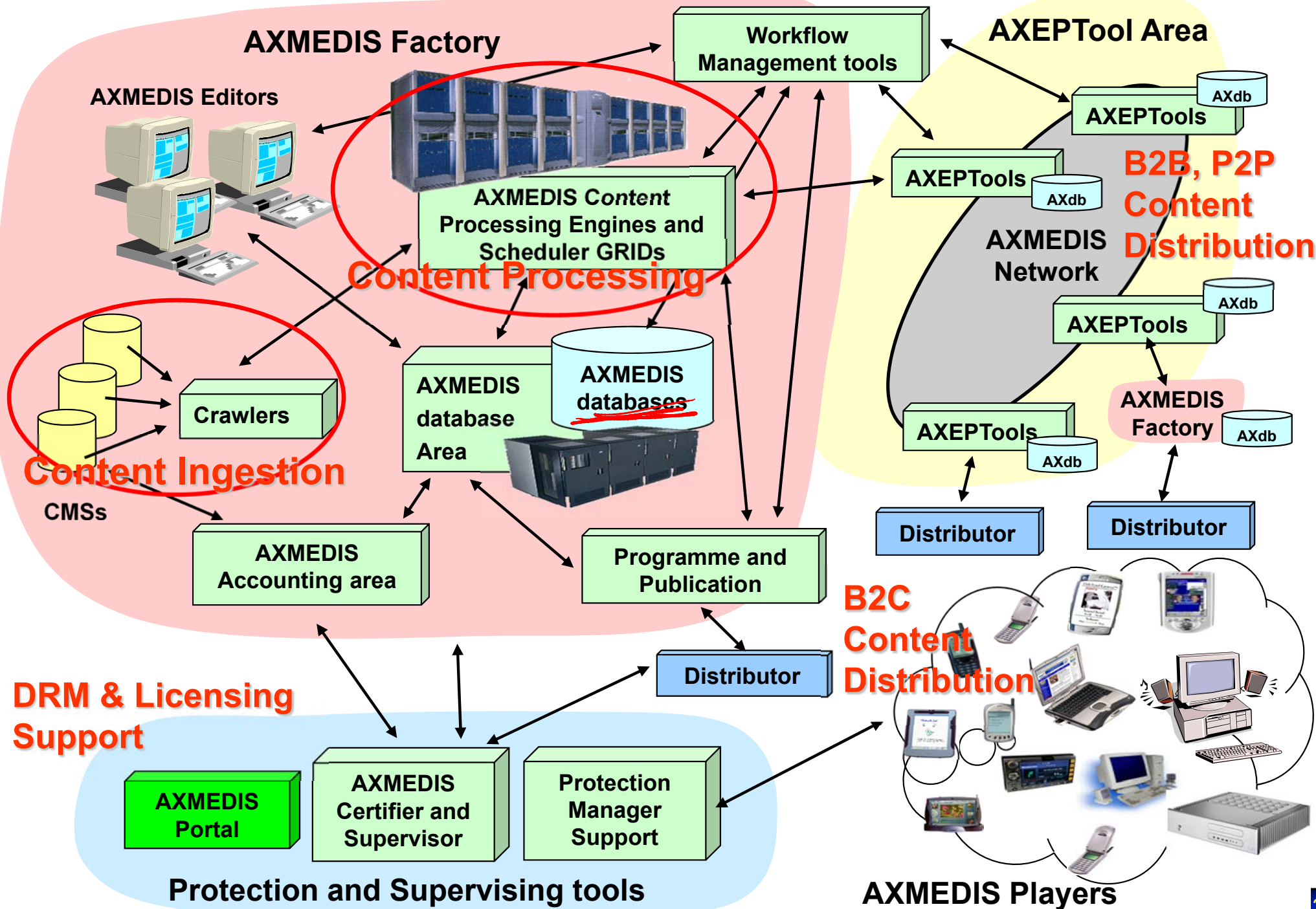
www.AXMEDIS.org

Partners

Partners Distribution
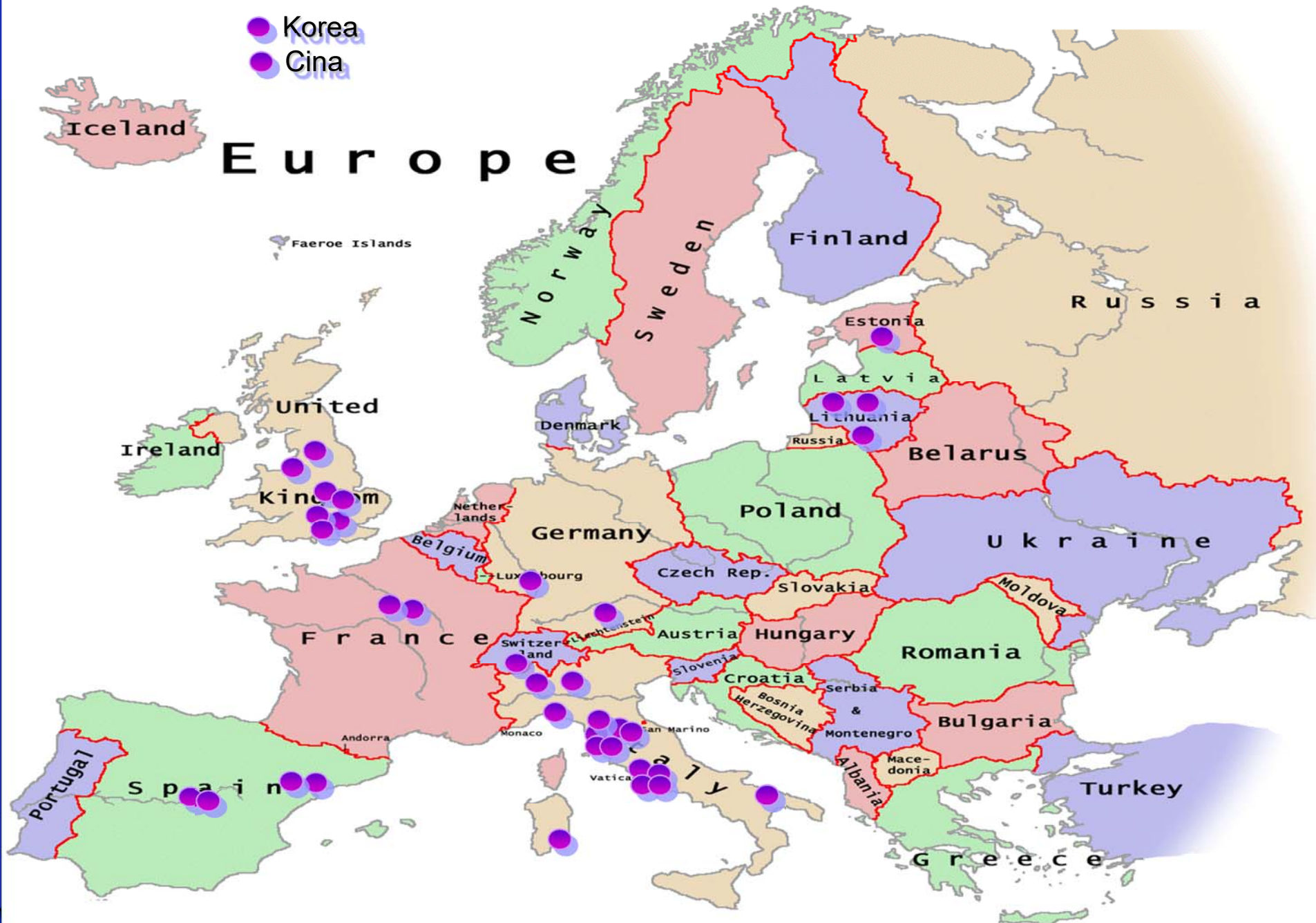
¿ **Perform research on enabling technologies to allow**

- ♦ reduction of distribution and aggregation costs for content production, protection and management
- ♦ using and exploiting new models, methods and tools for content production, protection and distribution

¿ **Create a unified platform for content production and distribution:**

- ♦ Supporting interoperability among different
  - ➔ content formats, cross media and simple resources
  - ➔ distribution channels (TV, PDA, mobile, kiosks, broadcasting,..)
  - ➔ DRMs (digital rights management) models (e.g., MPEG-21, OMA, Windows DRM, etc.)
- ♦ Supporting massive processing for content production and distribution (on demand), license processing, protection, tracking and DRM, exploitation of legacy CMSs
- ♦ Integration and Harmonization of DRM in B2B and B2C areas
  - ➔ Enforcing flexibility in business and transaction models
  - ➔ Modeling secure/legal P2P sharing for B2B and B2C
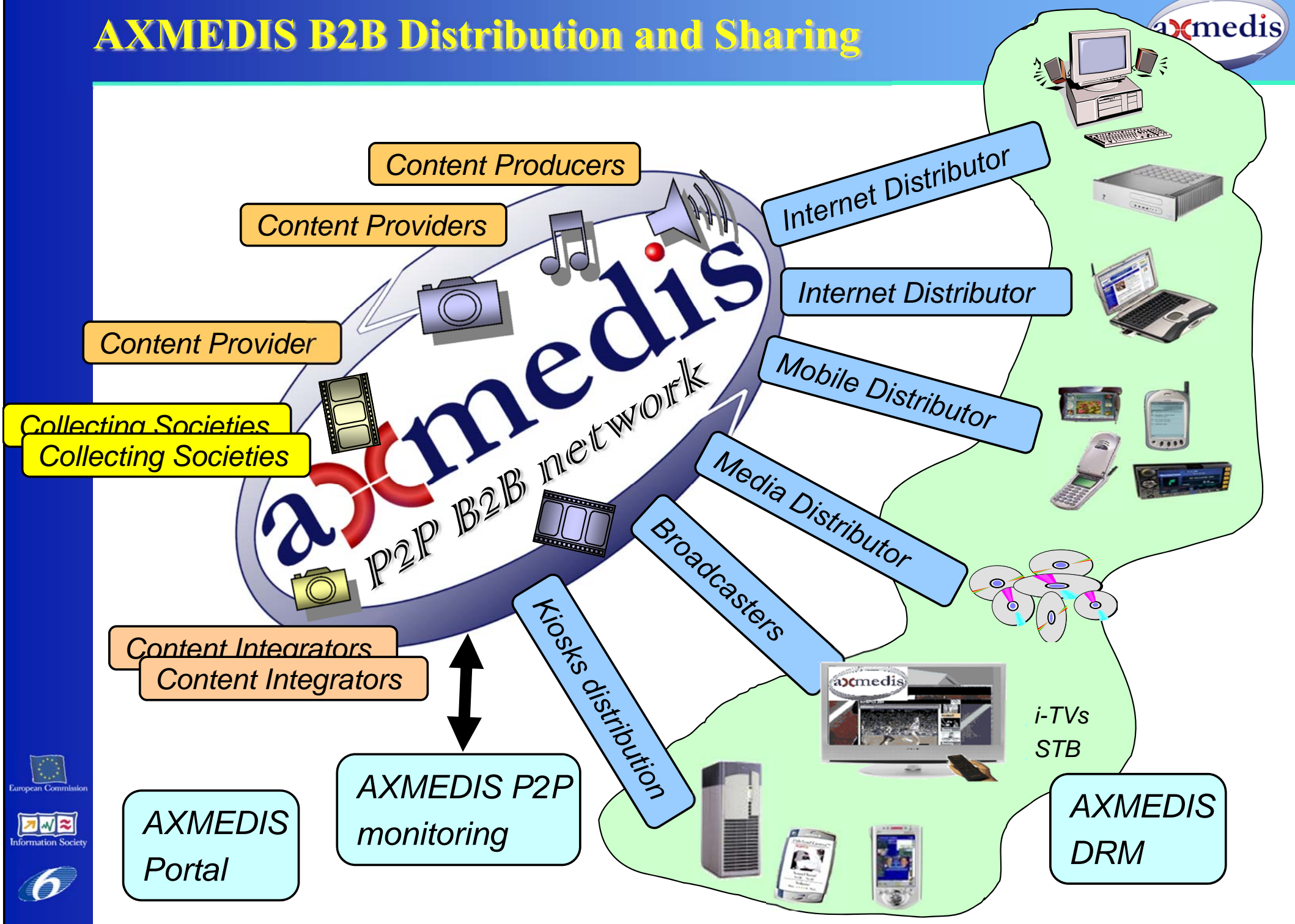 - ➔ Expanding and exploiting MPEG-21 standard

Multichannel Distribution

Content Factory

P2P Interface

AXCP

Content Factory

P2P Interface

AXCP

P2P network

Content Integrators

Content Producers

Intermed. Distributors

Direct B2B distribution

Internet Distribution

Mobile Distribution

Broadcasting

P2P Distribution

Multichannel Distribution

Licensing and reporting

Licensing and reprrting

MPEG-21 License Servers
OMA License Servers

registration, verification, certification, action log collection, services

DRM support

- **Applications of automated content production and protection**
  - Entertainment, edutainment, infotainment, educational, etc.
    - Real-time and non-real-time content distribution
    - Internet, P2P, broadcast, IPTV, mobiles, DVB-T, DVB-S, DVB-H, etc.
  - Other relevant applicative areas are:
    - banking, governmental, military and healthcare
- **Technical solution for**
  - Massive and scalable production of content on demand
  - Content distribution: single and multi-channel
  - Content protection and DRM, tracking and control
  - Content management
  - Content sharing among producers and distributors
  - Content integration and metadata enrichment
  - Etc.

- **AXMEDIS Framework for all**
  - Set up and maintenance of an European Platform for improving the knowledge and tools on e-Commerce of digital goods.
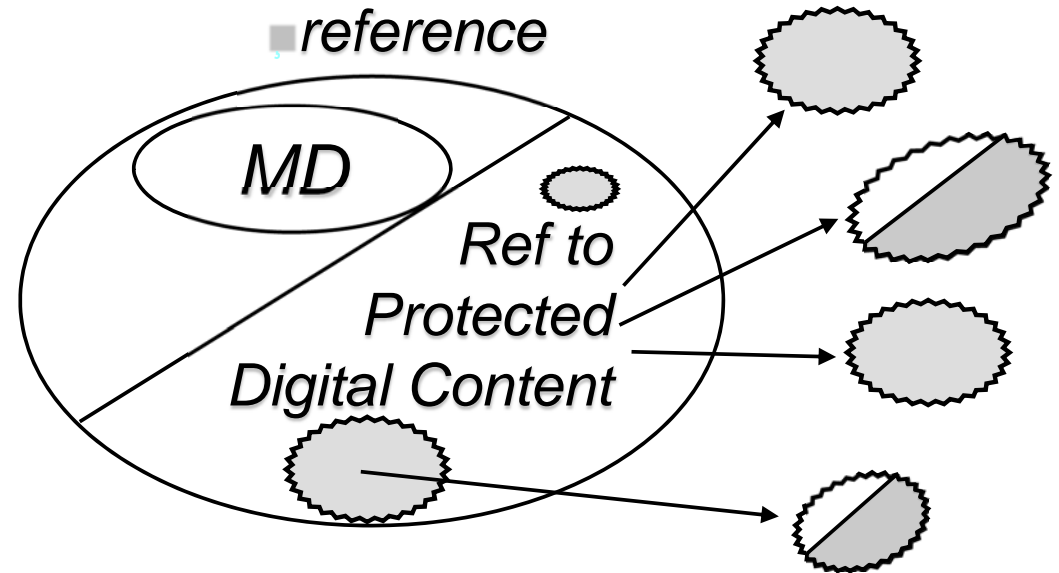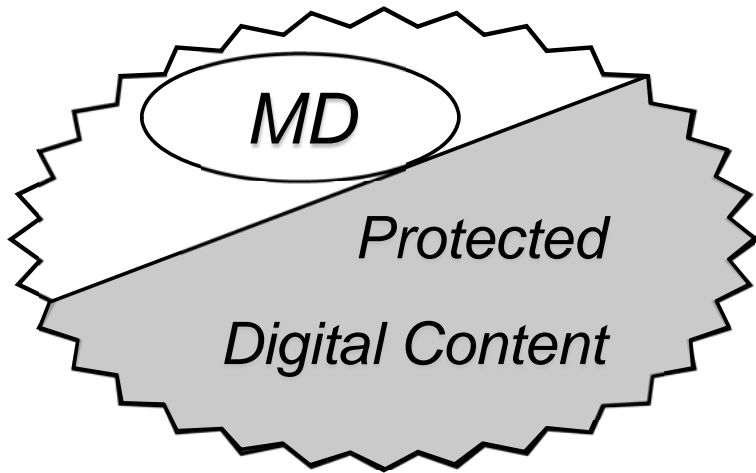 - Making the AXFW accessible

AXMEDIS Architecture
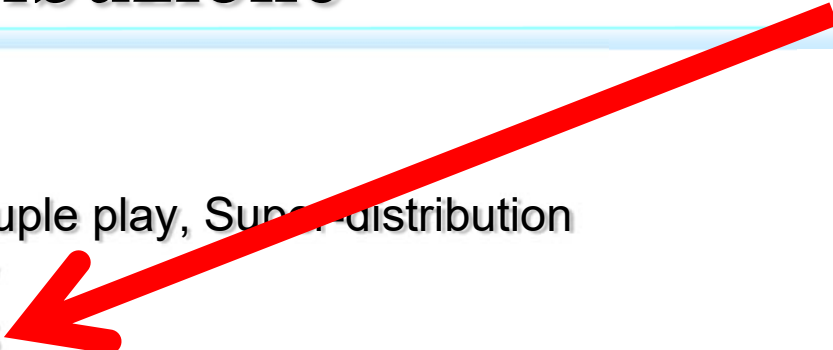
AXMEDIS B2B Distribution and Sharing

Content Producers

Content Providers

Internet Distributor

Content Provider

Internet Distributor

Collecting Societies

Collecting Societies

Mobile Distributor

Media Distributor

Broadcasters

Content Integrators

Content Integrators

Kiosks distribution

i-TVs

STB

AXMEDIS Portal

AXMEDIS P2P monitoring

AXMEDIS DRM

axmedis

P2P B2B network

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reference

MD

Ref to
Protected
Digital Content

MD

Protected

Digital Content

nested

MD

complete

- **Any digital resource**
  - ♦ Any hierarchy can be incorporate and modelled
  - ♦ Nested information

- **Addition of formalized Metadata**
  - ♦ AXMEDIS Information, AXInfo
  - ♦ Additional metadata and descriptors

- **Extension for AXMEDIS objects**
  - ♦ <file name>.axm, .mp21, m21

- **MPEG-21 based**
  - ♦ DID: Digital Item Declaration
  - ♦ DII: Digital item Identification
  - ♦ XML, binarization

- **AxObject**
  - an MPEG21 DIDL Item (or IPMPDIDL)
    - Recursive Structure
- **AxInfo**
  - B2B relevant metadata
    - Creator, Owner, Distributor,…
    - Workflow info, lifecycle details and history of commands
    - Potentially Available Rights (PAR): which describes rights can be acquired by a customer (B2B)
    - Fingerprint algorithms info, metadata certification
  - Object signature
- **Public and Private object metadata**
  - issue
    - Public must be always at disposal for indexing, querying, etc.
    - Private metadata are assets to be protected with the content
    - Some of the metadata are replicated in both locations
  - thus
    - Once resolved with "index" Item
    - Now addressed in new IPMPDIDL:ContentInfo
    - Metadata are reported in clear for protected content

- **Content Packaging for protection and distribution**
  - ◆ Streaming (so called real-time) and/or downloading
  - ◆ Sharing on P2P, etc..
  - ◆ portable on physical supports, etc. (scalable)
  - ◆ binary and/or XML, etc.

- **Real Cross Media**
  - ◆ Multimedia hierarchies of digital resources such as models based on:
    - ➔ HTML, SMIL, SCORM/IMS, WEDELMUSIC, MPEG-4, etc.
    - ➔ With internal and external links and relationships: *for example one HTML page may be build by using several images and audio files.*
  - ◆ **Integration of docs, audio, video, images, via spatial rendering and synchronization, providing interactivity**

- **The Content Package in the hands of the final user to be used may need of the following information**
  - ◆ Metadata………
  - ◆ Digital Resources……
  - ◆ Protection Information…..
 - ◆ License……..
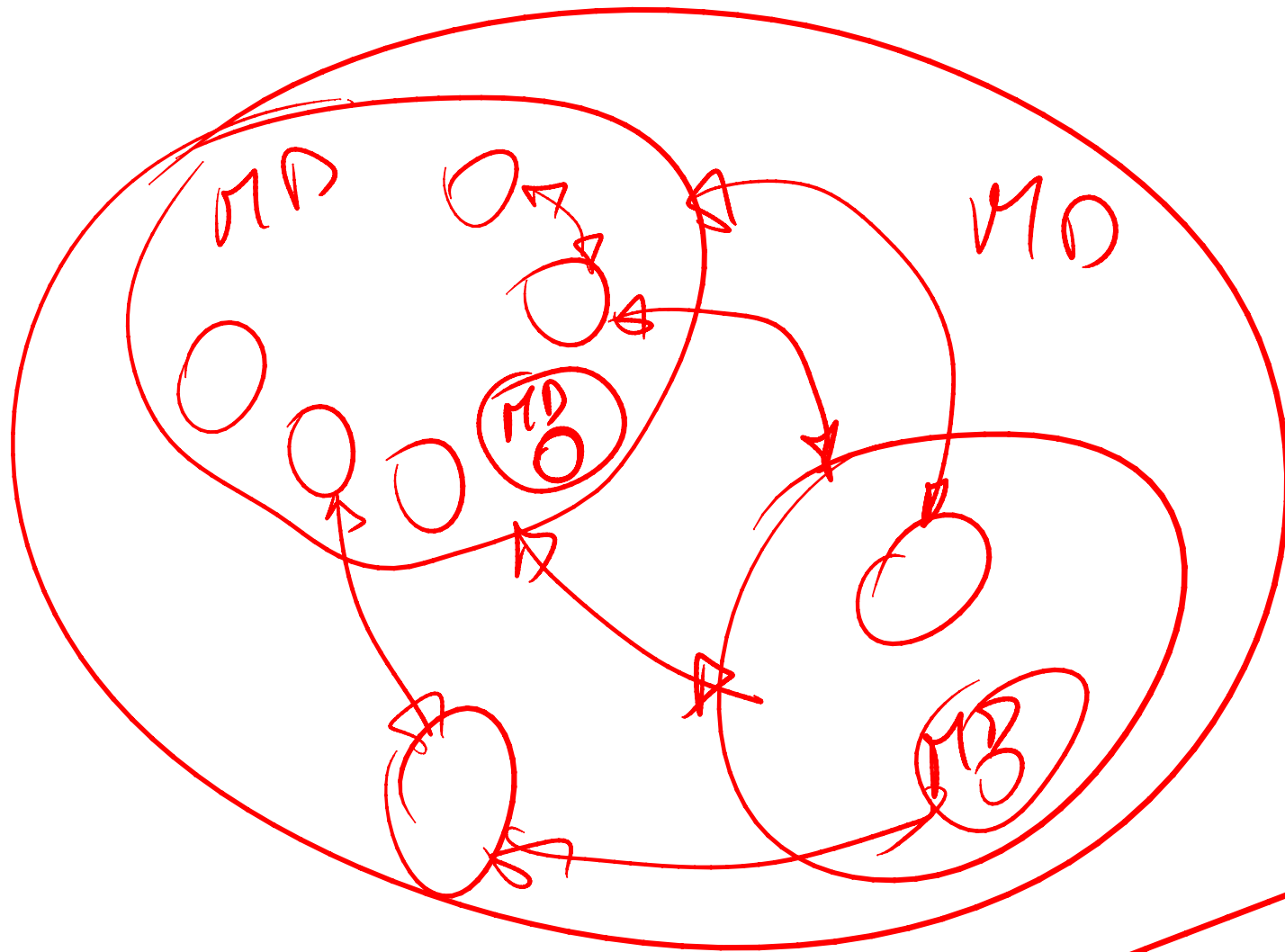
Packaging and Protection, AXMEDIS model
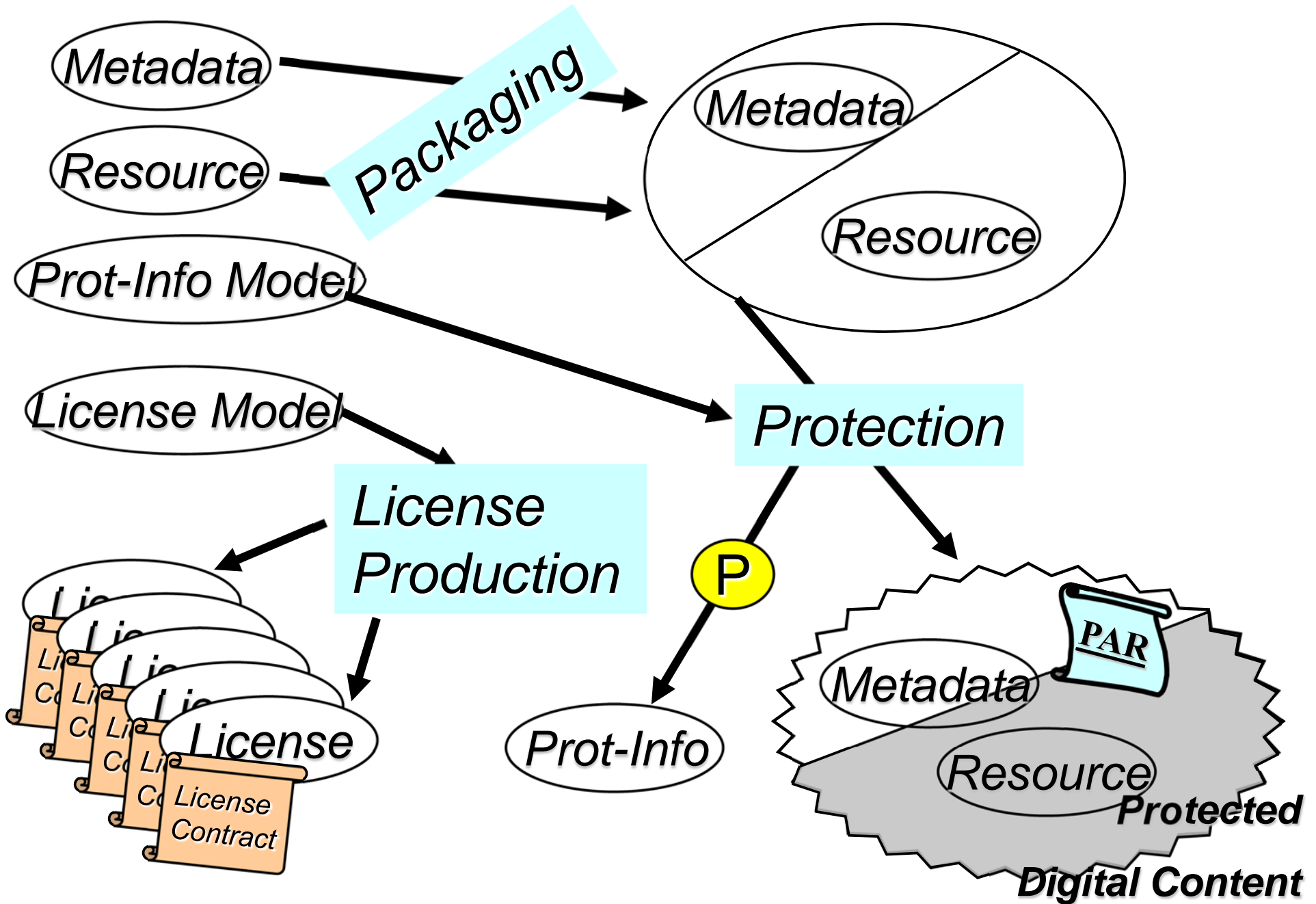
The Cross Media Content Model

- **Based on MPEG21 Digital Items, but not limited to**
- **Overcoming limitations in content modeling and DRM:**
    - Cross media:
        - any kind of metadata and any kind IDs
        - presentation and glue (e.g., HTML, SMIL, SVG), plus
        - digital resource images, documents, video, audio, games, MPEG-4, etc.;
    - Content components: composition and reuse;
    - DRM interoperability: MPEG-21 and OMA
    - DRM Chain of licenses: B2B and B2C integration;
    - Integration of semantics and behavior into the content.
- **DRM, Digital Rights Management**
    - Modeling licenses for the B2B-B2C areas
    - Algorithms and tools for processing licenses, chains and relationships
- **Supporting**
    - legal/secure P2P for B2B and B2C/C2C
    - B2B-B2C content production and transactions, for protected and non protected objects
   - Multichannel distribution
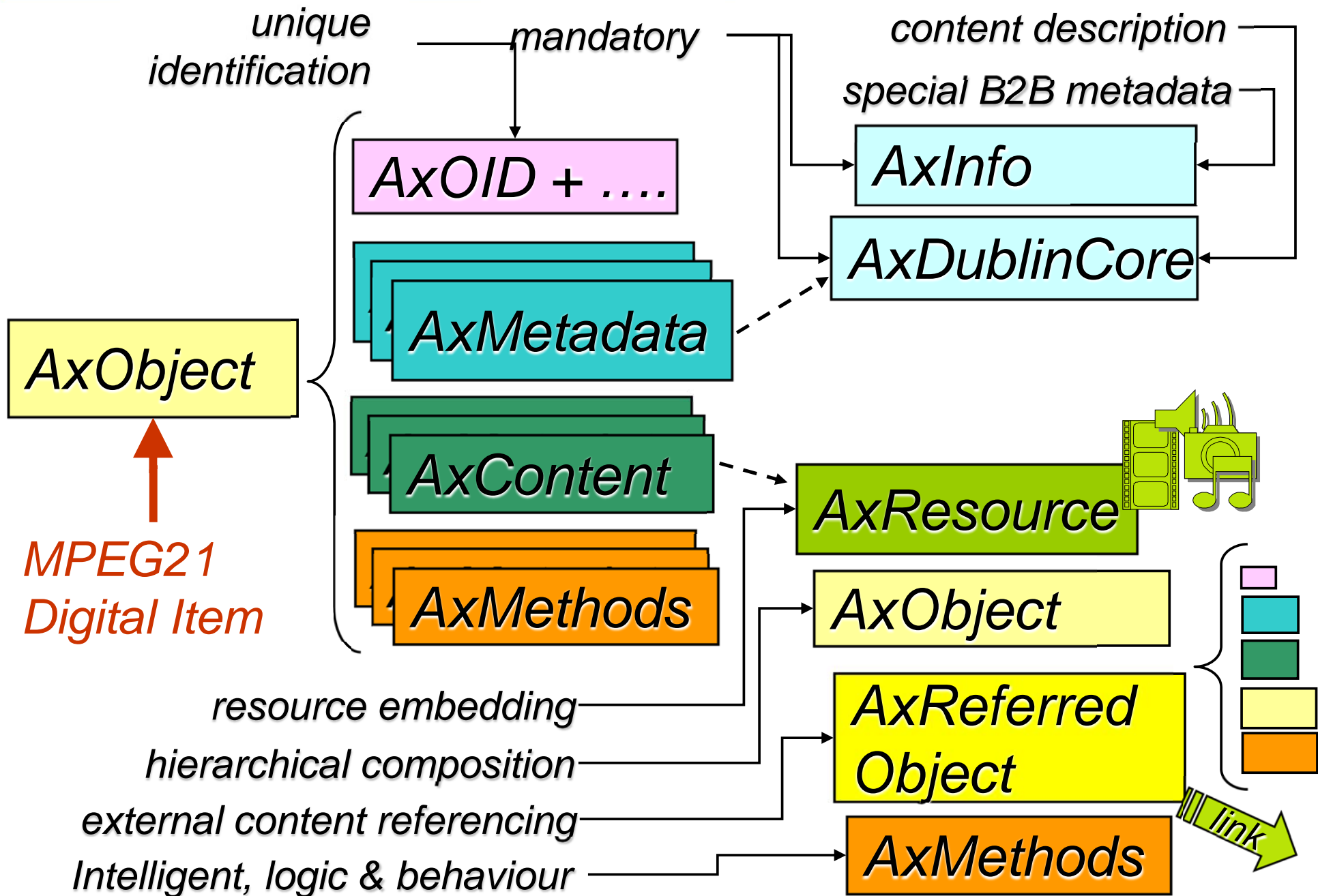
Interactive and intelligent content
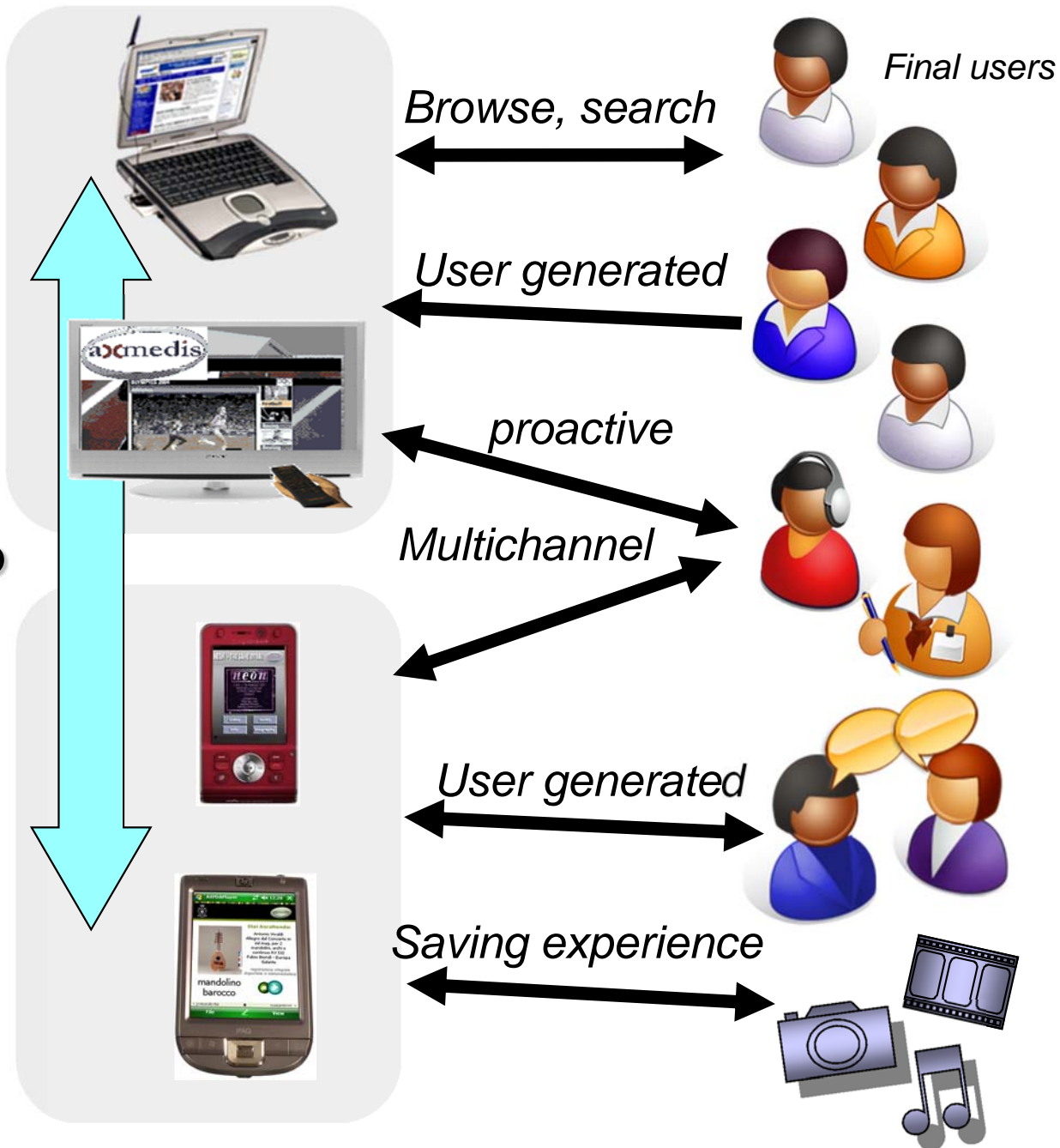
integrated media info

proactive with the users

attractive experience

personalized

multichannel interoperable

device interoperable

Final users

Browse, search

User generated

proactive

Multichannel

User generated

Saving experience

Intelligent Content

- **From buttons and events to actions**
  - ♦ HTML, SMIL, Flash may activate AXmethods
- **HTML forms to collect user inputs**
- **AXMethods intelligence in Extended javascript**
  - ♦ AXCP functionalities: ingestion, content processing, transcoding, database access, licensing, mailing, save/load, profiling, etc.
  - ♦ communication, monitoring, reporting events, etc.
  - ♦ content production, migration (from PC to PDA) and protection
  - ♦ coding presentations, sliding, sequences
  - ♦ educational intelligent content
  - ♦ non linear story telling
  - ♦ collecting user content
  - ♦ Internal search
  - ♦ Annotations (future)
  - ♦ autorun
- **Future:**
  - ♦ collaborative communications
  - ♦ cameras connections
  - ♦ etc.
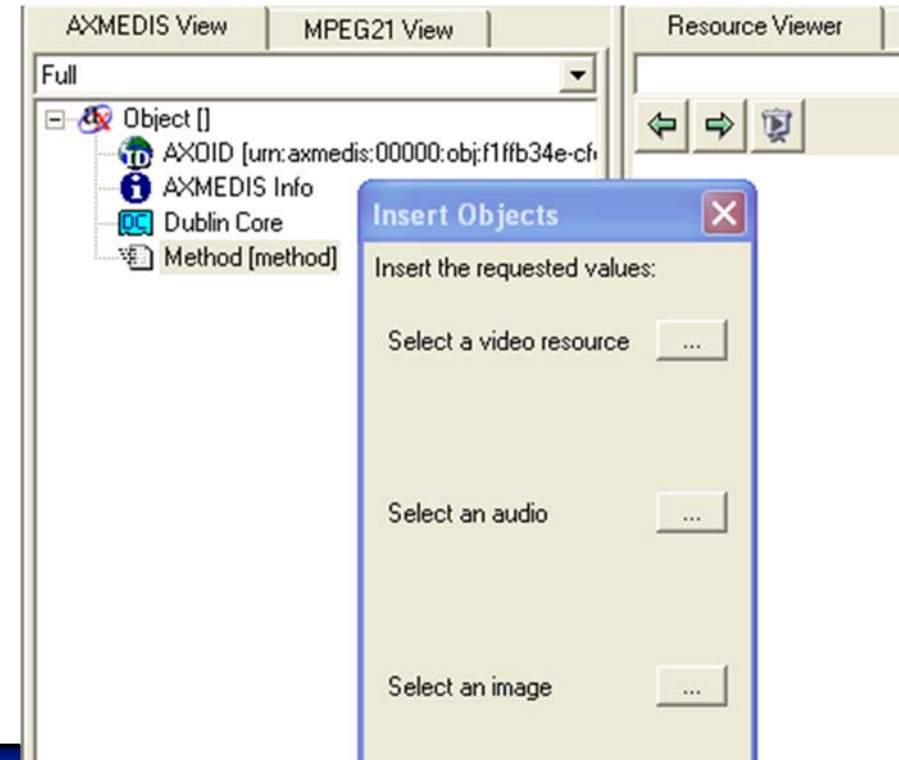
An example to wrap it all up
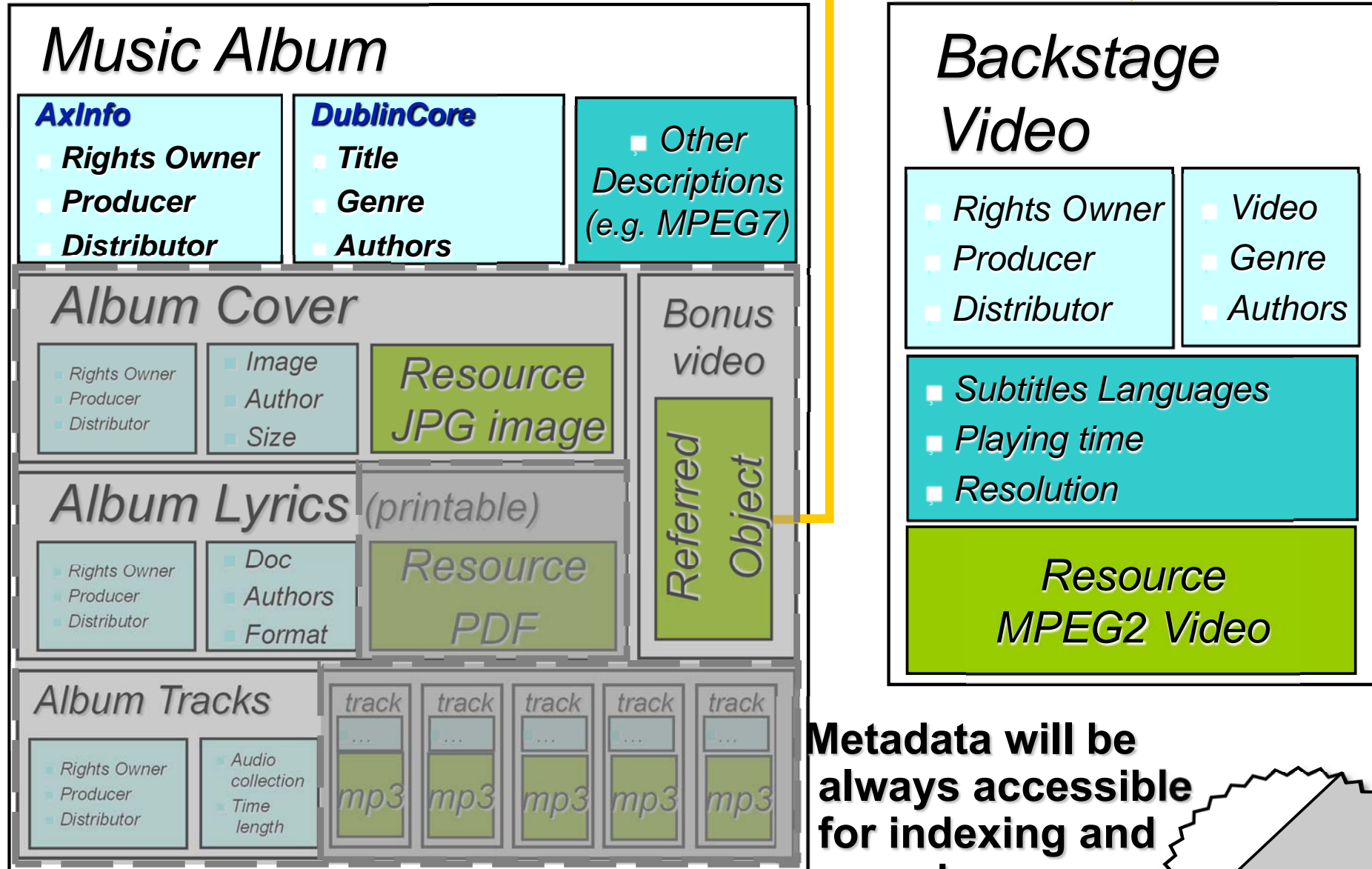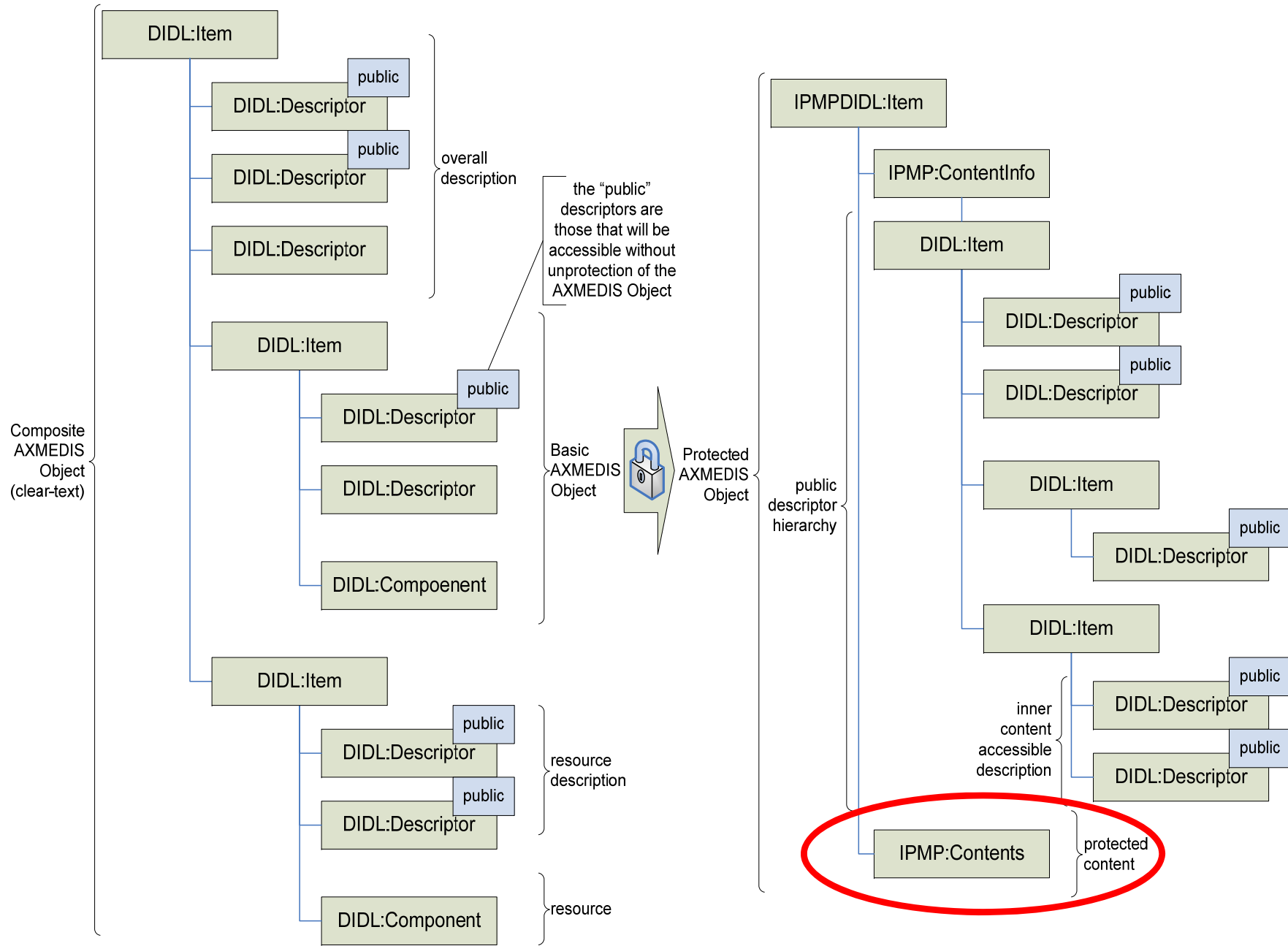
Abbiamo visto:

- ◆ Modello mpeg-21 non protetto
- ◆ Modello mpeg-21 protetto
- ◆ Passaggio a blog protetto
- ◆ Problemi di accesso al singolo file nel blog

Single Files:
- audio, video, documenti, immages, etc..

Interactive Content:
- HTML or SMIL as technology of User interaction
- Guids, games, etc.
- Valoriz. of Cultural Heritage content
- Educational Content

Proactive Wizard:
- Video messg. Recording, UGC
- Assisted upload
- Production of licenses
- User profile processing
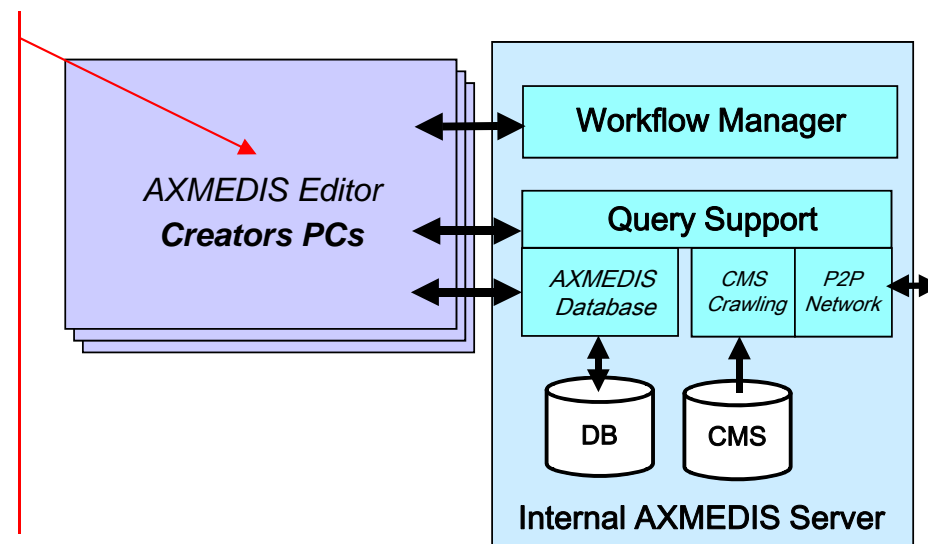- Taking decision
- Local indexing/searching
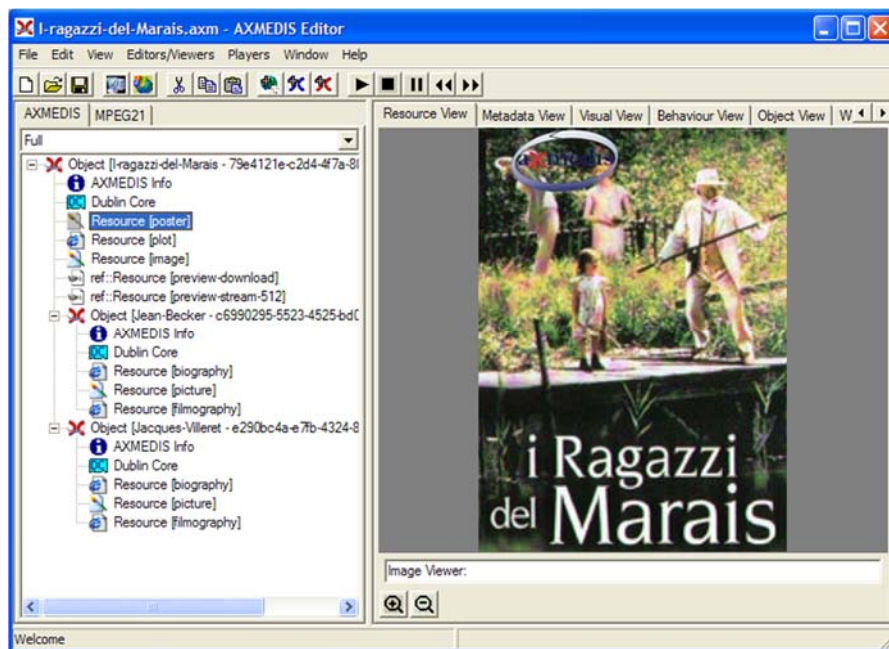- Local assistant
- ….

Motivations

- **A large number of cross media content formats: SCORM, MXF, NewsML, MPEG-21, Flash, HTML, etc.**

- **Major Issues for cross media content (DMS 2008):**
  - ◆ Packaging:
    - ➔ Metadata and descriptors, Ids
    - ➔ Digital essences
  - ◆ Distribution: download, streaming, progressive, P2P
  - ◆ Protection: CAS vs DRM
  - ◆ Hierarchical nesting levels: IPR, Metadata, etc.
  - ◆ Players and tools
  - ◆ Automated production, repurposing, etc…

- **Some lacks into the capabilities of the NewsML model and tools to cope with recently stressed aspects:**
  - ◆ IPR, intelligence, interoperability, etc.

Major Tools

- **Players for cross media content:**
  - PC, PDA, STB, mobiles, etc.
- **Tools for DRM and protection**
- **Content Production tools**
  - Authoring tools for cross media content: AXMEDIS Editor
    - for content, protection and licenses
  - Automated production tools for content, protection packages and licenses: AXCP, Workflow
  - CMS: search and retrieval, automated connection with your own and/or third parties CMSs
- **Content Distribution**
  - P2P tools for B2B and C2C in a controlled and safe/legal manner: AXEPTool, AXMEDIA
  - User and tool Registration portals
  - Certification authority, AXCA
  - License Server and Certifier and Verificator, PMS/AXCS
  - Scheduling: Program and publication, Workflow, etc.
  - Distribution Portal
  - Content acquisition portal for end user production

AXMEDIS Editor

¿ **The AXMEDIS Editor is an application allowing**

♦ manual production of AXMEDIS objects

♦ Inspection/change of automatically produced objects

♦ finishing AXMEDIS objects pre-produced automatically

♦ Protection of AXMEDIS objects

♦ Storing AXMEDIS objects into the AXMEDIS database
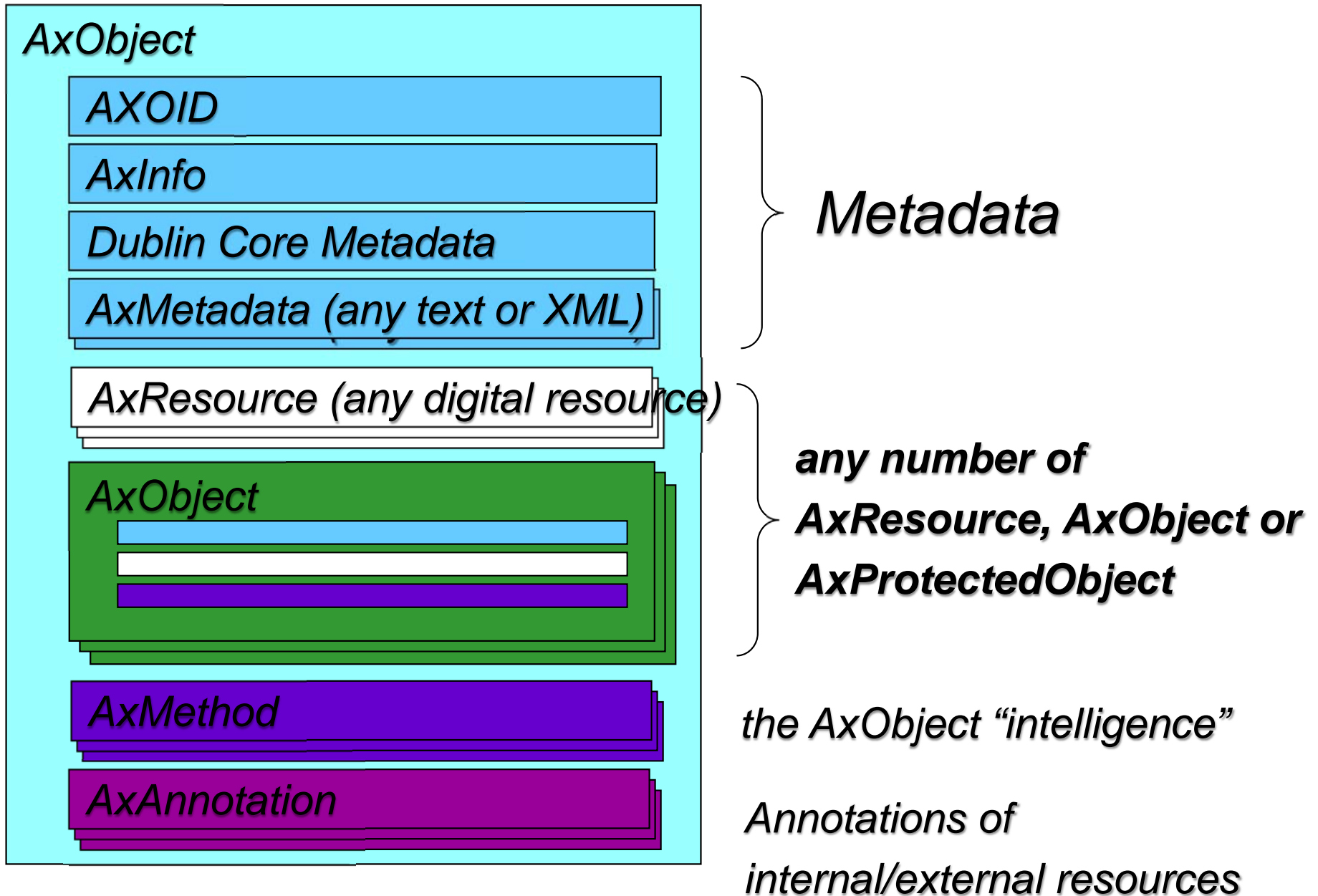
♦ Query and load AXMEDIS objects from the database

AXMEDIS Editor
Creators PCs

Workflow Manager

Query Support

| AXMEDIS Database | CMS Crawling | P2P Network |

DB   CMS

Internal AXMEDIS Server

State of the art

- ¿ **A number of standard formats:**
  - ♦ MPEG-21, MPEG-4, SCORM, HTML, MXF, MHP, NewsML, etc.
- ¿ **A number of proprietary industrial formats**
  - ♦ Adobe Flash, MS Silverlight
- ¿ **A number of presentation formats**
  - ♦ HTML+CSS, SMIL, SVG, MPEG-4 BIFS and LASER, etc.
- ¿ **A number of R&D formats:**
  - ♦ ACEMEDIA, X-MEDIA, AXMEDIS, SALERO, ICONS, etc…
- ¿ **…**

¿ **MPEG-21 ISO/IEC Standard**

- ◆ Supports most of the Intelligent Content Model requirements

- ◆ However it is not clearly defined how to present the Digital Items to the user

- ◆ DIP/DIM (Digital Item Processing, Digital Item Methods)

  - ➔ Defines how "intelligence" is put in a Digital Item

  - ➔ But it is not defined how to invoke from the presentation content the Digital Item Methods

- ¿ **Constrains a MPEG-21 Digital Item with**
  - ♦ A specific Digital Item structure (AXMEDIS Object)
  - ♦ A specific B2B metadata and basic Dublin Core metadata
  - ♦ A specific protection structure
  - ♦ A specific authorization protocol

- ¿ **Defines how presentation information (HTML, SMIL) can use raw content (images, audio, video, text)**

- ¿ **Defines an extension of DIM (AxMethods) supporting:**
  - ♦ Access to external data sources (http, ftp, odbc, web services, …)
  - ♦ Extensible content manipulation (plugins for media transcoding)
  - ♦ AXMEDIS Content creation

- ¿ **Defines how to invoke an AxMethod from presentation resources HTML, SMIL, Flash**

AxObject

AXOID

AxInfo

Dublin Core Metadata

AxMetadata (any text or XML)

Metadata

AxResource (any digital resource)

AxObject

any number of
AxResource, AxObject or
AxProtectedObject

AxMethod

the AxObject "intelligence"

AxAnnotation

Annotations of
internal/external resources

Problematiche

- Presenza di un presentation layer con HTML, o SMIL o che altro che deve poter acceder a risorse specifiche anche se annidate

- Presenza di metodi che possono modificare l'oggetto, I metadati, le risorse solo nel rispetto delle licenze che l'utente ha per quell'oggetto

- Annotazioni che possono voler identificare il singolo oggetto o anche elemento di (gatto dentro l'immagine, nel frame al time stampa 14:14:15 del video)

- Sviluppo di DIM (metodi) che possono fare accesso in modo programmatico

AxMethods

- ¿ **Extension of Digital Item Methods**
- ¿ **JavaScript based language**
- ¿ **Extension of AXMEDIS Content Processing Language**

```
function index() {
    var c=axDocument.getContent()
    var html="<html><body>"
    foreach(r in c) {
        if(c[r] instanceof AxResource)
            html+="<a href=\"
"+c[r].localPath+"\">Resource</a><br>"
    }
    html+="</body></html>"
    var axr=new AxResource
    axr.loadFromString(html, "index.html")
    axDocument.addContent(axr);
    DIP.play(axr, true);
}
```

URL to locate an AxResource

- **axmedis://**_<axoid>_**/**_<localpath>_
- **axmedis://**_<axoid>_**/**_<subaxoid>_**/**_<localpath>_

URL to locate an AxMethod

- **axmedis://**_<axoid>_**/axmethod/**_<method name>_**( )**
- **axmedis://**_<axoid>_**/**_<subaxoid>_**/axmethod/**_<method name>_**( )**

axmedis://axoid1/index.html

… href="axoid2/index.html" …

… href="axoid3/index.html"

axoid1

index.html

axoid2

index.html

axoid3

index.html
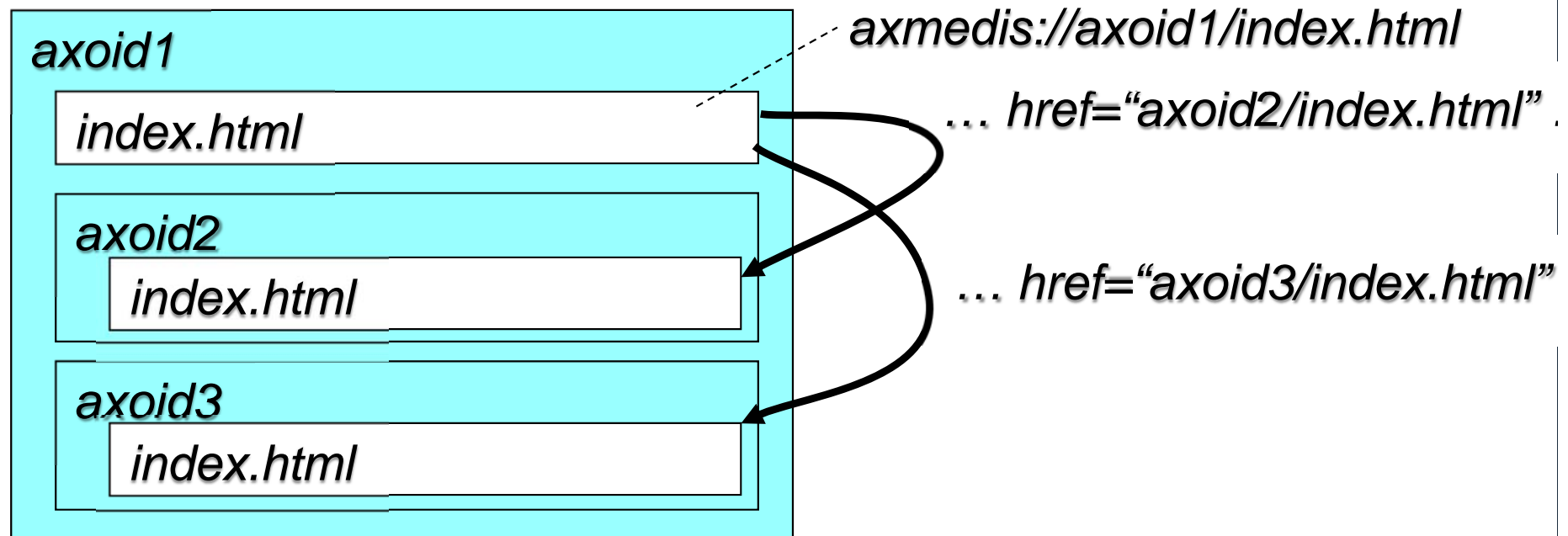
Using links (HTML, SMIL & Flash)

- ◆ e.g. `<a href="axmethod/send()">Send</a>`

Using an HTML Form in a AxResource

```
<form method="GET" action="axmethod/find()">

…

<input name="search">

…

</form>
```

■ *The AxMethod relative URL*

The AxMethod can get the data submitted in the form using the variable URL_QUERY_ARRAY:

```
function find() {

    var s=URL_QUERY_ARRAY["search"]

    …

}
```

Example

AXMEDIS player with annotations
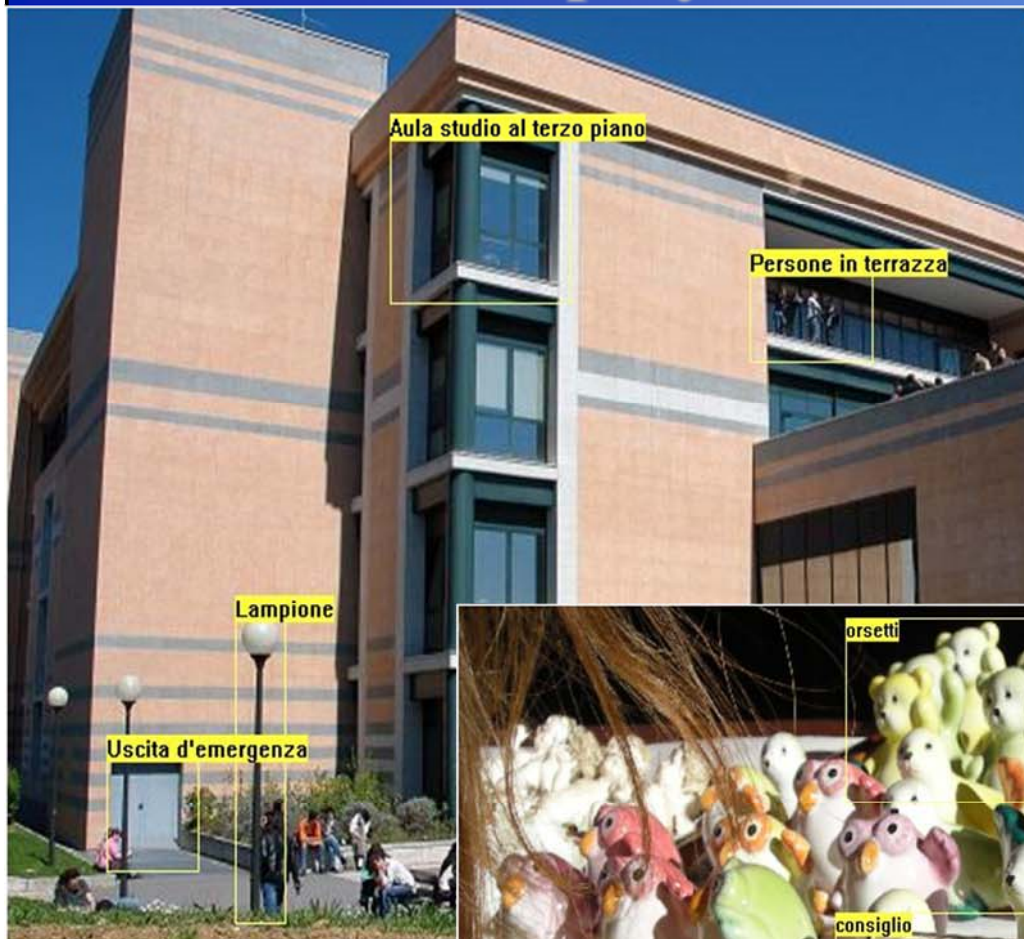
¿ **AxAnnotation element uses MPEG21 DIDLAnnotation element**

target (the resource annotated)

AxAnnotation

> *AxMetadata*

AxAnchor

> *AxMetadata*

FragmentId (URI to a resource part)

mp(~region(rect(100,2,200,123)))
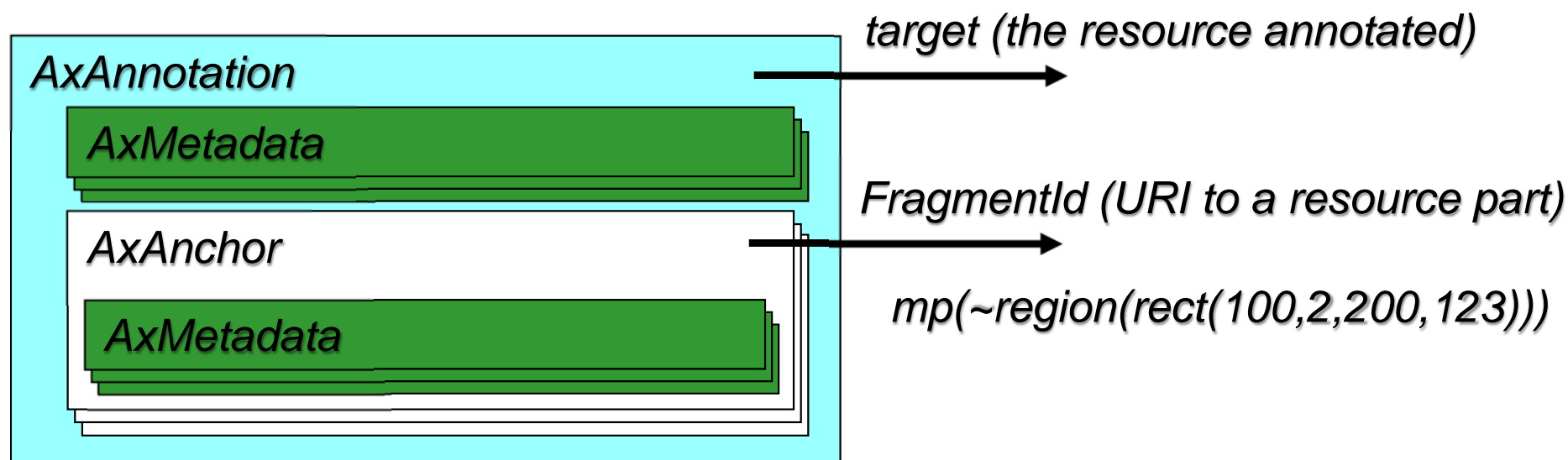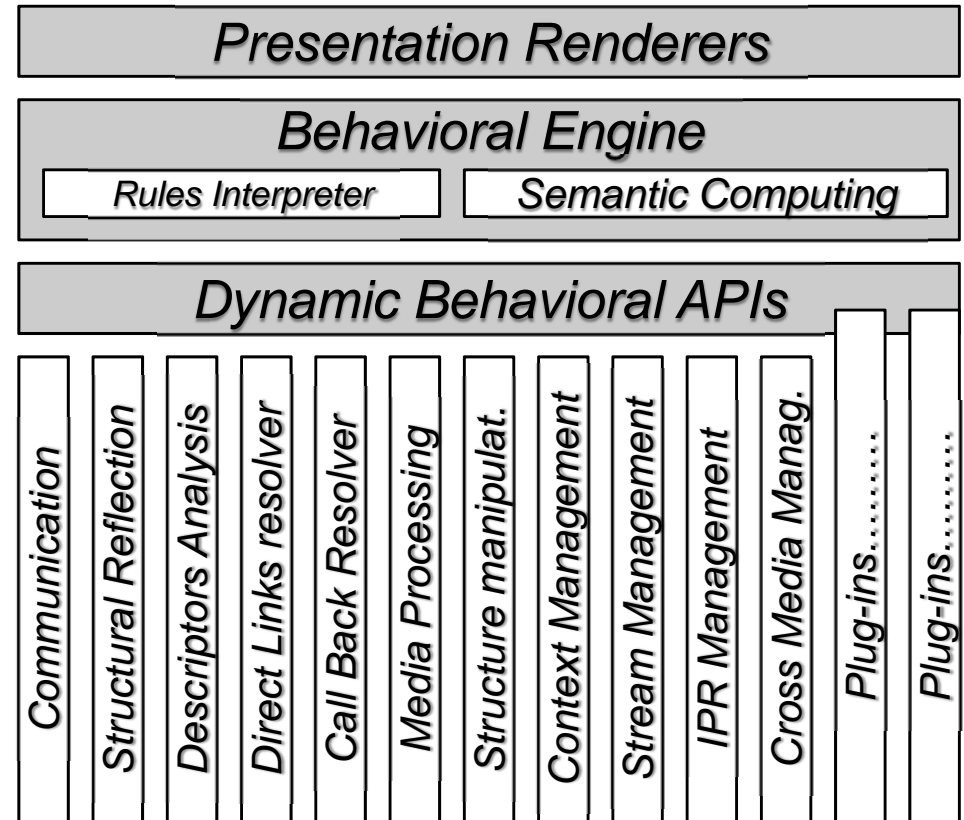
¿ **An annotation can be saved internally or externally (in another AxObject) allowing to annotate also protected content**

Different relationships and player architecture
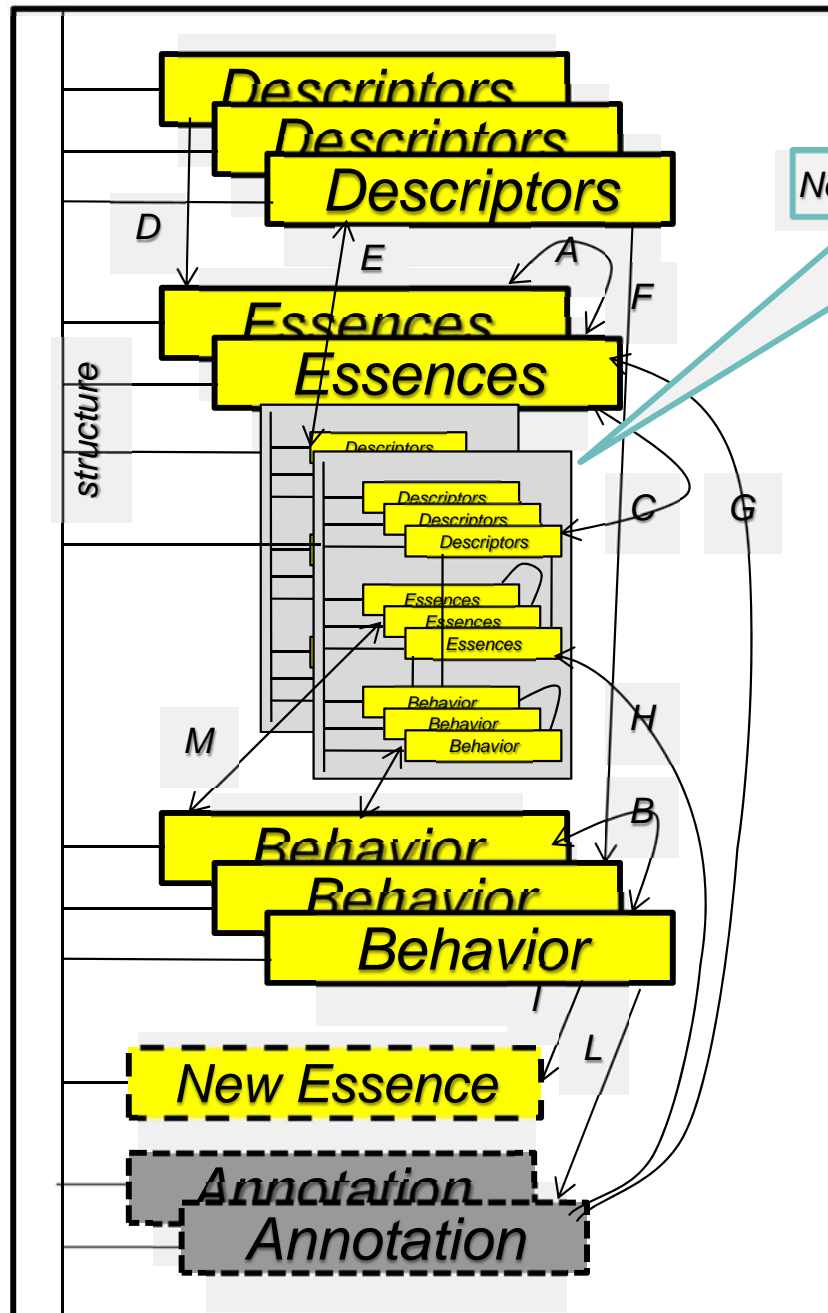
AXMEDIS Client Tools

¿ **AXMEDIS clients tools**

- ◆ Based on AXOM module plus a set of players
  - ➔ Audio player
  - ➔ Video player
  - ➔ Document viewer
  - ➔ Image viewer
  - ➔ Etc.
- ◆ Different devices:
  - ➔ PC player, PDA player, etc.
- ◆ AXMEDIS Plug ins:
  - ➔ Active X for integration with IE, Authorware, Tool Book, etc.
  - ➔ For Mozilla
- ◆ Possible integration of AXMEDIS AXOM in any player

Interoperability among devices

- ¿ **interoperability among devices, e.g., getting**
  - ♦ a video for the TV and reproducing it on mobiles, PC, etc.
  - ♦ an MP3 audio track and using as ringtone in the phone, reproducing it on the car stereo, or in the living room, passing to a friend.
  - ♦ a guide in a museum for his mobile/PDA, using there, and passing and playing it at home on the TV set and/or on the PC
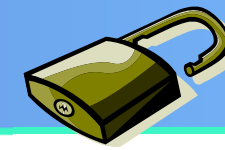 - ♦ Making annotations on a video and pass to a friend, …
  - ♦ ....

- ¿ **Buy once to use on all**
  - ♦ According to the business model
  - ♦ Via different DRM models and tools

Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
- ¿ Definizioni
    - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- ¿ Architettura AXMEDIS overview
- ¿ Package MPEG-21 e AXMEDIS
    - ♣ AXMEDIS, NewsML, MXF
    - ♣ Intelligent content, Behavior e annotazioni
- ¿ Player AXMEDIS e DirectX
- ¿ Aspetti di DRM avanzati
- ¿ AXMEDIS Major Tools
    - ♣ AXMEDIS player multipiattaforma
- ¿ Content Production and workflow
- ¿ Distribuzione dei contenuti
    - ♣ Controlled P2P content Distribution
    - ♣ Content Distribution via Kiosks
    - ♣ Satellite broadcasting, Terrestrial Broadcasting
    - ♣ Cultural Heritage content distribution
    - ♣ Interoperabilita nel Backoffice
    - ♣ Integrazione con Portale di distribuzione
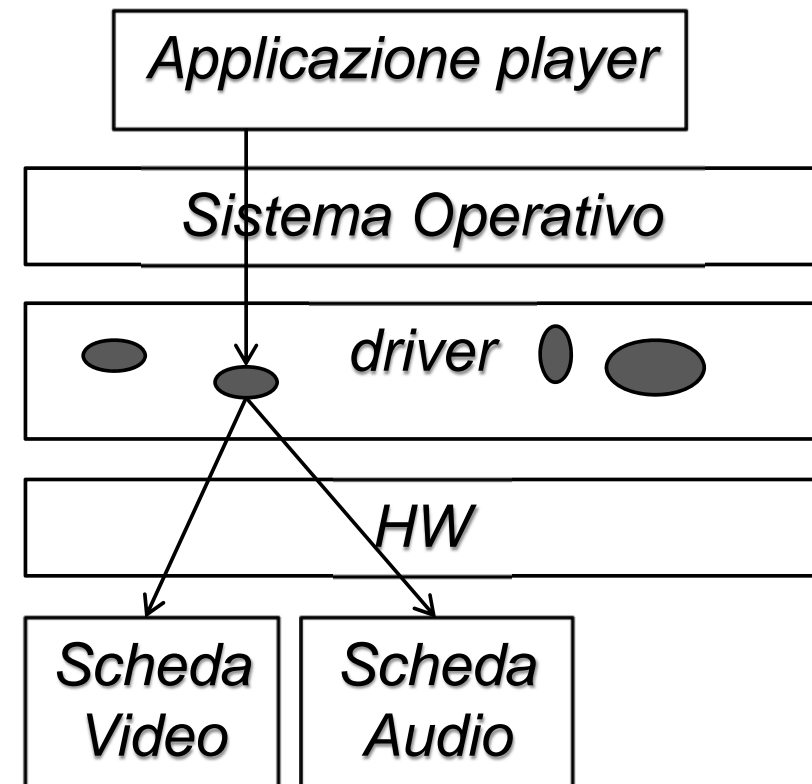- ¿ DRM Reciprocal Trust via P2P

¿ **To allow exploiting the digital content functionalities (rights) in a controlled manner**

- ♦ To who has been registered the first time and continuously: **authenticated and certified**

- ♦ To do what is defined in a **license** (to allow exploiting the rights)

- ♦ By using technologies to **protect content** (e.g., encryption, fingerprint, watermark, etc.)

- ♦ **Verifying/Control/Supervise** if the above conditions and others are respected

Execution of commands

Data access
Resource streaming

- *add, delete, …*
- *change resource*
- *edit metadata*
- *save, upload on DB*

DRM

Object

Metadata
Metadata

clone

stream

prot. info

authorization

Object

Metadata
Metadata

Resource
Resource
Resource

AXOM

load   *save*

Protected
Object

Metadata
Metadata

Resource
Resource
Resource

- **Trusted manipulation**
- **DRM enforcement**
- **On-the-fly un-protection**

Problematiche

- ♦ Il player passa al sistema operativo uno stream audiovideo in chiaro (descripted) per il play su scheda audio e video

- ♦ Il sistema operativo potrebbe avere dei driver installati che catturano lo stream in chiaro e lo copiano da qualche parte, violando la sicurezza

- ♦ Il player deve verficare che gli elementi del SO siano certificati e quelli giusti!!

Applicazione player

Sistema Operativo

driver

HW

Scheda Video
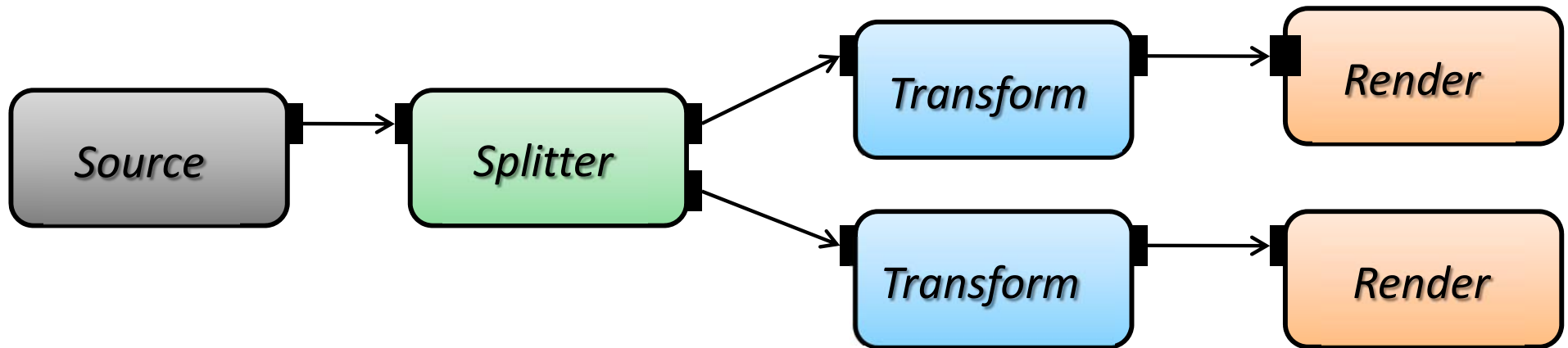
Scheda Audio

Microsoft DirectShow, direct X

- **Basato sul concetto di Filtro.**

- **Isolamento dell'applicazione dall'Hardware a disposizione.**

- **Supporto ad un gran numero di formati e possibilità di estensione.**
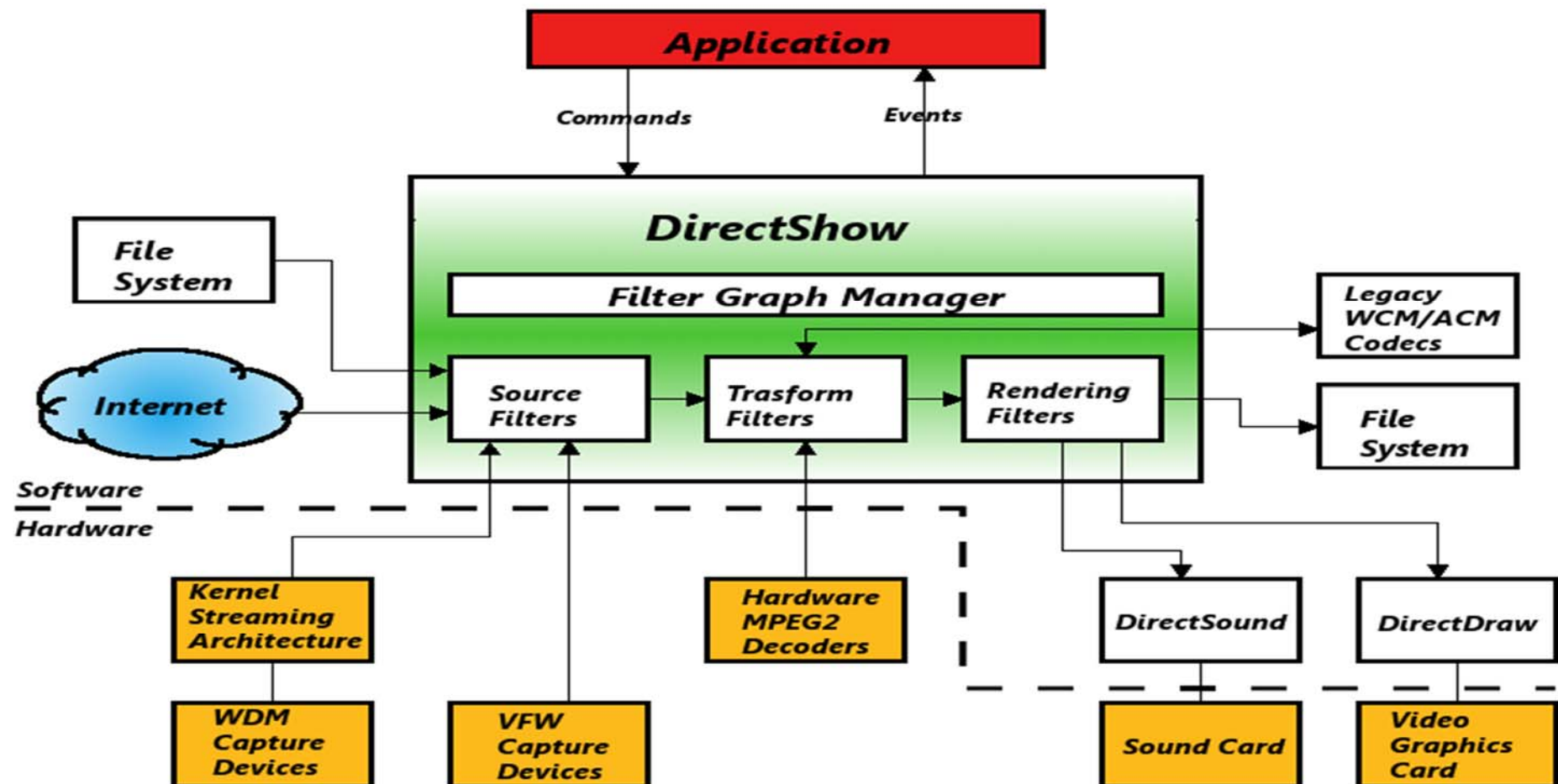
- *Categoria di appartenenza (Source, Splitter, Transform, Mux e Render).*

- *Identificazione: GUID. Istanziato tramite CLSID.*

- *Numero di Pin variabile.*

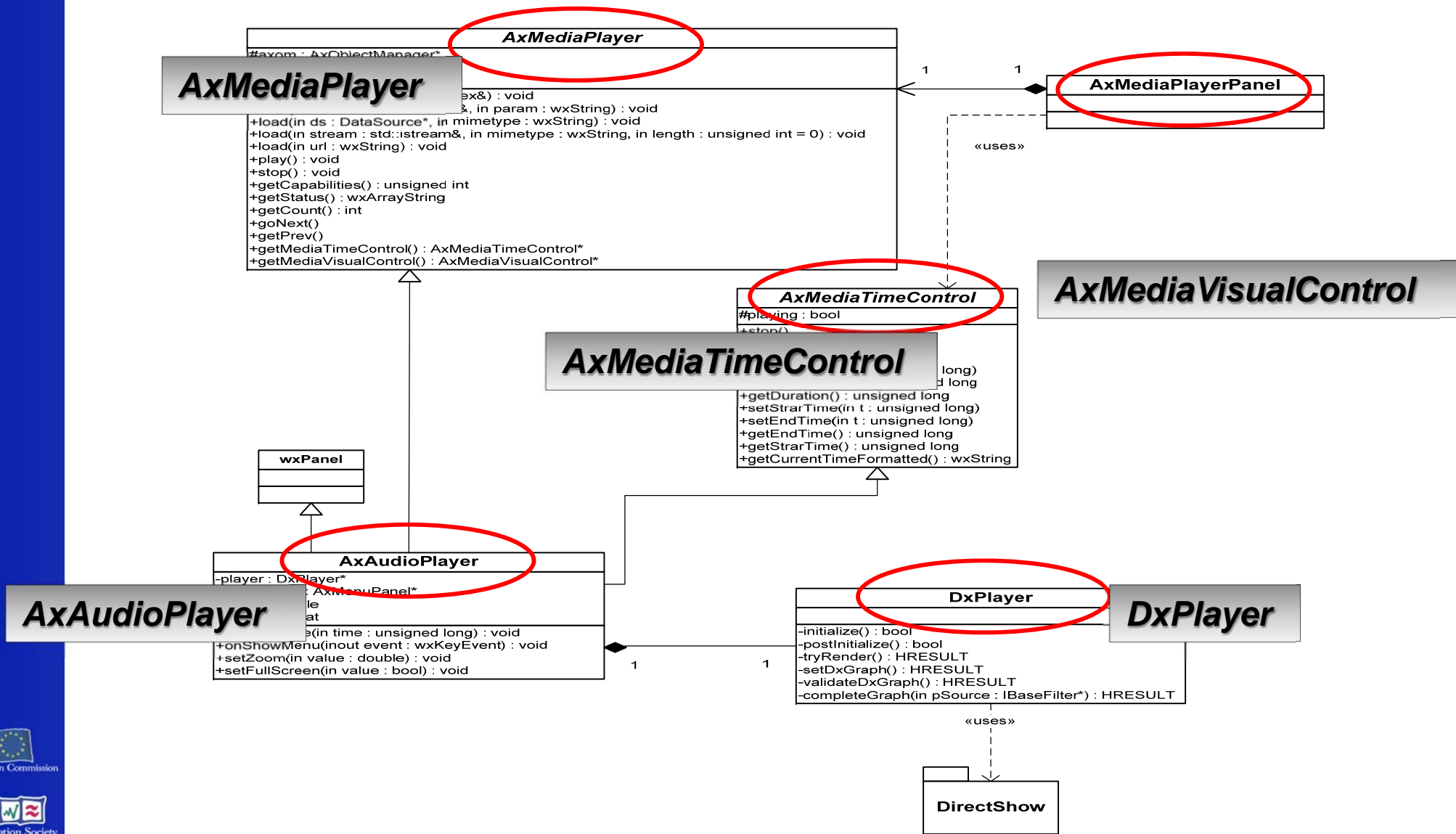- *Descrittore formati supportati: MediaType.*

Filtro

Input Pin

Output Pin

Requisiti di Sicurezza

- **Verifica dei filtri DirectShow**
- **Utilizzo dei DRM e costruzione _controllata_ dei Grafi**

```
Source → Splitter → Transform → Render
                  → Transform → Render
```

- **Fingerprint del filtro attraverso una funzione di Hash**

AE234FWS3432424DFSA

DirectShow Interface

DxGraphFactory

DxGraphControl

DxAudioGraph

DxVideoGraph

IBasicVideo2

IMediaDet

IVideoWindow

IMediaControl

IMediaSeeking

IGraphBuilder

DxPlayer

-initialize() : bool
-postInitialize() : bool
-tryRender() : HRESULT
-setDxGraph() : HRESULT
-validateDxGraph() : HRESULT
-completeGraph(in pSource : IBaseFilter*) : HRESULT

DxGraphFactory

DxFilterControl ◁ DxGraphControl

DxAudioGraph

#filterMap
#pSplitter : IBaseFilter*
#pAudio : IBaseFilter*
#pAudioRender : IBaseFilter*

+completeGraph(in pSource : IBaseFilter*) : HRESULT
#initializeMap() : void
#initialiaze() : HRESULT
#connect(in a : IBaseFilter*, in b : IBaseFilter*) : HRESULT
#convertCLSID() : HRESULT
#checkMediaType() : HRESULT
#getOutputPin(in pFilter : IBaseFilter*, in i : int) : IPin*
#getInputPin(in pFilter : IBaseFilter*, in i : int) : IPin*

DxVideoGraph

#pVideo : IBaseFilter*
#pVideoRender : IBaseFilter*

+completeGraph(in pSource : IBaseFilter*) : HRESULT

DxMp4Graph

DxFlvGraph

DxAviGraph

DxWmvGraph

DxMpegGraph

DxMp3Graph

DxWavGraph

DxWmaGraph

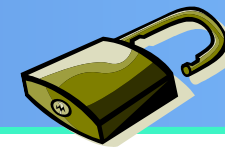# Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
- ¿ Definizioni
  - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- ¿ Architettura AXMEDIS overview
- ¿ Package MPEG-21 e AXMEDIS
  - ♣ AXMEDIS, NewsML, MXF
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  - ♣ Content Distribution via Kiosks
  - ♣ Satellite broadcasting, Terrestrial Broadcasting
  - ♣ Cultural Heritage content distribution
  - ♣ Interoperabilita nel Backoffice
  - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

- ¿ **Once obtained the content a license is needed to exploit the right you have acquired,**
  - ♦ or at least you need a server that verify that you are authorized to exploit some right and provide you the Authorization
- ¿ **Once you are Authorized to exploit the rights you may get a reference to**
  - ♦ the Protection Information to Unprotect the specific object segment and/or digital resources
- ¿ **License and Protection Information are typically located in external and remotely located Servers**
  - ♦ but may be cached on the terminal device if allowed by the license issuer
- ¿ **During all these phases the AXMEDIS Certifier and Supervisor verify integrity and certificate**

① Registration for Authentication

AXMEDIS or Distributor Registration Site

④⑤ Content Access

Any Distributor front end Server

⑤④ Business Transaction

Transaction front end Server

Installation

②

⑥ Usage

Control and Supervision

⑥

AXMEDIS Protection Manager

③ Tool Certification

AXMEDIS Compliant Players

AXMEDIS Certifier and Supervisor
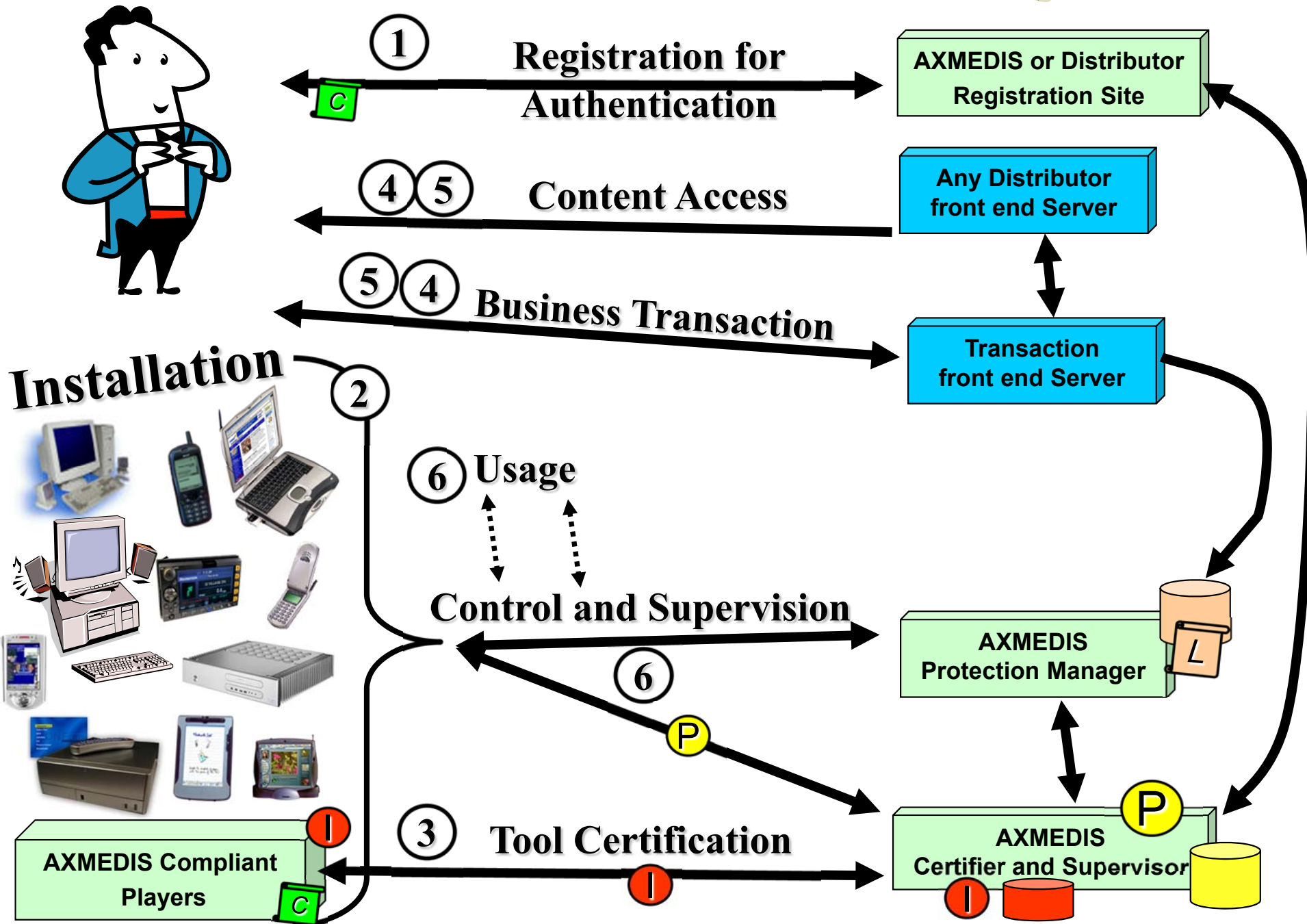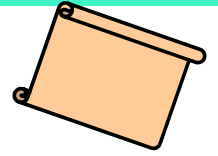
¿ **License:**

- ◆ digital version of the contract
- ◆ contains the list of acquired rights
- ◆ may be signed by clicking
- ◆ supported by a way to demonstrate its authenticity
- ◆ can be stored in the digital object or not
  - ➜ If not, may in the terminal or remotely located
- ◆ may refer to other licenses, creating a chain of licenses for the evaluation of each given grant associated to a right
- ◆ formalized in some language
  - ➜ Refer to some dictionary for terms that define the semantics of the expressions of the language
- ◆ may be revoked
- ◆ Etc.

Managing License Chain, B2B and B2C
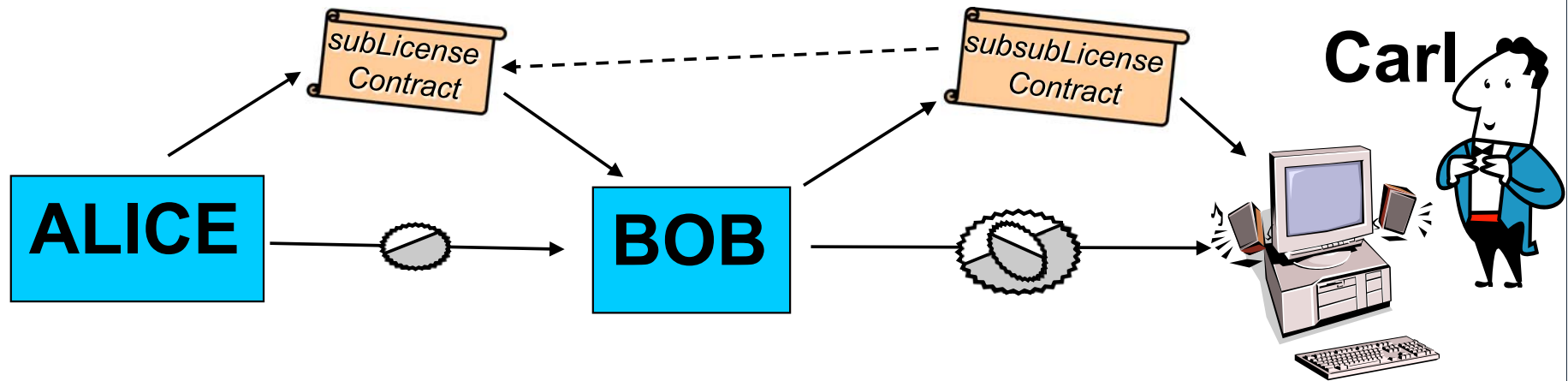
- ¿ **Alice states**, *"Bob has the right to issue a license to anyone to print the book in Italy"*

- ¿ **Bob states**, *"Carl has the right to print the book in Italy"*

- ¿ **To solve the SubSubLicense for Carl all the connected Licenses are needed**

- ¿ **Licenses have to be accessible on Processing Engine**

- ¿ **Alice can revoke the license to Bob**

Cross media content and composition

¿ **AXMEDIS objects can be used as components for creating other added values AXMEDIS objects**

- Allowing the production added value object for composition or integration of protected content
  - Who is composing can add its own protection and licensing
- Allowing the Rights Management Of Composition, in the digital world similarly at what is performed in the physical world
- The shares along the value chain are de facto formalized

k4 k3 k1

IPMP management

Splitter

Transform *Transform*

Scheda Video *Scheda Audio*
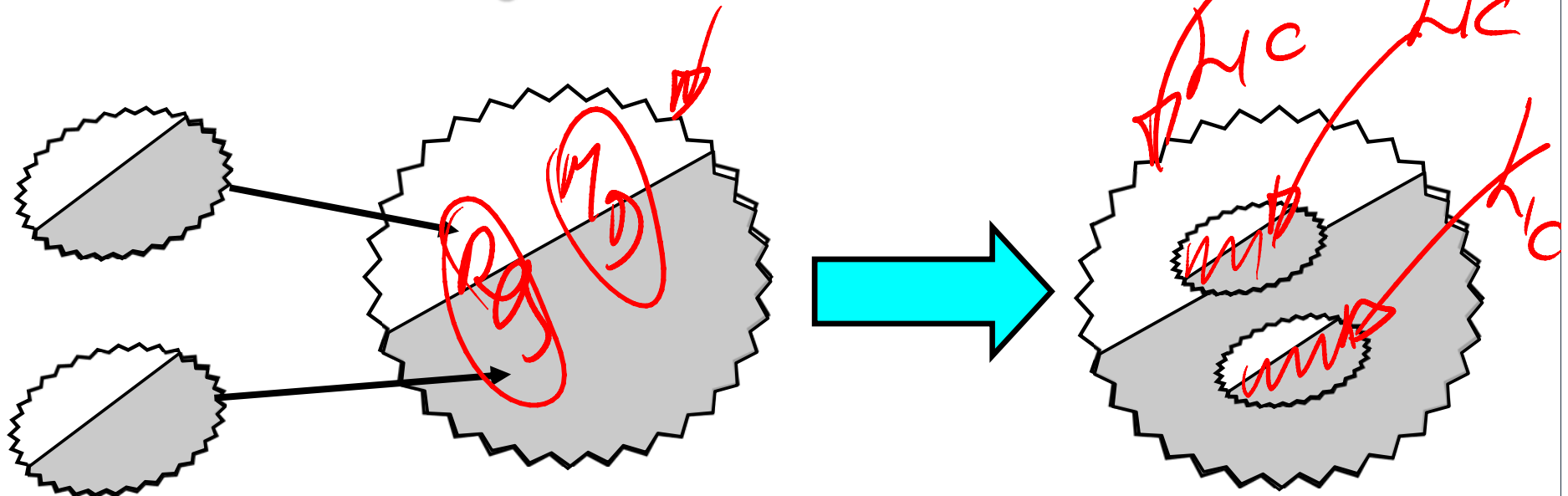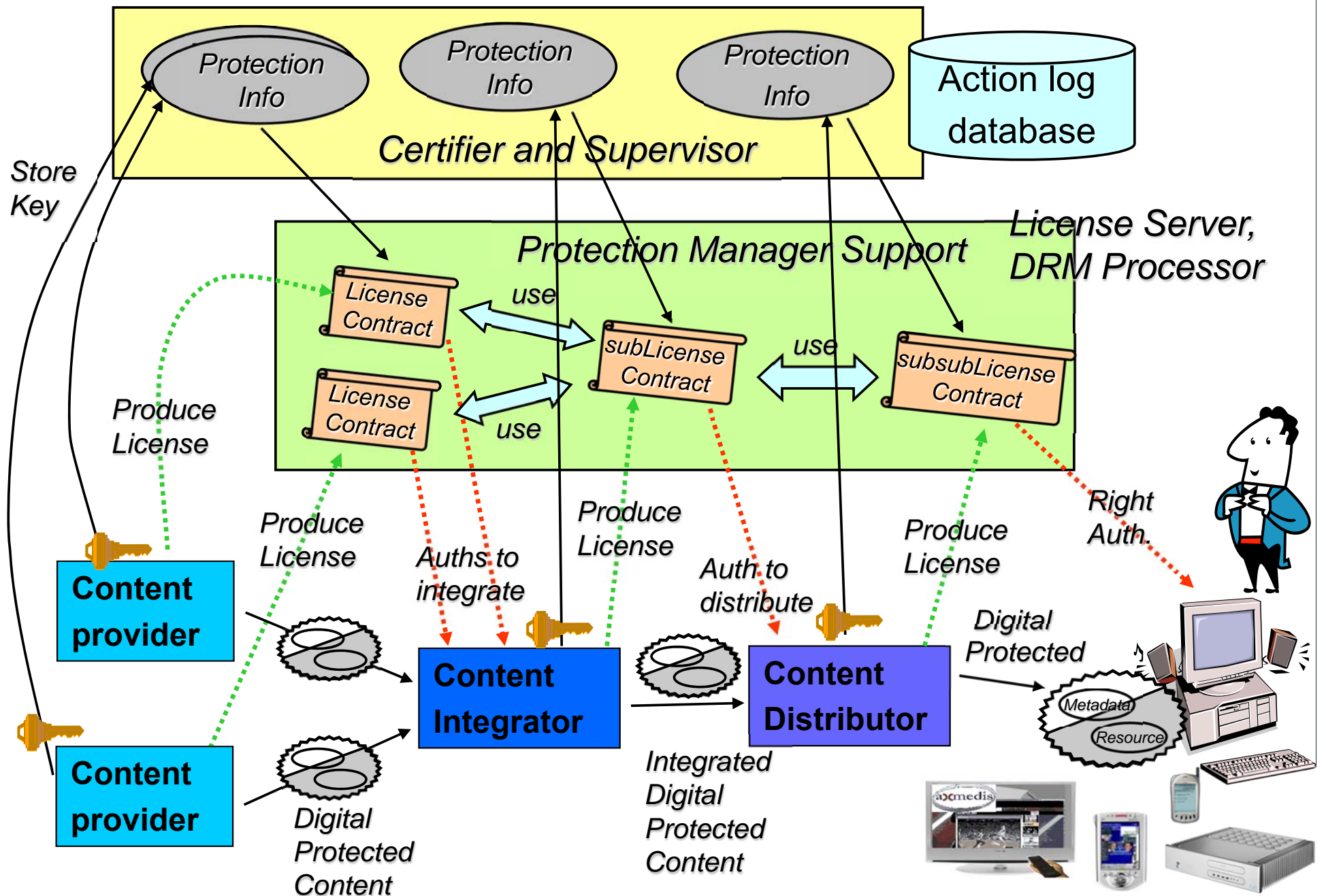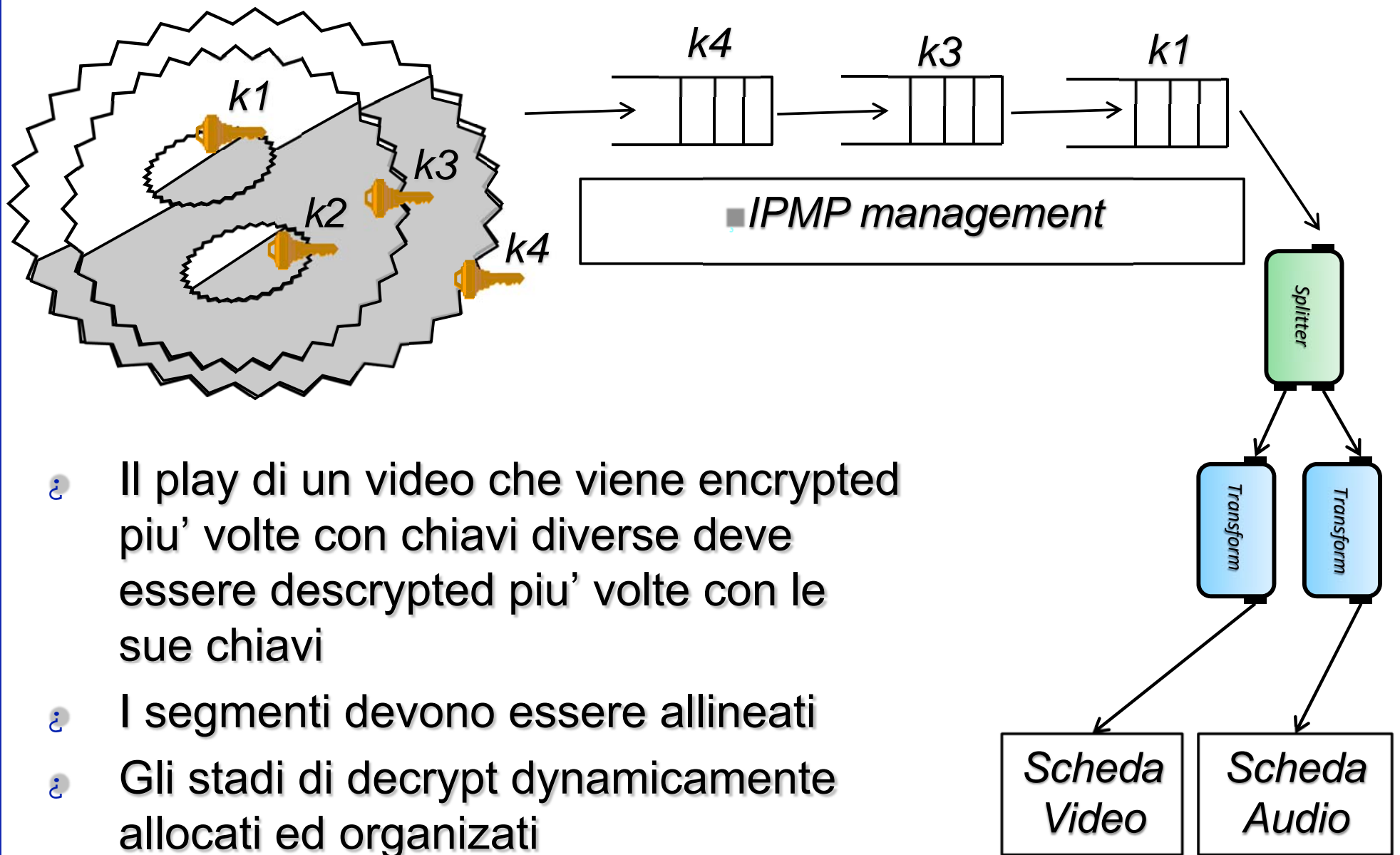
¿ Il play di un video che viene encrypted piu' volte con chiavi diverse deve essere descrypted piu' volte con le sue chiavi

¿ I segmenti devono essere allineati

¿ Gli stadi di decrypt dynamicamente allocati ed organizati

Make easier the B2B market of digital content

- **PAR: Potentially Available Rights into AXMEDIS objects**
- **The PAR can be used to make queries**
    - ♦ PARs based content trading, Customers may know directly which rights they could buy and by who
    - ♦ PARs may be used to harmonize and automate B2B and B2C

PAR

Content Producers

Content Integrators

Collecting Societies

Distributors

Distributors

axmedis
P2P B2B network

■ *Controlled P2P network*
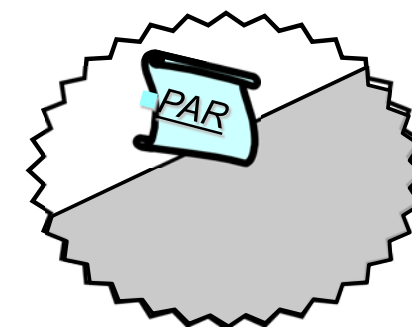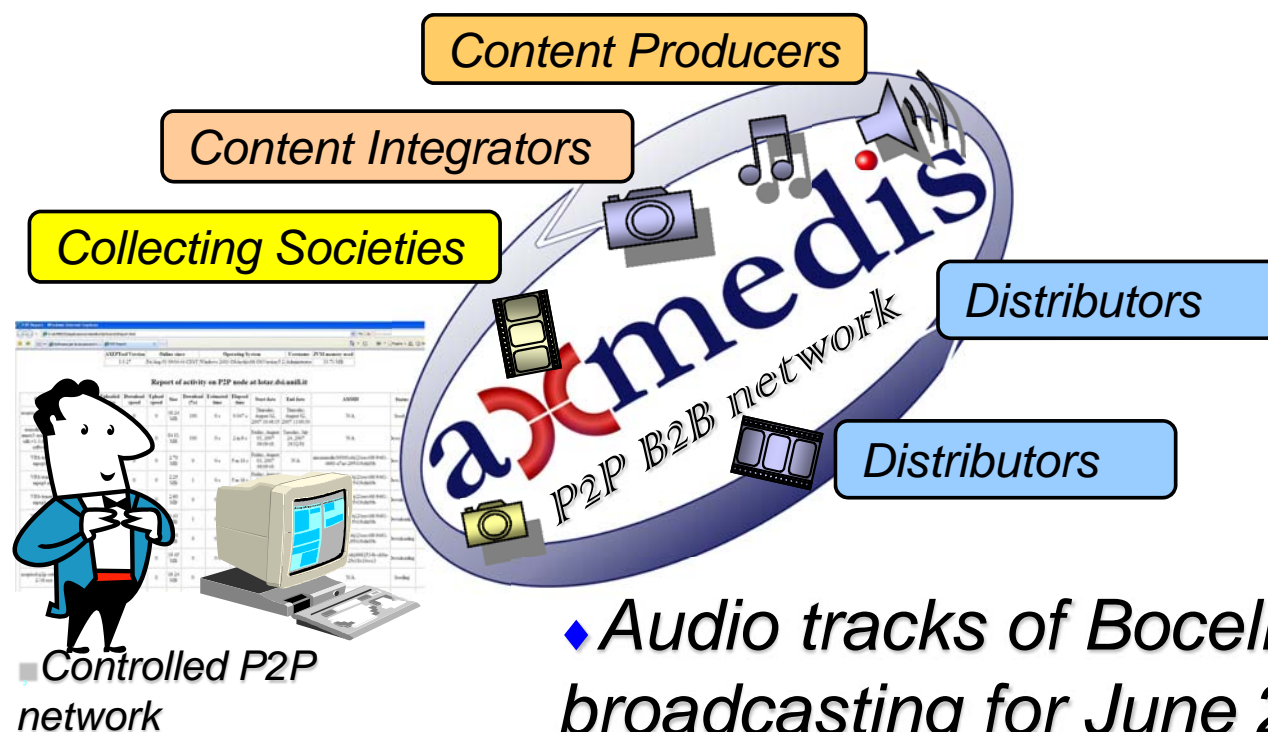
♦ *Audio tracks of Bocelli for Audio broadcasting for June 2008 in Germany?*

A Distributor

Requesting license Production (WS):

--Distributor ID
--Object ID
--User ID
--Rights

AXMEDIS
License Editor

AXCP

AXMEDIS
Protection Tool

Protected Object:
Post ProtInfo
(WS)

post license
(WS)

L

L

P

P

AXMEDIS
Protection Manager

AXMEDIS
Certifier and Supervisor

P

L
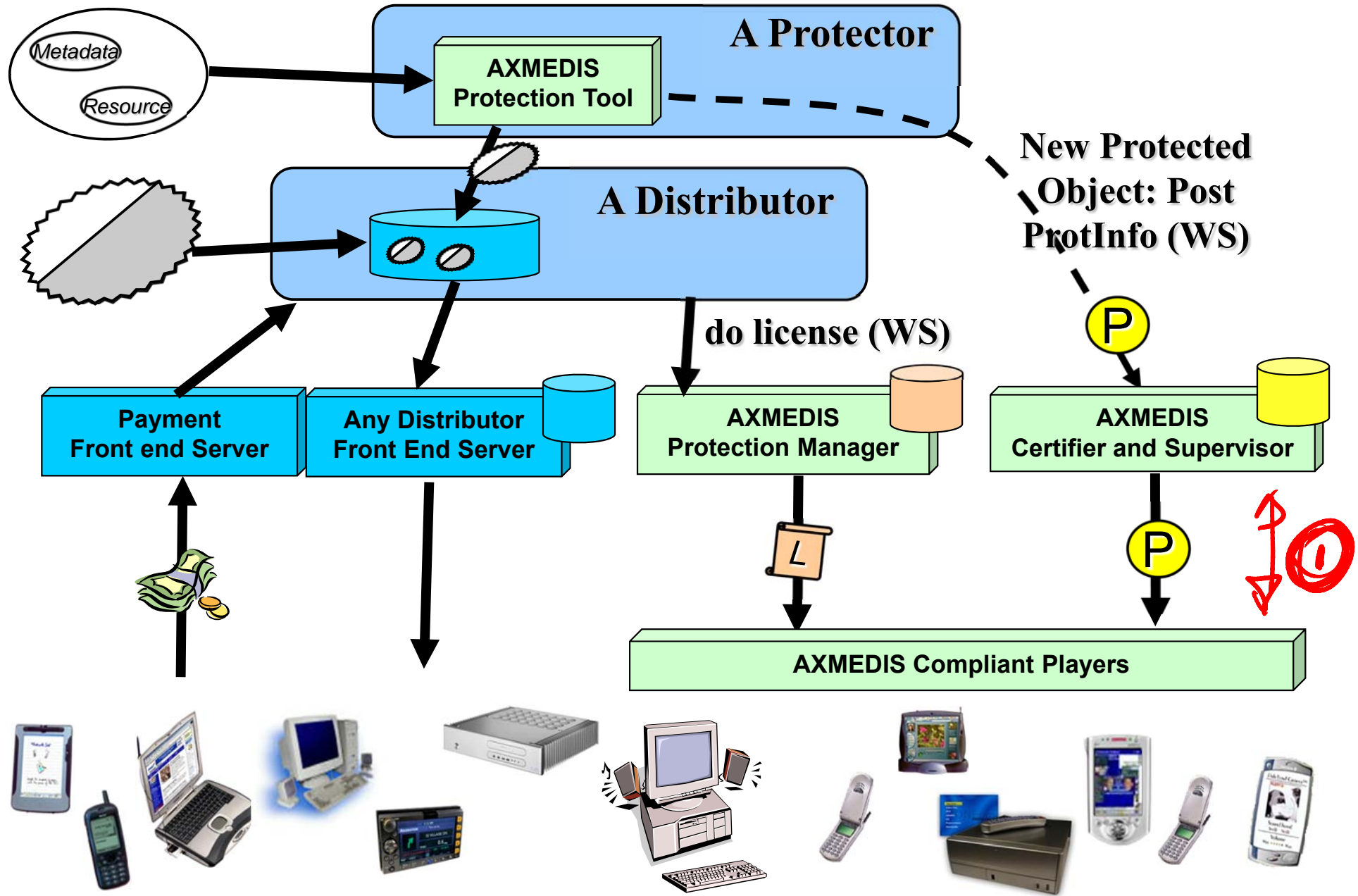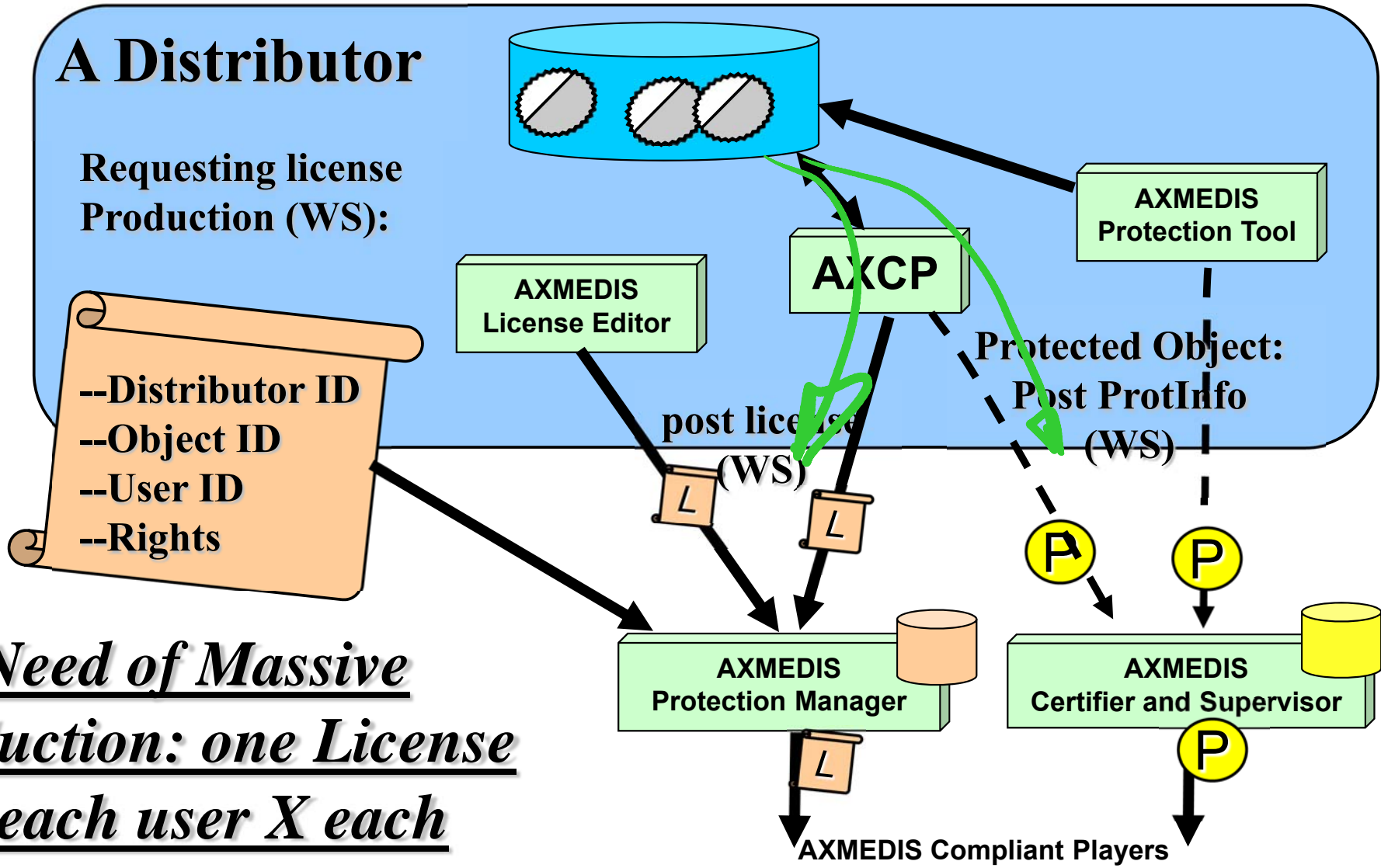
Need of Massive Production: one License X each user X each resource

AXMEDIS Compliant Players

¿ **Users are strongly interested in acquiring a content to be used in their domain in which they have their**

- ♦ Home devices, cars, mobiles, etc.

¿ **Media Centers and/or Home Servers are going to manage content and licenses for the whole domain**

- ♦ One license for all devices and people

ADSL

Licenses

Domain Server

Control and Supervision

AXMEDIS Protection Manager

AXMEDIS Certifier and Supervisor

AXMEDIS Certification Authority

AXMEDIS Compliant Players
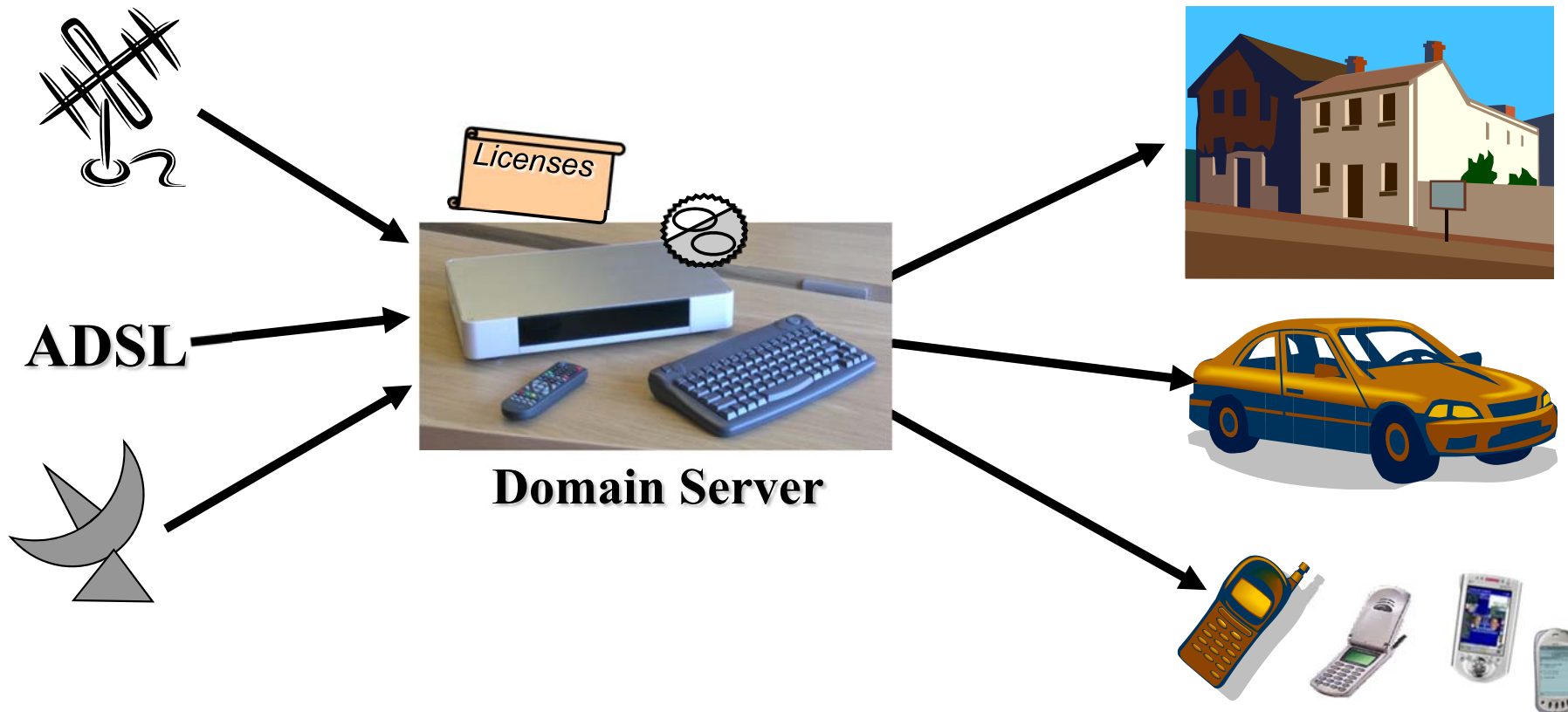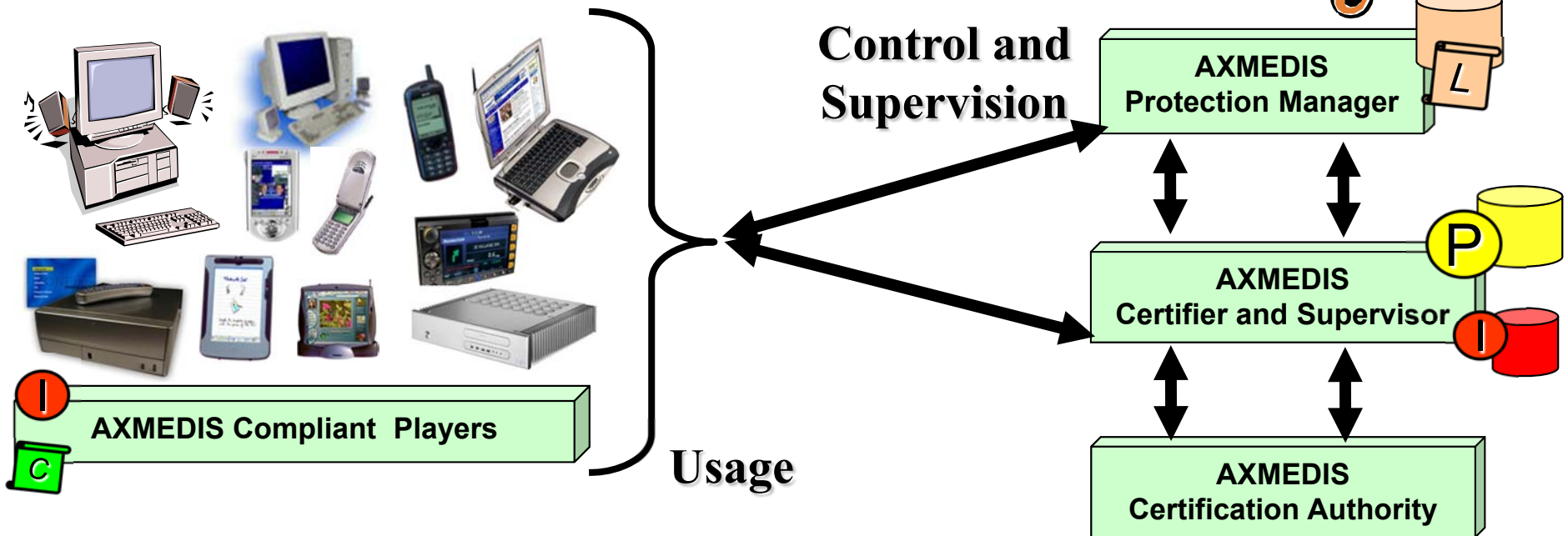
Usage

¿ **Performed by the: AXCS and AXMEDIS PMS**

¿ **Continuously verify and certify the trusting level of the Tool/Device/Terminal and of the User**

¿ **Collect Action Logs (event logs) related to rights exploitation and thus to License usage**

¿ **Allow the implementation of black lists for Users, Tools, Devices/Terminals, Licenses**

Tracking and monitoring Exploitation of Rights

- ¿ **REL and Composition enforce flexibility in business and transaction models, multiple models for the same channel**
  - ◆ Pay per play, all you can eat, subscription, etc. etc.
- ¿ **Different reports and statistics for different roles**
  - ◆ Reports on licensing and on the consumption/exploitation of rights

Distribution of exploited objects Playing in March

- ¿ **Single traces, events, etc.**
- ¿ **Statistical data for reporting and analysis**
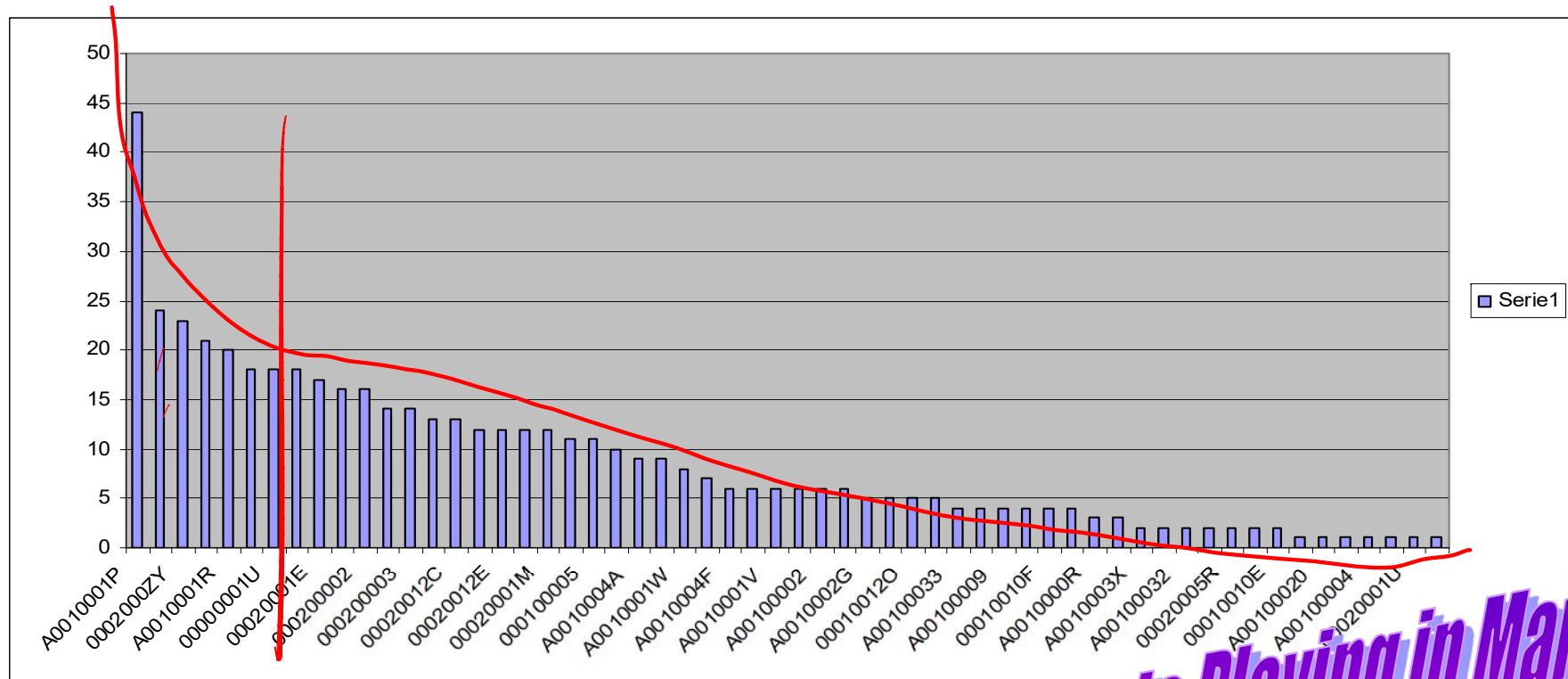
Distribution of exploited objects Playing in March
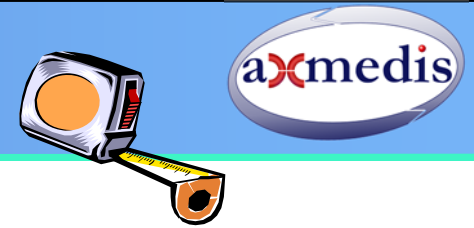
¿ **Collecting Events and Actions**

- ◆ Further reporting
- ◆ Further verification of consistency
- ◆ provide the evidence about the exploitation of rights to: content owners, producers, collecting societies, distributors, etc.
- ◆ provide the billing information to the final user
- ◆ provide the statistical information

¿ **Counting the usage, exploitation of rights**

- ◆ how many times a music piece has been played, how many print out have been produced, etc.
- ◆ Dynamic definition of price for example…

¿ **Extending MPEG-21 Event Reporting**

- ■ Specifies how to express ER-Request and Event Report and how they are represented as digital item

Business Models	**Larger number of Business Models**
B2C DRM	**B2B, B2C, B2B2C DRM solution**
Proprietary / Standard DRM and model	**Standard DRM: MPEG-21, OMA, etc.**
Non interoperable DRM	**Allowed Interoperable DRM: MPEG-21, OMA, etc.**
Fixed/Flexible Protection Model	**Any Protection Model, key, algorithms, etc.**
Separation among Content and license	**Separation among Content and license**
Signed Content Header	**Signed Content AXINFO, any Metadata**
Channel distribution	**Multichannel with the same license**
Players and Devices	**Players and Devices: PC MS-Windows, PDA Windows Mobile, STB, Linux OS, Apple MAC (in progress), Java Mobiles**
License Proprietary: number of rights	**Licenses MPEG-21 REL: Expandable dictionary, any type of rights, licenses OMA, domains**
Authentication of Player	**Authentication of device, user, domain, etc.**
Revocation per Player	**Revocation per device, user, etc,**
Revocation per license	**Revocation per license**
Source code non accessible	**Source Code Acessible**
Limited Metadata	**Any metadata, custom metdata, any ID, any Descriptor**
Media content, simple content, not intelligent	**Any digital format, of any type: audio, video, image, games, doc, and Cross media: SMIL, HTML, MPEG-4,… INTELLIGENT content**
Customizable Tools	**Customizable Tools: servers and player clients**

¿ **Advantages of B2B DRM**

- ♦ Automation of contract-based deals
- ♦ Assessing the Usage in the B2B
- ♦ Reducing costs of B2B promotion
- ♦ Allowing integration and composition of protected content
- ♦ Allowing content production on demand, no contracts signatures, immediate DRM processing
- ♦ Try and buy, try and use for business
- ♦ Free try for Business users
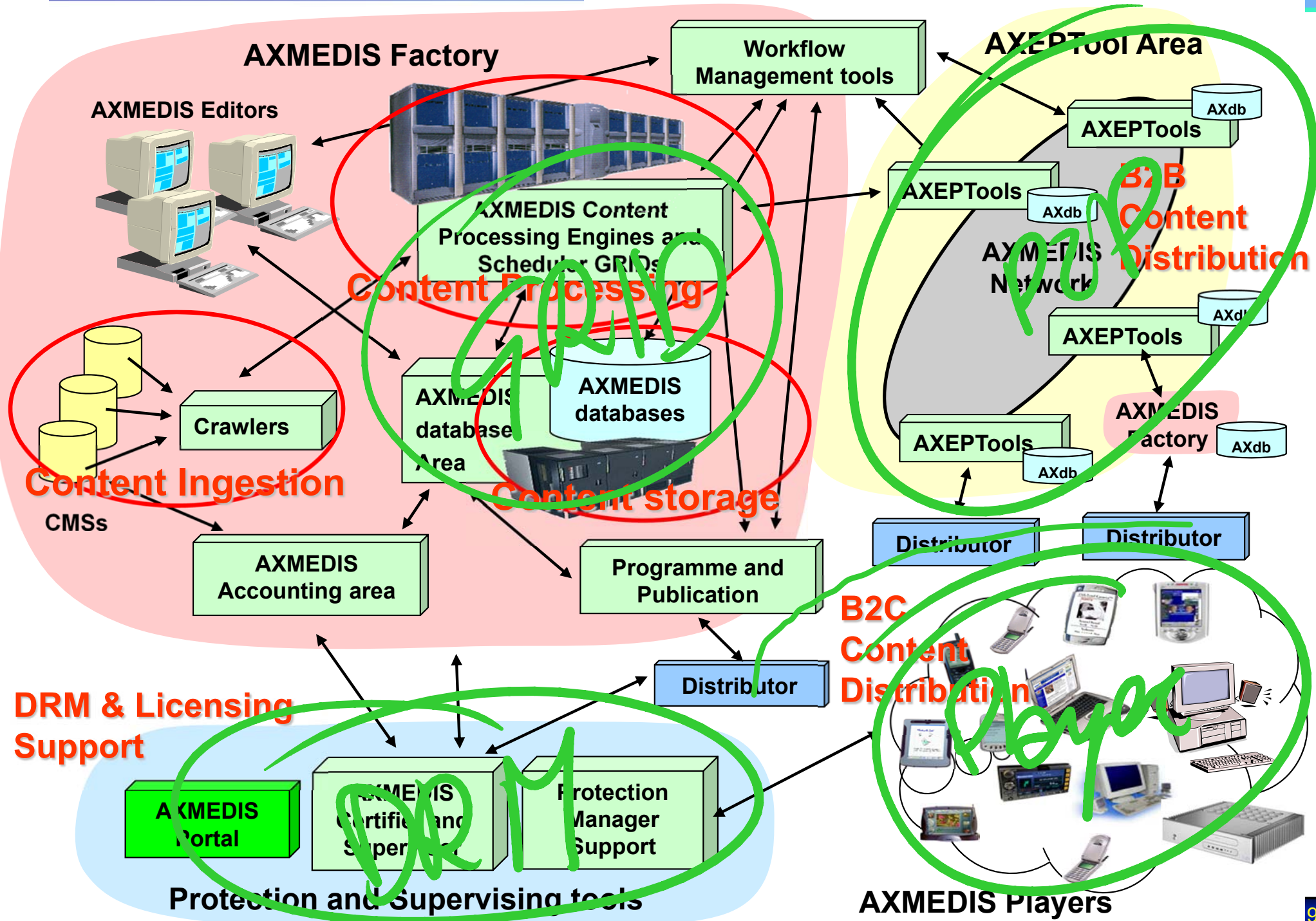- ♦ Increasing the control, decreasing the risk

Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
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  - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Major Tools

- **Players for cross media content:**
    - PC, PDA, STB, mobiles, etc.
- **Tools for DRM and protection**
- **Content Production tools**
    - Authoring tools for cross media content: AXMEDIS Editor
        - ➔ for content, protection and licenses
    - Automated production tools for content, protection packages and licenses: AXCP, Workflow
    - CMS: search and retrieval, automated connection with your own and/or third parties CMSs
- **Content Distribution**
    - P2P tools for B2B and C2C in a controlled and safe/legal manner: AXEPTool, AXMEDIA
    - User and tool Registration portals
    - Certification authority, AXCA
    - License Server and Certifier and Verificator, PMS/AXCS
    - Scheduling: Program and publication, Workflow, etc.
    - Distribution Portal
    - Content acquisition portal for end user production

AXMEDIS Architecture

AXMEDIS Factory

AXMEDIS Editors

AXMEDIS Content Processing Engines and Scheduler GRIDs

Content Processing

AXMEDIS database Area

AXMEDIS databases

Content storage

Content Ingestion

Crawlers

CMSs

AXMEDIS Accounting area

Programme and Publication

Workflow Management tools

AXEPTool Area

AXEPTools — AXdb

AXEPTools — AXdb

AXMEDIS Network

AXEPTools — AXdb

AXEPTools — AXdb

AXMEDIS Factory — AXdb

B2B Content Distribution

B2B

Distributor

Distributor

Distributor

B2C Content Distribution

DRM & Licensing Support

AXMEDIS Portal

AXMEDIS Certifier and Supervisor

Protection Manager Support

Protection and Supervising tools

AXMEDIS Players

(green handwritten annotations: GRID, P2P, Player, DRM)

99

¿ **AXMEDIS/MPEG-21 Model plus a set of players**

♦ Audio and video players: almost any format

♦ Document viewers: PDF, HTML, etc.

♦ Image viewers: any format

♦ Cross media: MPEG-4, SMIL player, HTML, etc…

♦ Etc.

¿ **AXMEDIS Metadata support**

♦ AXInfo, Dublin Core, etc.

♦ Any descriptors, etc.

¿ **Possible integration AXMEDIS AXOM core module in any player**

♦ The access to the AXMEDIS Framework allows you to create in short time your customized AXMEDIS compatible player in many platforms based on AXOM:

➔ Windows

➔ Linux

➔ PDA, Windows Mobile 5

➔ Etc.

Any content inside a package:

- **Mix of: HTML, SMIL, MPEG-4, video, audio, text, Documents, images, actions, games, animations, etc.**
- Additional content and interactivity for the end users
- compliant and extending MPEG-21

AXMEDIS Intelligent content allow user/producers to

- create content for other devices: ringtones, mobiles, …
- support social activity
  - annotations
  - user generated content
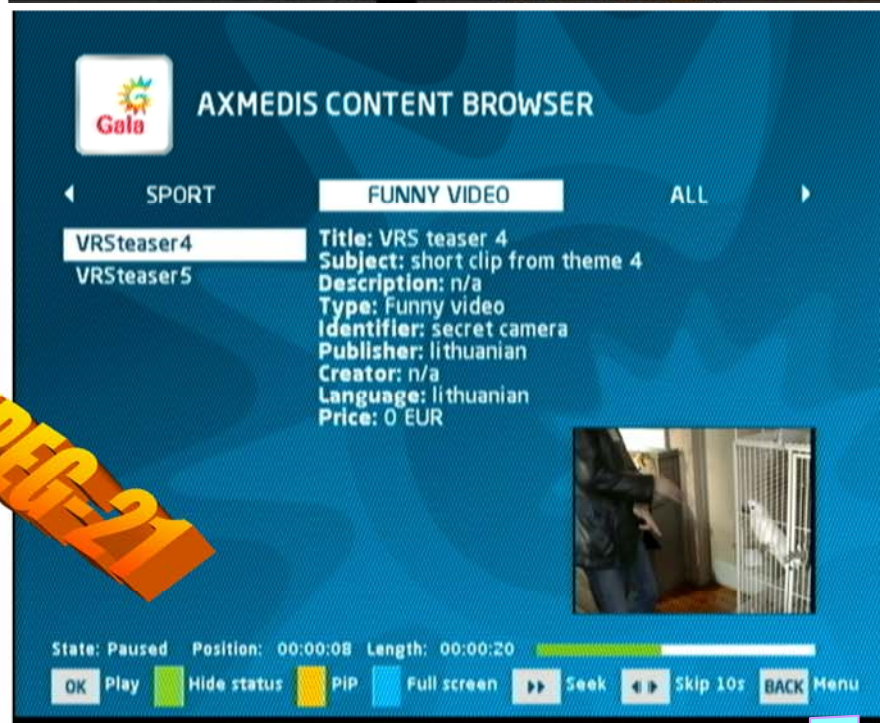 - personal collections
- internal query
- customized for culture and language
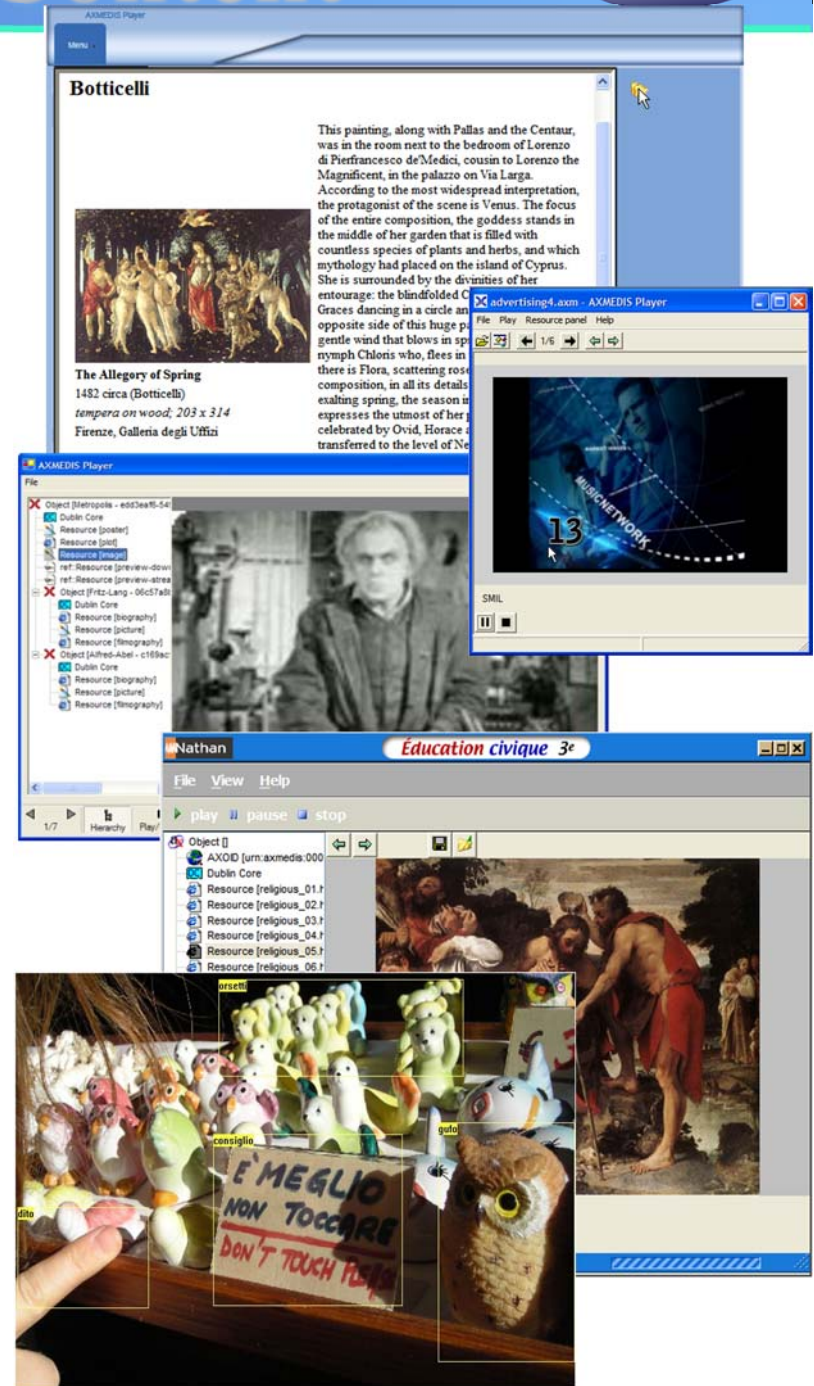
Custom MM Players

- **Multimedia Players**
- **Customizable for**
  - ◆ Skin, multiple
  - ◆ Functionalities
  - ◆ Formats
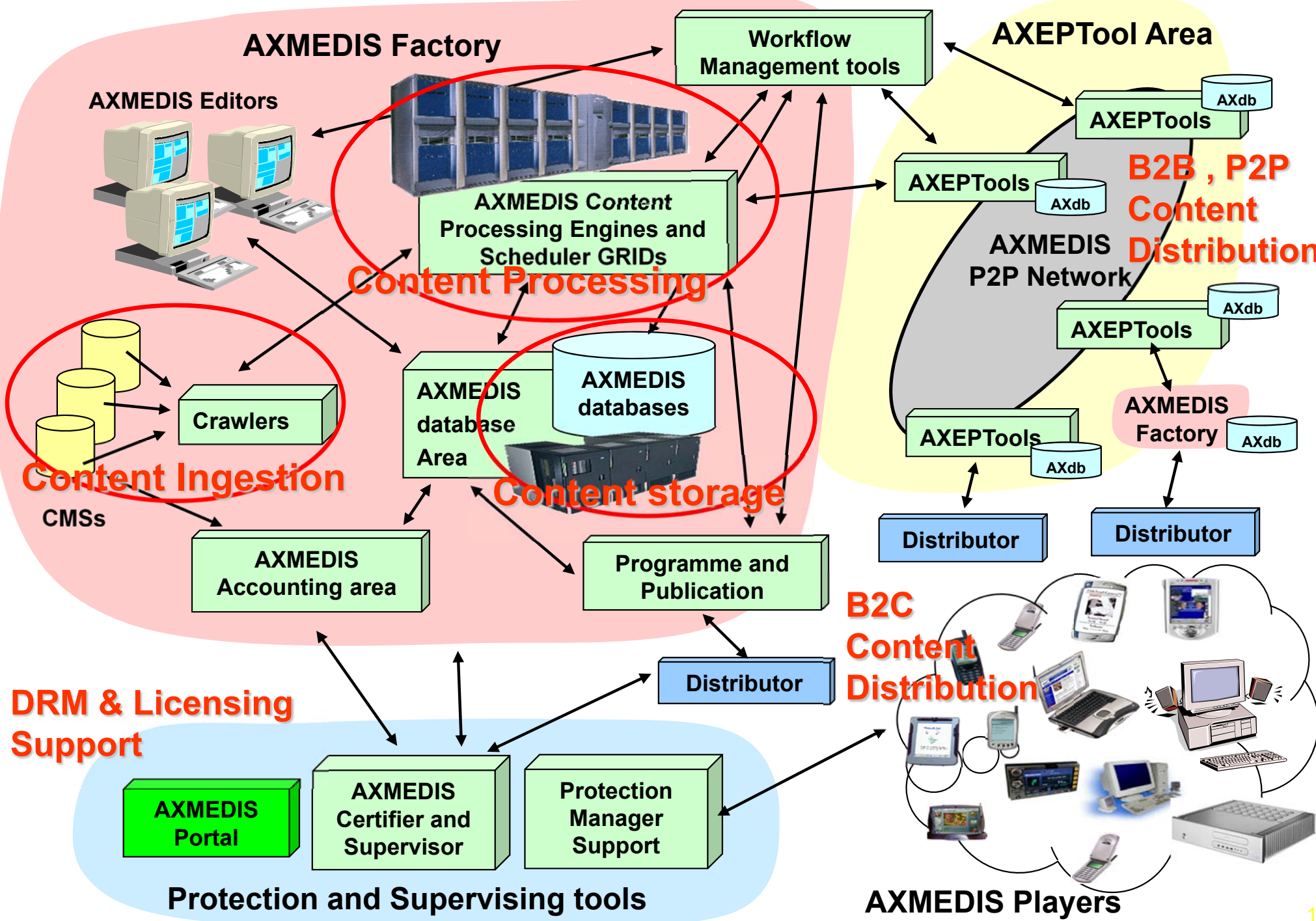 - ◆ Interface
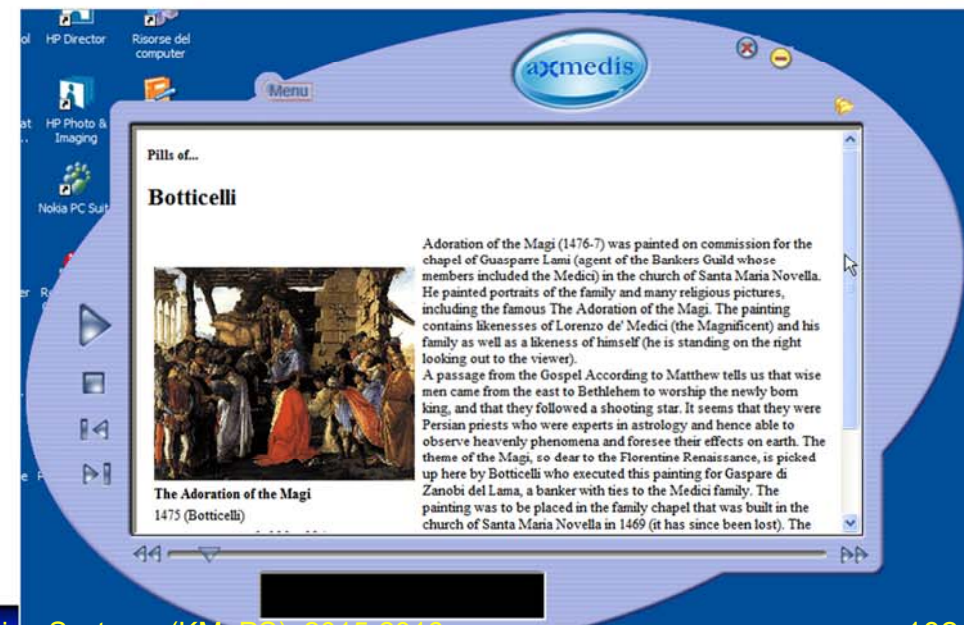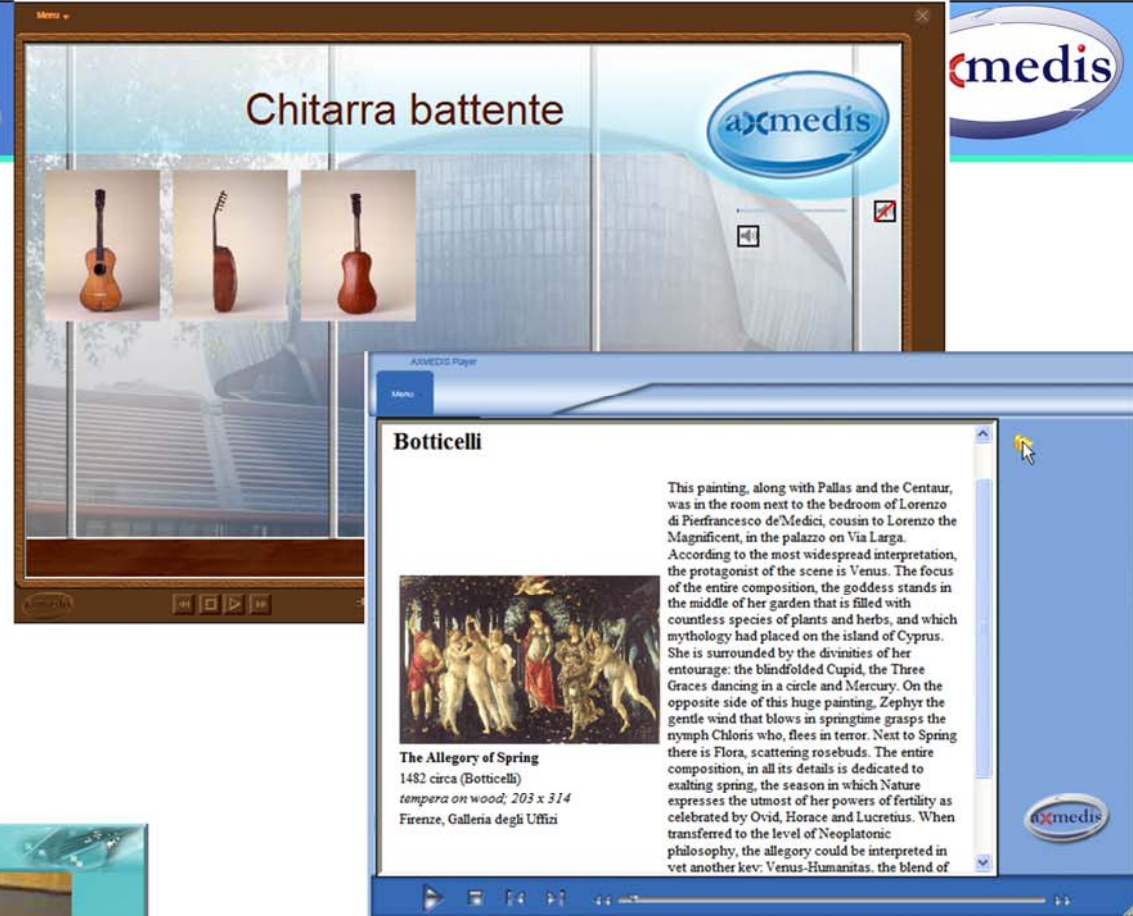
STB with AXMEDIS tech

# Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
- ¿ Definizioni
  - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- ¿ Architettura AXMEDIS overview
- ¿ Package MPEG-21 e AXMEDIS
  - ♣ AXMEDIS, NewsML, MXF
  - ♣ Intelligent content, Behavior e annotazioni
- ¿ Player AXMEDIS e DirectX
- ¿ Aspetti di DRM avanzati
- ¿ AXMEDIS Major Tools
  - ♣ AXMEDIS player multipiattaforma
- ¿ Content Production and workflow
- ¿ Distribuzione dei contenuti
  - ♣ Controlled P2P content Distribution
  - ♣ Content Distribution via Kiosks
  - ♣ Satellite broadcasting, Terrestrial Broadcasting
  - ♣ Cultural Heritage content distribution
  - ♣ Interoperabilita nel Backoffice
  - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

AXMEDIS Architecture

Factory and integration
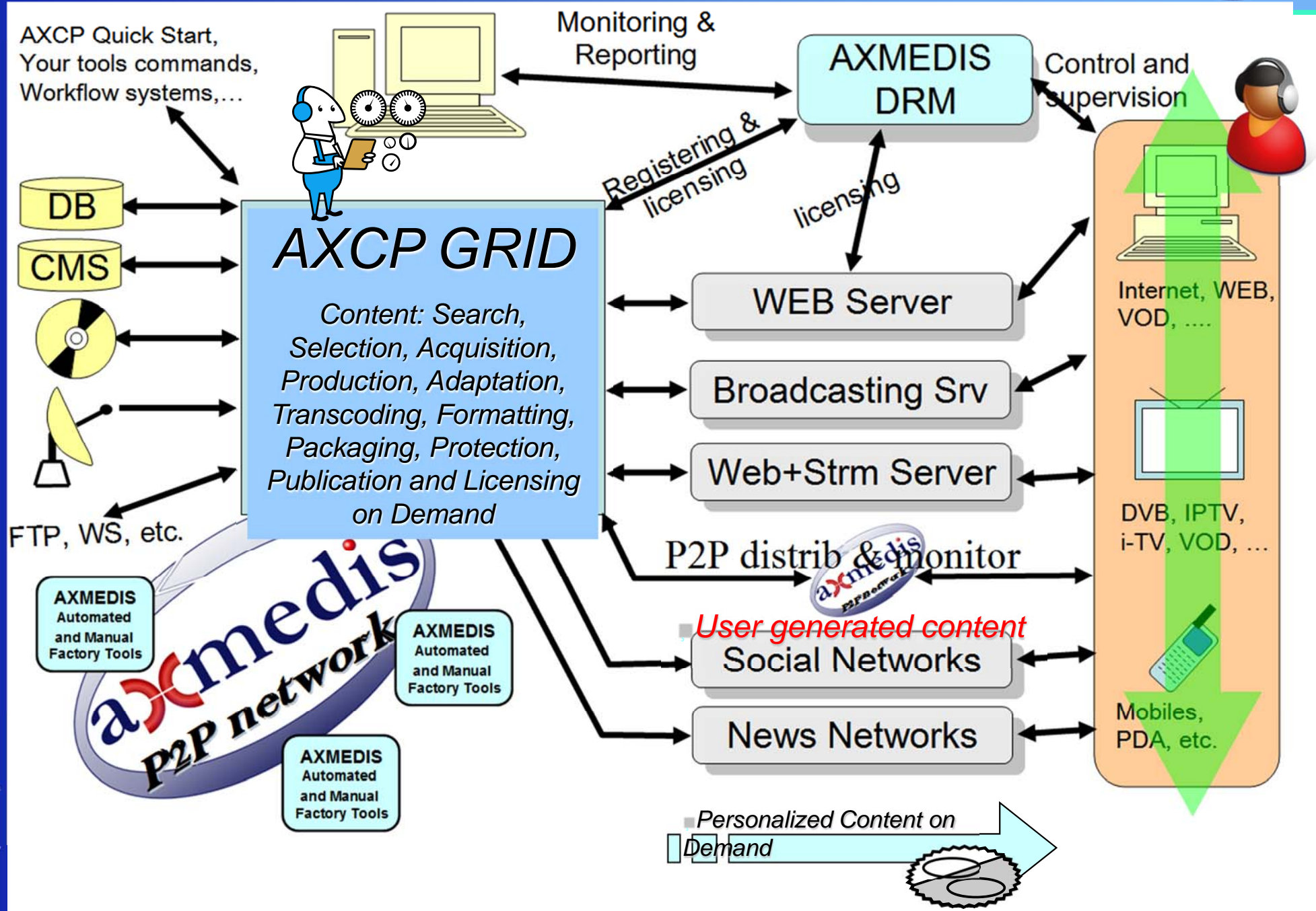
- ¿ **AXMEDIS allows you to reduce costs and increase efficiency of your content management.**

- ¿ **Automating back office content production/protection and distribution**

  - ◆ Open and secure architecture for content production, processing, protection and enrichment, based on a scalable GRID model

  - ◆ Maximum flexibility with

    - ➔ AXMEDIS content processing GRID Language

    - ➔ Uses plugins for content adaptation/transcoding for multi-channel production, fingerprinting, processing profiles, etc.

- ¿ **AXCP GRID solution allows automated management of:**

  - ◆ content, metadata and licensing information, etc.,

- ¿ **AXCP tools can be integrated and controlled by your applications and/or workflow management systems.**
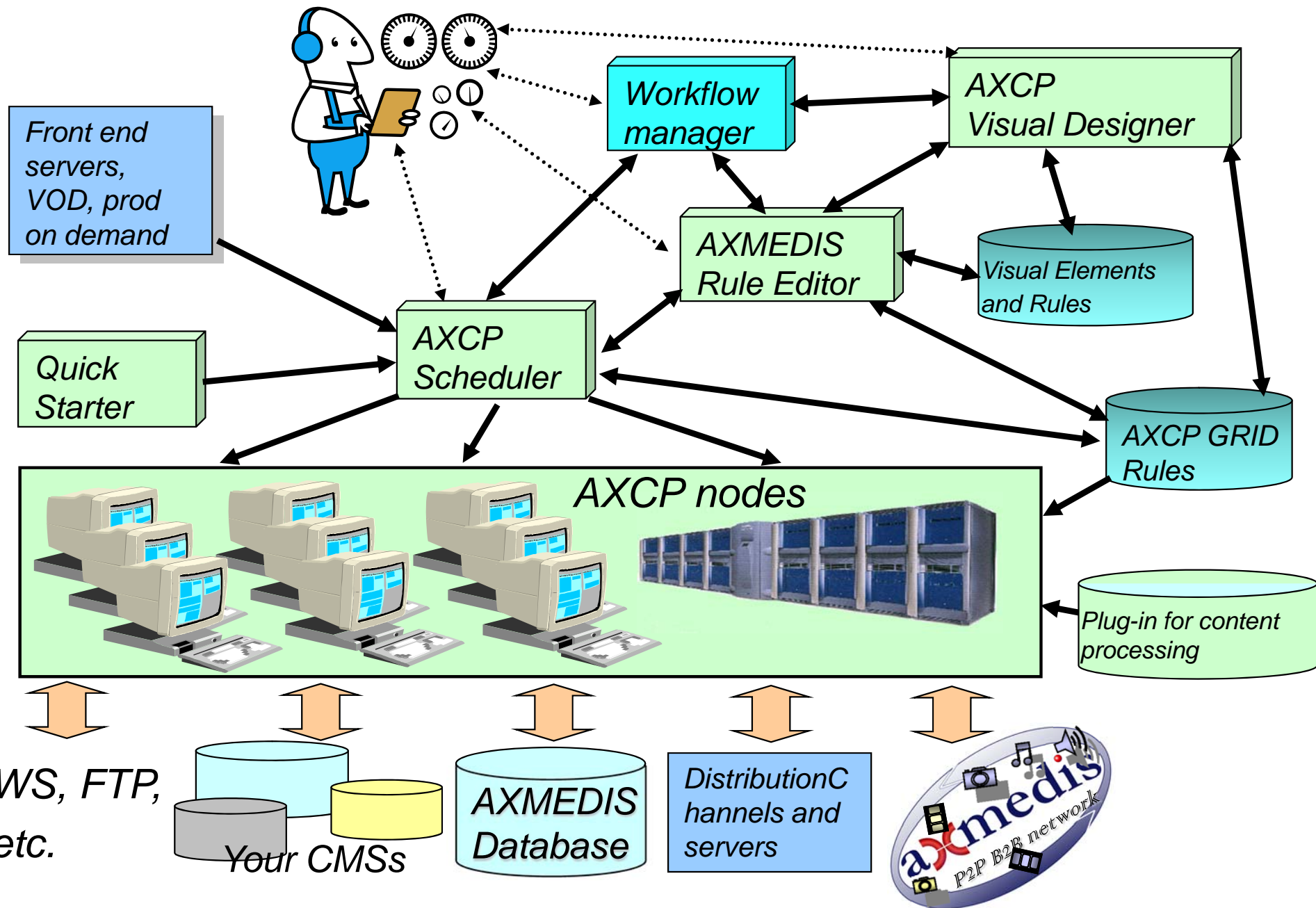
¿ **AXMEDIS GRID language and tools for**

- ♦ Automated Content Ingestion and Gathering
- ♦ Automated Content Query and Retrieval
- ♦ Automated Content Load and Storage: databases and files

- ♦ Automated Content and Metadata Processing, enrichment
- ♦ Automated Content and Data processing
- ♦ Automated Content Filtering and Repurposing
- ♦ Automated Content Composition, Formatting
- ♦ Automated Content Protection and Licensing

- ♦ Automated Content Publication/Download on/from:
  - ➔ Any channel including P2P Network
- ♦ Automated Content Distribution
- ♦ Automated Profiles management and processing
- ♦ Automated Production of Content on Demand

Some Snapshots from the examples shown

Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
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    - ♣ Satellite broadcasting, Terrestrial Broadcasting
    - ♣ Cultural Heritage content distribution
    - ♣ Interoperabilita nel Backoffice
    - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

AXMEDIS Multichannel Distribution

- ¿ VOD, Video or Content on Demand:
    - ♣ Internet P2P, PC, mobile
    - ♣ IPTV streaming: STB Motorola
    - ♣ Streaming of AXMEDIS MPEG-21, audio/video
    - ♣ Progressive download of AXMEDIS MPEG-21, audio/video
- ¿ Satellite data broadcast
    - ♣ Distribution in Push, STB/PVR
- ¿ DVB-T
    - ♣ EPG + recording + intelligent content
    - ♣ HD protection in stream
- ¿ PDA and Kiosks
    - ♣ Push on Kiosks, Download on PDA
    - ♣ http://XMF.axmedis.org
- ¿ Mobiles
    - ♣ Interoperable MPEG-21 and OMA DRM production
    - ♣ AXMEDIS/MPEG-21 player for mobiles
    - ♣ Download and progressive download on mobiles, java
    - ♣ http://XMF.axmedis.org
- ¿ UGC, user generated or posted content
    - ♣ Automated production, transcoding, licensing, etc.
    - ♣ Multichannel support
    - ♣ XMF, social network, ..
    - ♣ Http://XMF.axmedis.org
- ¿ P2P as support for the above channels
    - ♣ B2B and/or B2C networks
    - ♣ http://XMF.axmedis.org

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

- **PCs via Internet+P2P, AXMEDIS P2P and PC player: TISCALI Media Club, DSI**

- **PCs via Internet, AXMEDIS PC player:**
  - ELION, VRS

- **PCs via Satellite data broadcast, AXMEDIS PC player:**
  - EUTELSAT, UNIVLEEDS

- **PDA via Kiosks, AXMEDIS PDA player:**
  - ILABS + ANSC Kiosks, TISCALI, DSI

- **STBs and PVRs:**
  - AXMEDIS STB: IPTV, Internet VOD: TEO, VRS
  - AXMEDIS STB/PVRs via Satellite data broadcast: EUTELSAT, MBI

- **Mobiles:**
  - AXMEDIS mobile player: ILABS, TISCALI, DSI
  - OMA player: Telecom Italia (TI), DSI

- **PCs via Internet+P2P, AXMEDIS P2P and PC player:**
  - free air DVB-T + home domains/media center
  - BBC, SDAE, ETRI, UPC

¿ **P2P network set up for content distribution**

- ◆ BitTorrent Technology with Query and Catalogue
- ◆ Protected content, legal P2P set up
- ◆ P2P Client Tools
- ◆ Automated B2B content distribution/publication via P2P, fast seeding,
- ◆ Automated and efficient control of P2P networks
- ◆ CONSUMER content distribution and sharing

¿ **Content Sharing among, producers, integrators, archives and libraries, etc.**
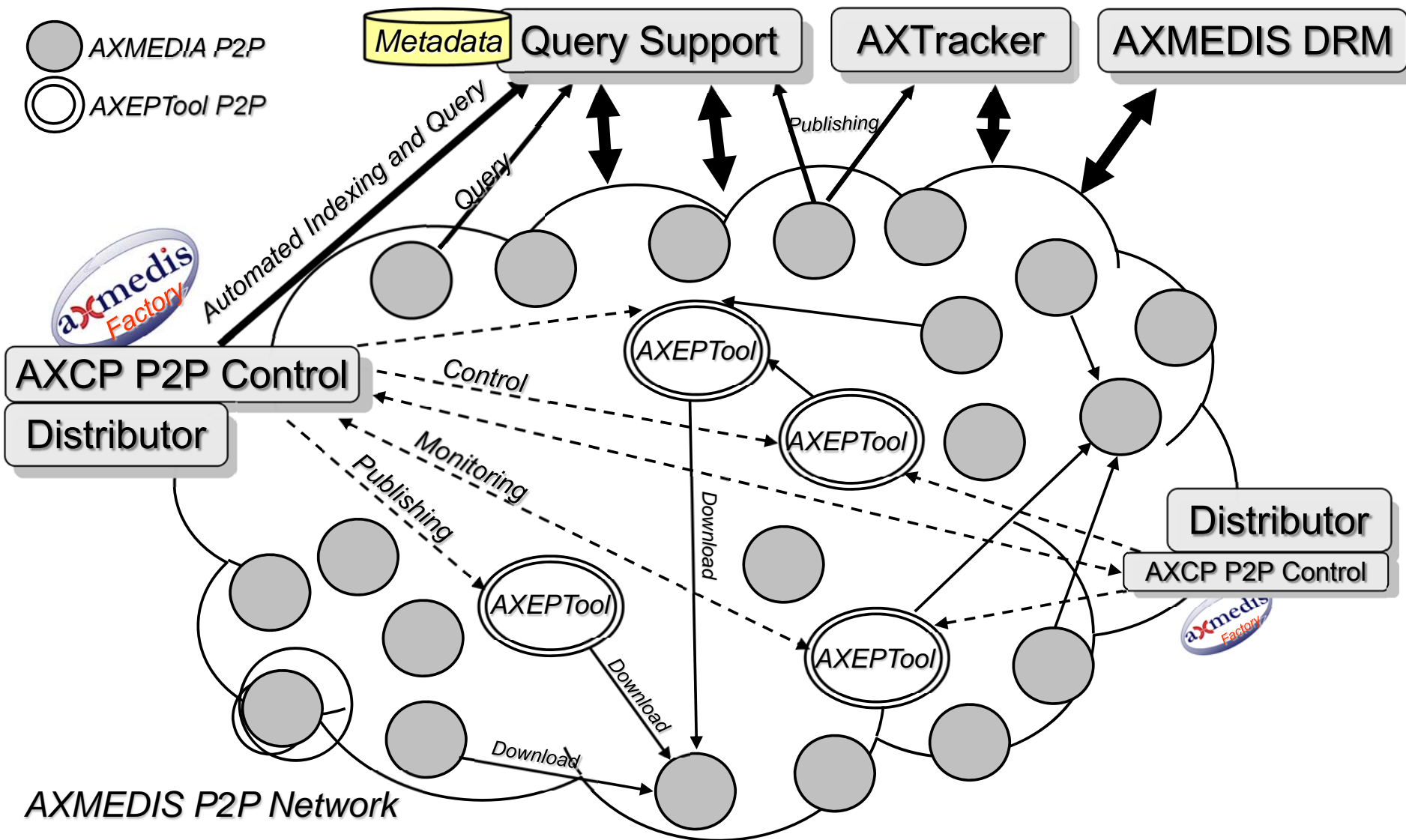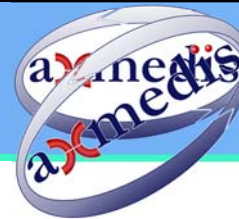
AXCP for empowering WEB portals

Users

AXMEDIS Rule Editor

User and Device profile

Few Ready to use rules

Add info

Activate Rule

Content Databases

Scheduler

AXCP GRID

Personalized Content on Demand

Content: Search, Selection, Acquisition, Production, Adaptation, Transcoding, Formatting, Packaging, Protection, Publication and Licensing on Demand
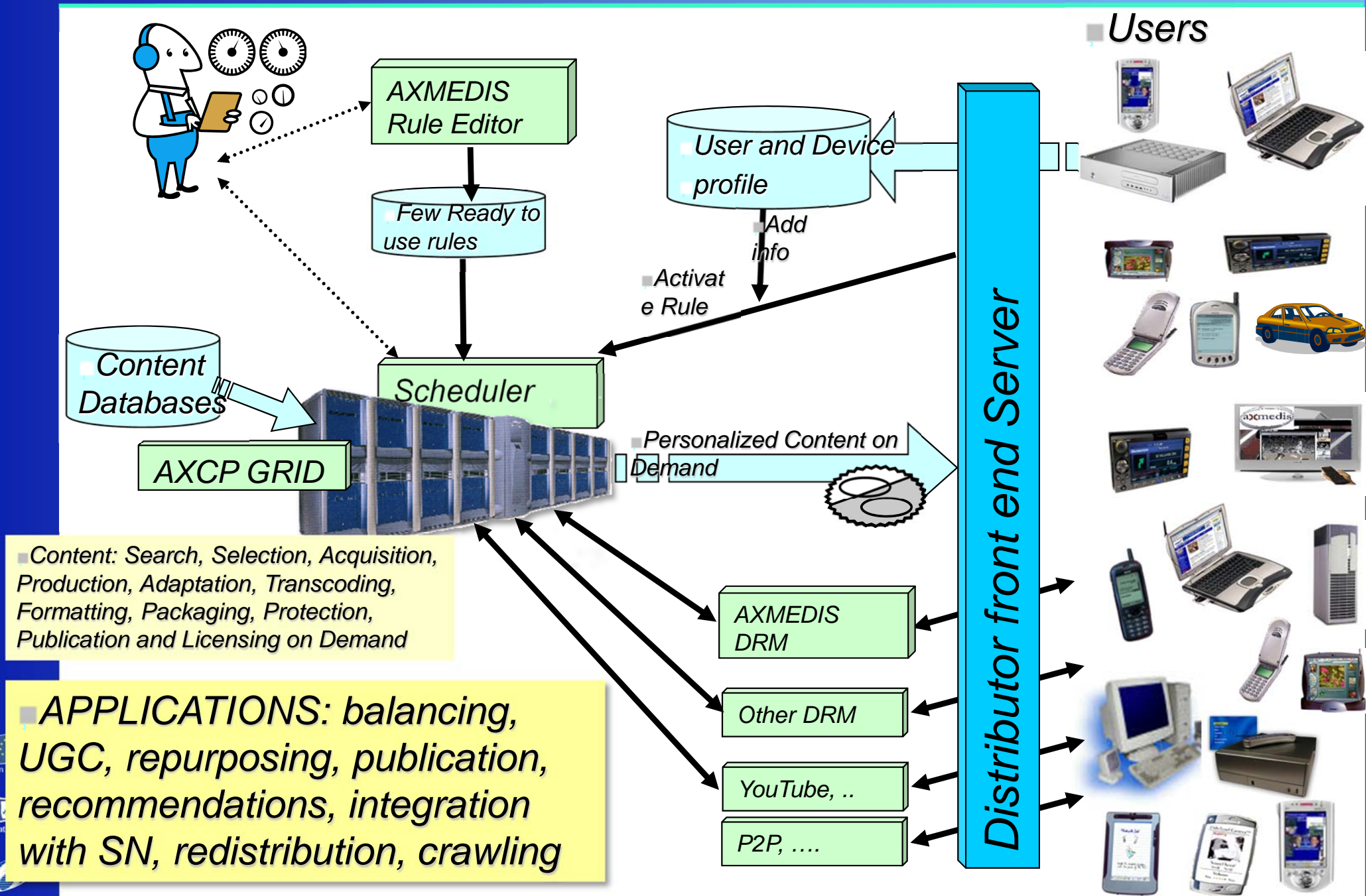
APPLICATIONS: balancing, UGC, repurposing, publication, recommendations, integration with SN, redistribution, crawling

AXMEDIS DRM

Other DRM

YouTube, ..

P2P, ….

Distributor front end Server

Cross media Content, from video, audio to complex content

VOD
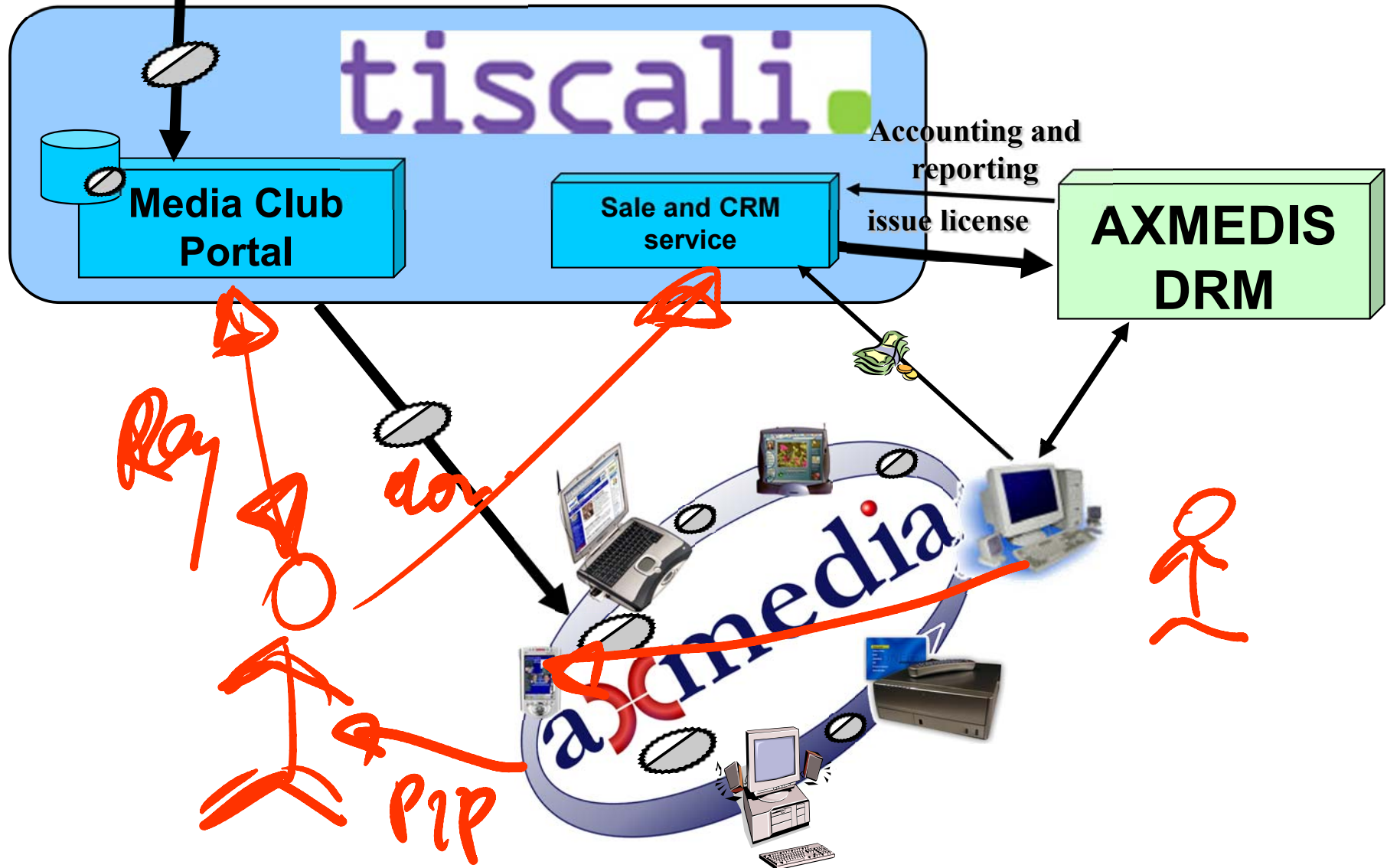
tiscali.

Media Club Portal

Sale and CRM service

Accounting and reporting

issue license

AXMEDIS DRM

PIP
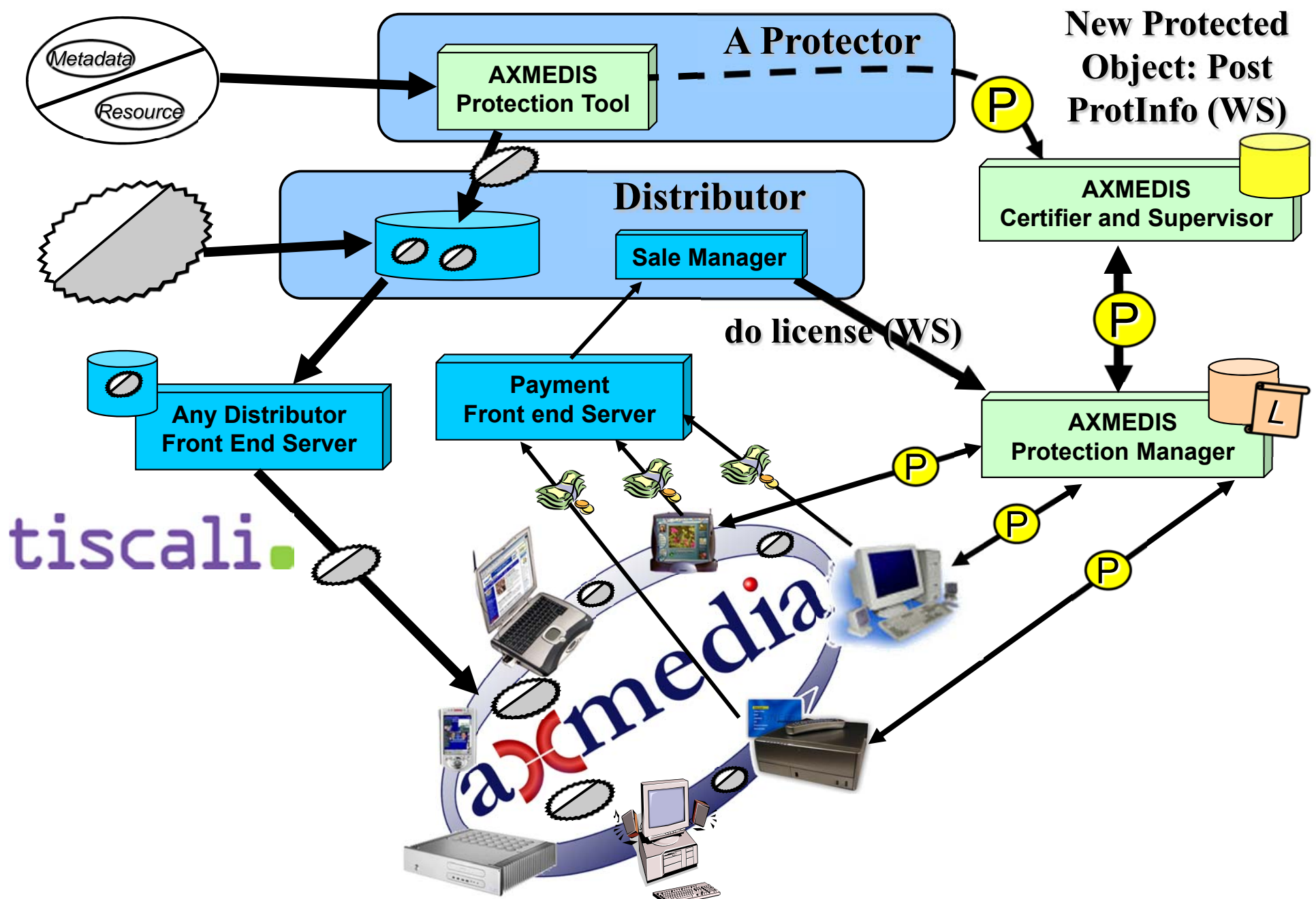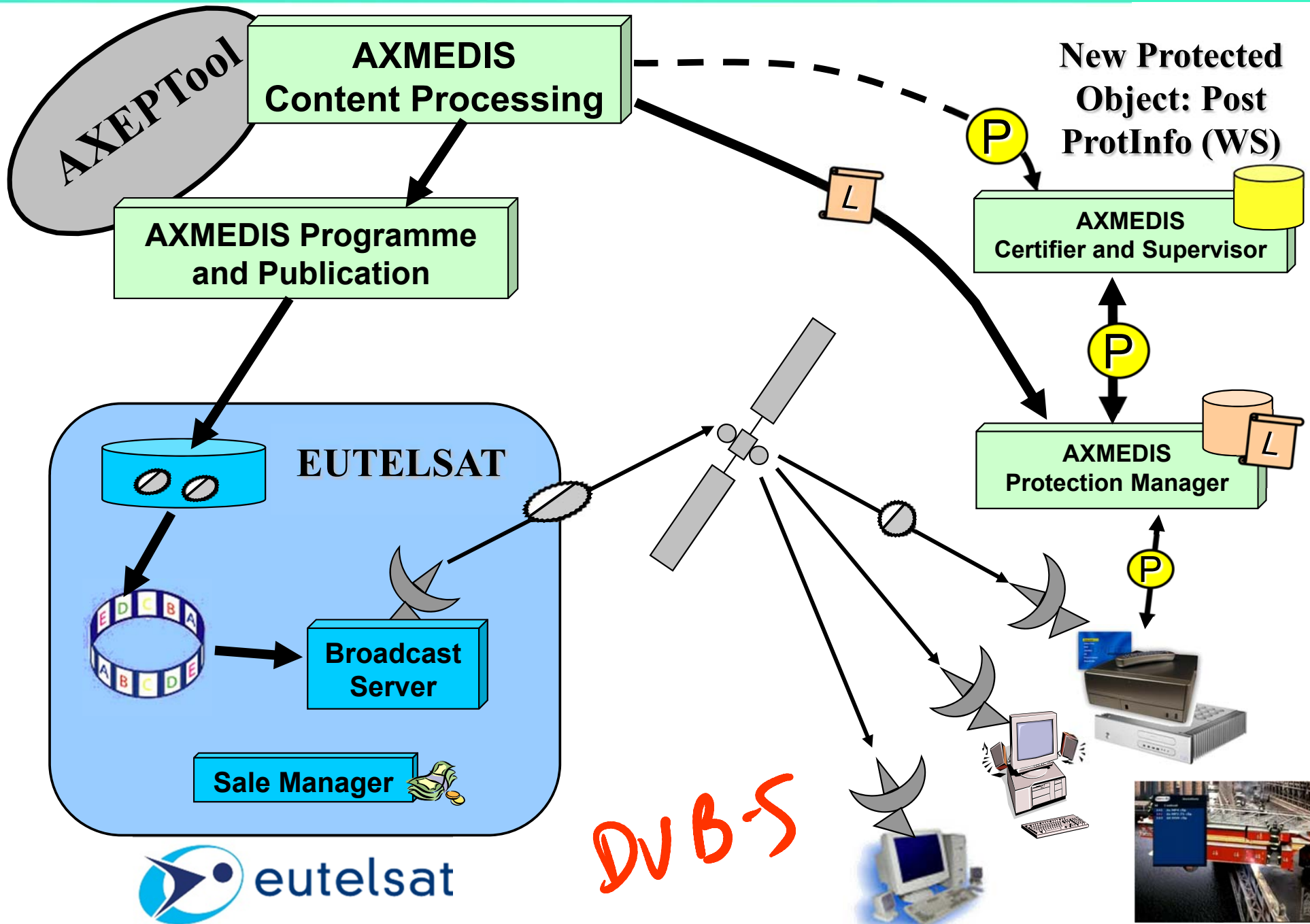
AXMEDIS Service on ATLANTIC BIRD™ 1:

➔ **12.5° West, covering Europe and Americas**

➔ **Frequency: 11.428GHz**

➔ **Symbol rate: 30000KSym/s**

➔ **Polarization: Horizontal**

eutelsat

51 dBW

38 dBW

http://www.eutelsat.com/satellites/125e.html
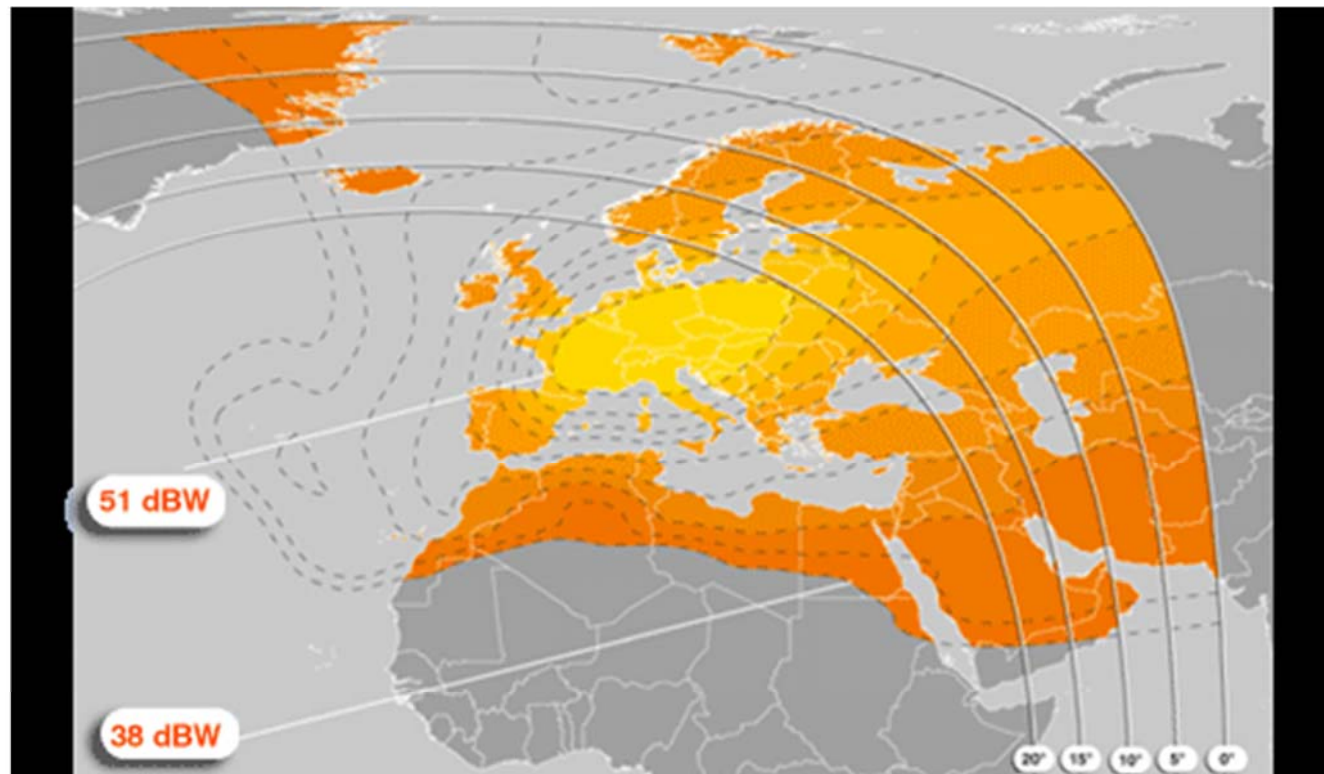
Content Production on the Consumer Side

- *Cross media Content, from video, audio to complex content*

- *Cross media Content, from video, audio to complex content*

BBC

- *TV free on air*

- *Added value content via ADSL*

axmedis P2P B2B network

- *Recording, added value Content Package on site production and* **domain** *management*

BBC Broadcasting DVB-T

- *Free on air transmission*

- *Accounting and reporting*

- *Grant authoriz.*

AXMEDIS DRM
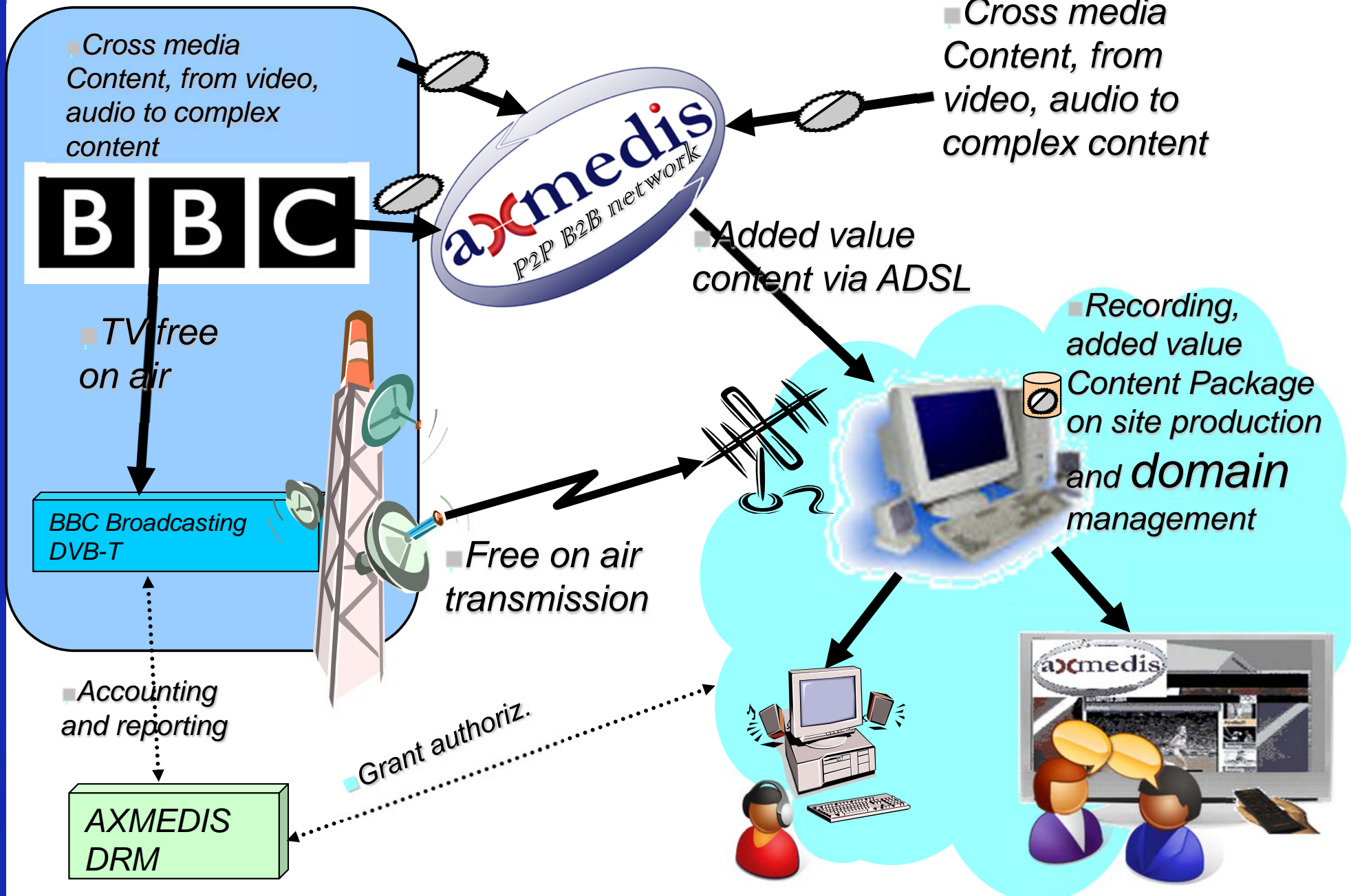
■ *The Axmedis content can be intelligent to be proactive with the users and bring it suggestions and stimulus*
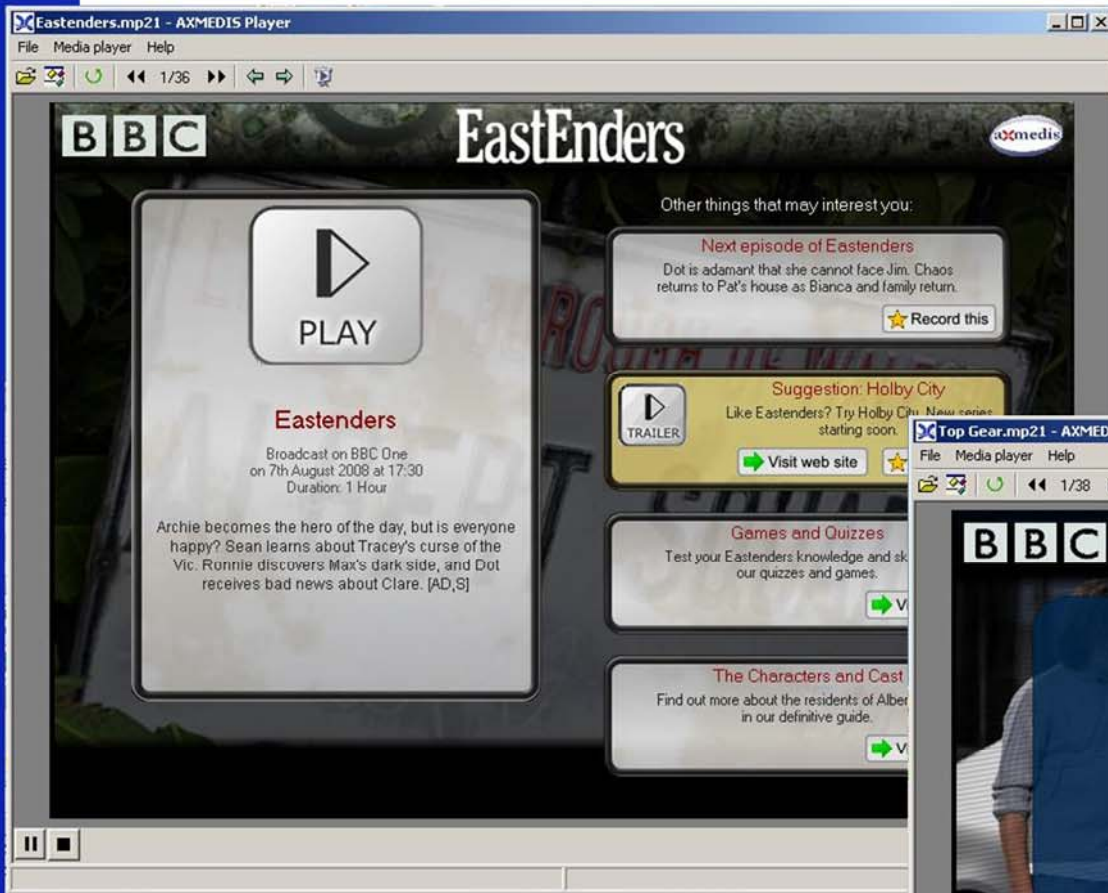
Mobile distribution, OMA and MPEG-21

Production & Distribution back-office

Distribution Front end
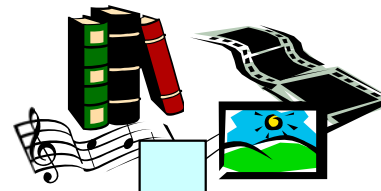
AX_RuleG(..)

Dir=ProfileProcessing(UID,DP,NP)
A=GetContent(db);
B.MP21_Package(A);
Pinfo=MP21_RandDefinePinfo();
B.MP21_Protection(Pinfo);
C.ObjPublishing(Portal1);

B.Adaptation(A, Dir);
OPinfo=OMA_RandDefinePinfo();
E.OMA_DRMPackager(B, OPinfo);
E.OMA_ObjPublishing(Portal2);

AXCP GRID Scheduler

AX_RuleL(..)

D=ProfileProcessing(UID,DP)
L.LicenseSet(UID,OID, DID, Const);
L.RelProduction();
L.RelPosting(ls1);

M.Rel_to_OMAdrmConversion(L, D);
M.ODRLPosting(ls2);

AXMEDIS License Server

AX Dist. Service

OMA Content Issuer

Rights server

Promotion Portal

Selling Portal

Regist. Portal

[UID,OID, DID, Const]

Content Acquisition & usage

Content Selection

Rights acquisition x exploitation

Collection of Actions Logs Records

TELECOM ITALIA

AXMEDIS DRM Single channel integration

AXMEDIS Technical Architecture
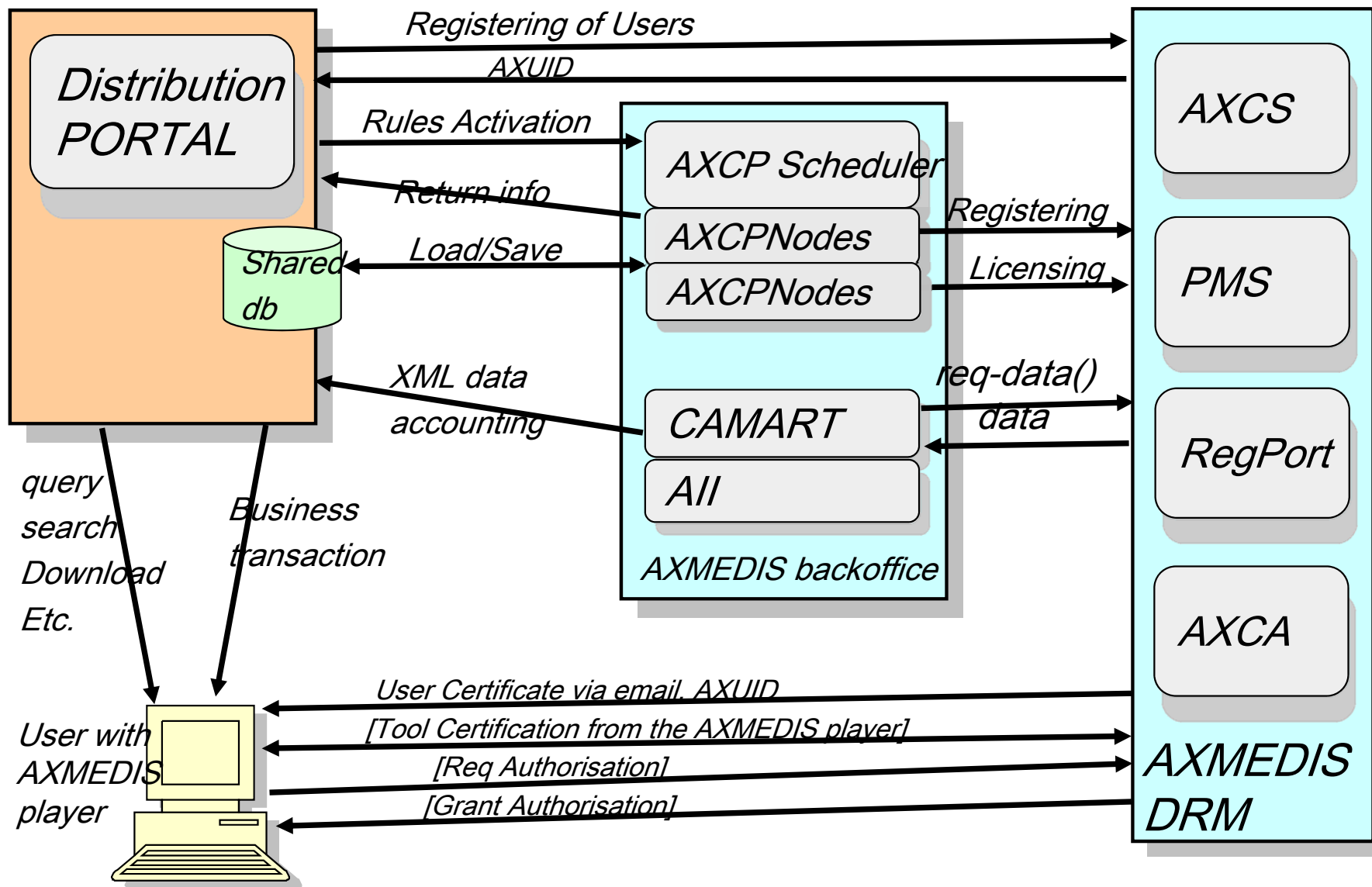
User Interaction and/or Automated Control via WSs

AXMEDIS (CP) Content Processing
- Script Editor and Debug
- AXCP GRID Scheduler

AXMEDIS Authoring Tools
- Metadata
- Resources
- X& Multimedia
- Styles
- DRM Licenses
- Plug-ins …..
- Protection information

AXMEDIS manual and autom. content sharing and Distribution Tools
- AXEPTool B2B P2P
- AXMEDIA B2C P2P
- Programme and Pub

AXMEDIS Administrative Tools

AXMEDIS DRM Reporting Tools

AXMEDIS MPEG-21 Multidev. Player & Plugins

Plug in Manager	DRM Support	Protection Support	Content Adaptation	Query Support	Workflow Support	Content Descriptors
Content Crawling	Packaging Support	Content Processing	Content Formatting	Database Support	Communic Support	Metadata Support

AXMEDIS Model Supports and Plug-ins   including support for XML, XSLT, WSDL, OS, etc.

WS, https, FTP, Webdav, etc.

CMSs

AXMEDIS, MPEG-21 Databases

AXMEDIS DRM Servers

Traditional and P2P Distribution Channels and servers

References

- AXMEDIS: www.axmedis.org
- CRF: Content Reference Forum: http://www.crforum.org/
- DMP: Digital Media Project, www.chiariglione.org
- EITO 2005: European Information Technology Observation 2005: http://www.eito.com/index-eito.html
- ODRL: http://odrl.net/
- OMA: www.openmobilealliance.org
- MI3P, Music Industry Integrated Identifier Project, http://www.mi3p-standard.org/
- MPEG, MPEG-21: www.chiariglione.org
- MUSICNETWORK: www.interactivemusicnetwork.org
- WEDELMUSIC: www.wedelmusic.org
- Microsoft Windows Media: http://www.microsoft.com/windows/windowsmedia/default.aspx

- **editor-new5b.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3643
- **play5-N.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3645
- **play5-VIDEO-NESI.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3671
- **new-xim-ansc-objects-with-audio.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3669
- **pda-player-medium.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3668
- **sat-dist-with-audio.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3667
- **kiosk.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3848
- **AXELTEO-TEO-STB-demo.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3670
- **ELION-enduser-nesi.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3649
- **bbc-user4.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3672
- **siae-presentation-short-July2007-new-nov07.wmv**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3651

- **AXMEDIS for all**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3108
- **AXMEDIS Object model**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3845
- **AXMEDIS Automated Content processing**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3624
- **AXMEDIS P2P**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3612
- **AXMEDIS DRM**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3616
- **AXDRM how to use on a portal**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3616
- **Video on demand and STB, TEO show case**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3738
- **Content on demand on Internet, ELION show case**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3745
- **Content distribution via Satellite Data broadcast EUTELSAT Case**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3820

- **AXMEDIS PC player:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3715
- **AXMEDIS PC player with SKIN**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3716
- **AXMEDIS PC player, Active X and .Net**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3717
- **AXMEDIS PC player for EUTELSAT OPENSKY:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3767
- **AXMEDIS Editor:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3720
- **AXMEDIS content production tools (includes the above AXMEDIS Editor):**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3722
- **PDA player:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3842
- **PDA content:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3748
- **P2P Client tool AXEPTool:**
  - http://www.axmedis.org/documenti/view_documenti.php?doc_id=3840

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  - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P

P2P reciprocal Trusting for DRM

- ¿ le prestazioni del DRM AXMEDIS sono fortemente condizionate dal numero di chiamate contemporanee;
  - ♣ Ad esempio, in certi casi, ogni 8 richieste di autorizzazione in contemporanea, 2 non hanno esito positivo, a causa dei ritardi nell'elaborazione;
  - ♣ il DRM AXMEDIS ha complessità computazionale lineare 1:N (1 server:N client), e.g., 10 alla 12. O(R), O(U*C), un milione di utenti per un milione di content.

Obiettivi:

- ¿ **Scalabilità**: definire e sviluppare una soluzione scalabile che consenta di far fronte a carichi elevati sul sistema, decentralizzando le risorse da aggiungere, in modo da poter soddisfare un elevato numero di richieste contemporanee.

- ¿ **Sicurezza**: adottare politiche adeguate alla nuova soluzione, mantenendo gli stessi standard di sicurezza

Richiami sul DRM

- **AXMEDIS e'**
  - ♣ **un'**infrastruttura distribuita multipiattaforma per la creazione, protezione, distribuzione e consumo delle risorse digitali
- **Digital Rights Management, DRM**:
  - ♣ meccanismi di gestione dei diritti di risorse digitali, grazie alla possibilità di rendere protette, identificabili e tracciabili le risorse stesse
- **DRM AXMEDIS** fornisce
  - ♣ una serie di strumenti che consentono di
    - ➔ certificare utenti e dispositivi,
    - ➔ gestire i diritti e
    - ➔ controllarne lo sfruttamento da parte degli utenti finali

Architettura DRM AXMEDIS
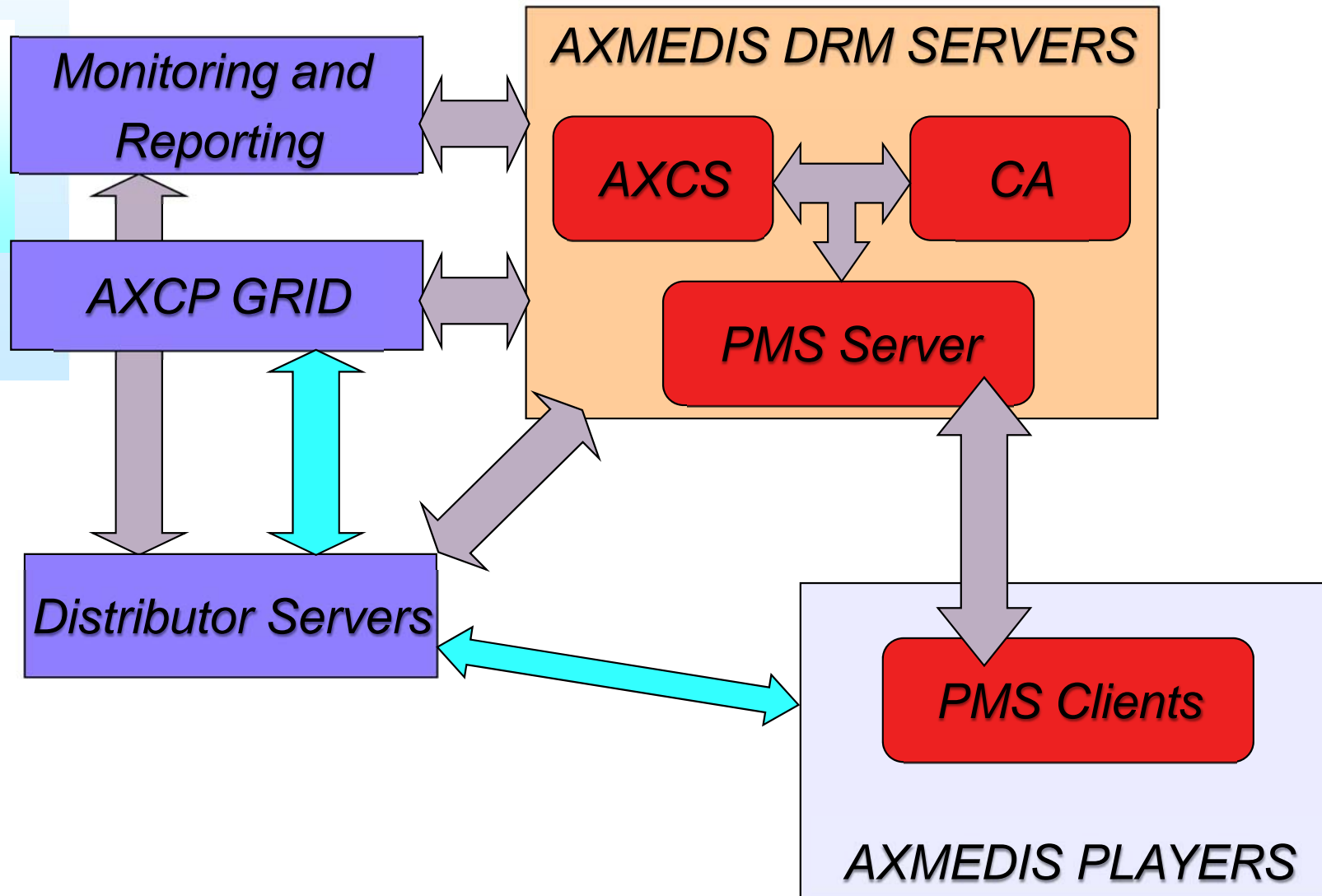
DRM AXMEDIS/MPEG-21

¿ Procedure fondamentali del DRM:

- **Server side**
  - registrazione di: utente e tool type
  - protezione e registrazione del contenuto
  - registrazione della licenza
- **Client side**
  - certificazione del tool: salvataggio dei dati relativi al tool utilizzato
  - verifica del tool: controllo sull'integrità
  - autorizzazione: concessione del grant all'utente finale

DRM AXMEDIS Esempio

Autorizzazione

Verifica del tool

Registrazione della licenza

Certificazione del tool

AXMEDIS Player

Utente finale

Licensor

AXMEDIS DRM

PMS Server

DB

AXCS

DB

CA
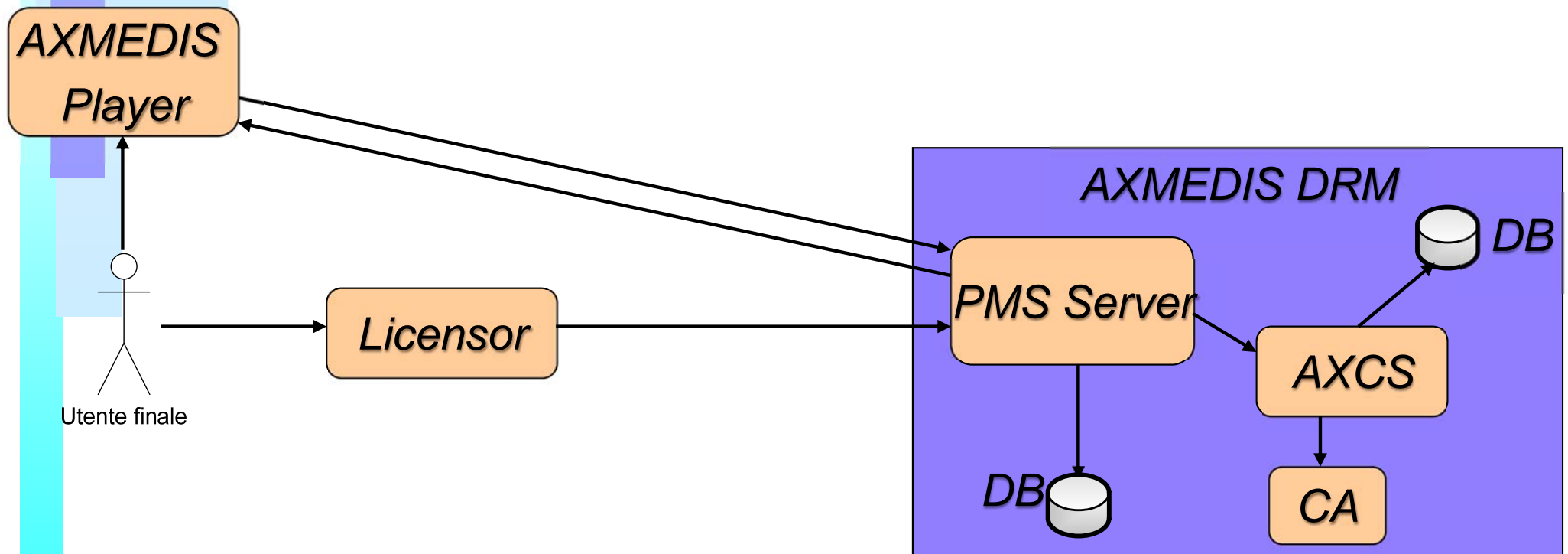
Scelta della struttura decentralizzata

- ¿ **Si concretizza la decentralizzazione** scegliendo di delegare l'esecuzione di alcune procedure chiave ad una DHT su rete P2P
  - ♣ DHT: Distributed Hash Table:
  - ♣ Classe di sistemi distribuiti decentralizzati che partizionano l'appartenenza di un set di chiavi tra i nodi che fanno parte della rete P2P;
  - ♣ hanno complessità computazionale logaritmica
- ¿ Perché Bamboo DHT:
  - *due insiemi di vicini: leaf set e routing table*
  - *interfacce put/get predefinite: XML-RPC*
  - *gestione del churn*
  - *open source*

RETE P2P

Monitoring and reporting

Reporting

AXMEDIS DRM SERVERS

Registering Licensing

Grant

AXCP GRID

DB

CMS

Content

processing

registration

packaging

protection

licensing

Licensing

Protected content

SERVERS

PLAYERS

INTERNET, WEB...

BROADCAST, IP-TV, i-TV...

MOBILES, PDA...

AX P2P NETWORK

AX P2P
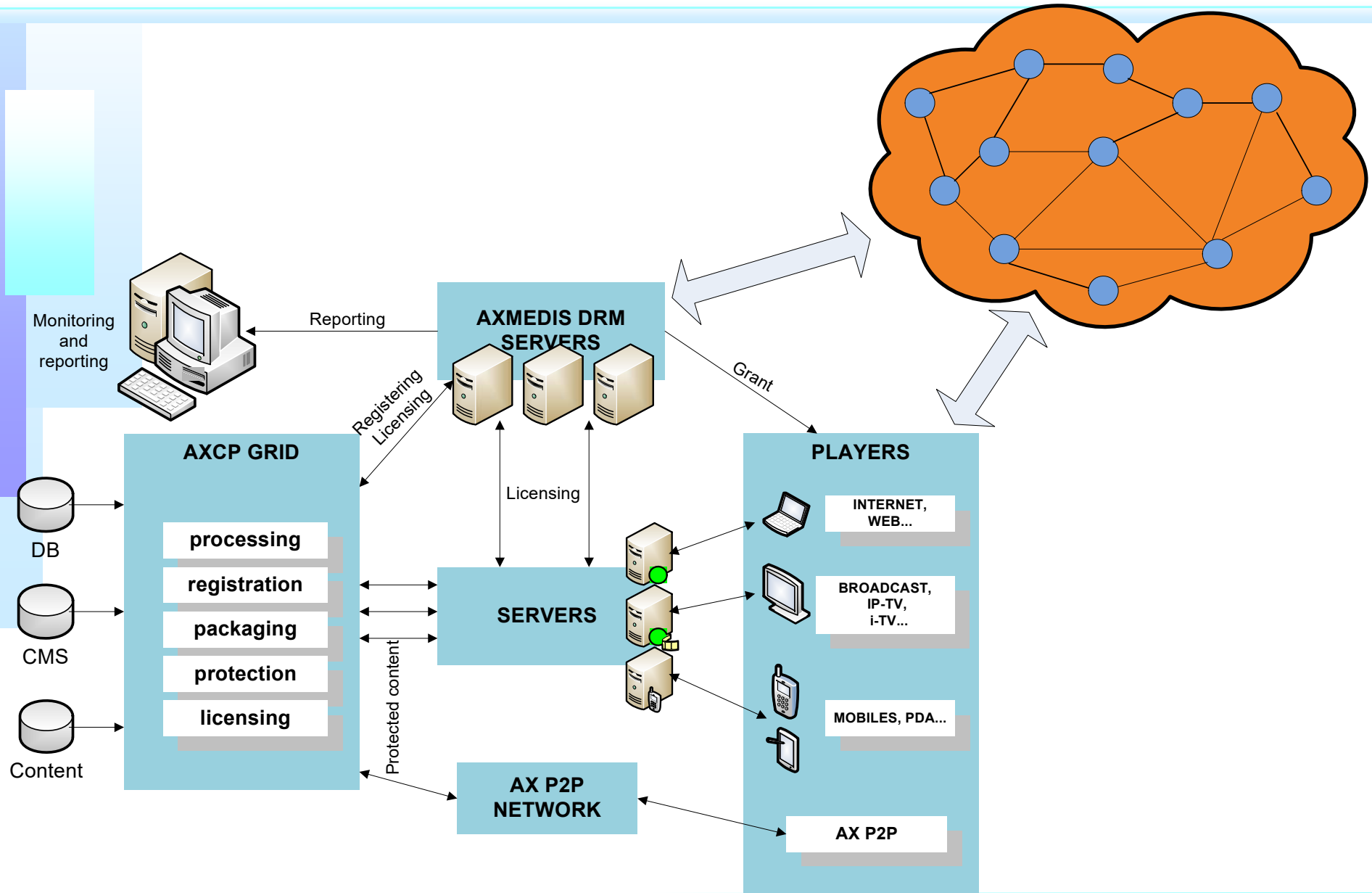
Salvataggio dati sulla DHT

- **avviene** nei casi di
  - ♣ certificazione del tool e
  - ♣ registrazione della licenza.
- **si effettua** durante
  - ♣ la verifica del tool e
  - ♣ l'autorizzazione per l'utente finale.
- **Il PMS Server**, completate le rispettive procedure, effettua
  - ♣ una connessione ad un nodo Bamboo Gateway per trasmettere le informazioni utili.
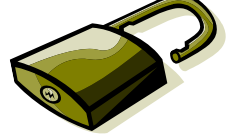
Recupero dati dalla DHT

- **Si effettua, come scelta prioritaria**,
  - ♣ ogni volta che si eseguono le procedure di verifica e autorizzazione.
- **Spetta al PMS Client** effettuare un lookup sulla DHT,
  - ♣ in base alla chiave specifica per la relativa procedura.
- **Quando viene trovata una corrispondenza sulla rete P2P**,
  - ♣ la procedura viene espletata direttamente,
  - ♣ senza dover ricorrere ai server di DRM AXMEDIS.

DHT in action: put()
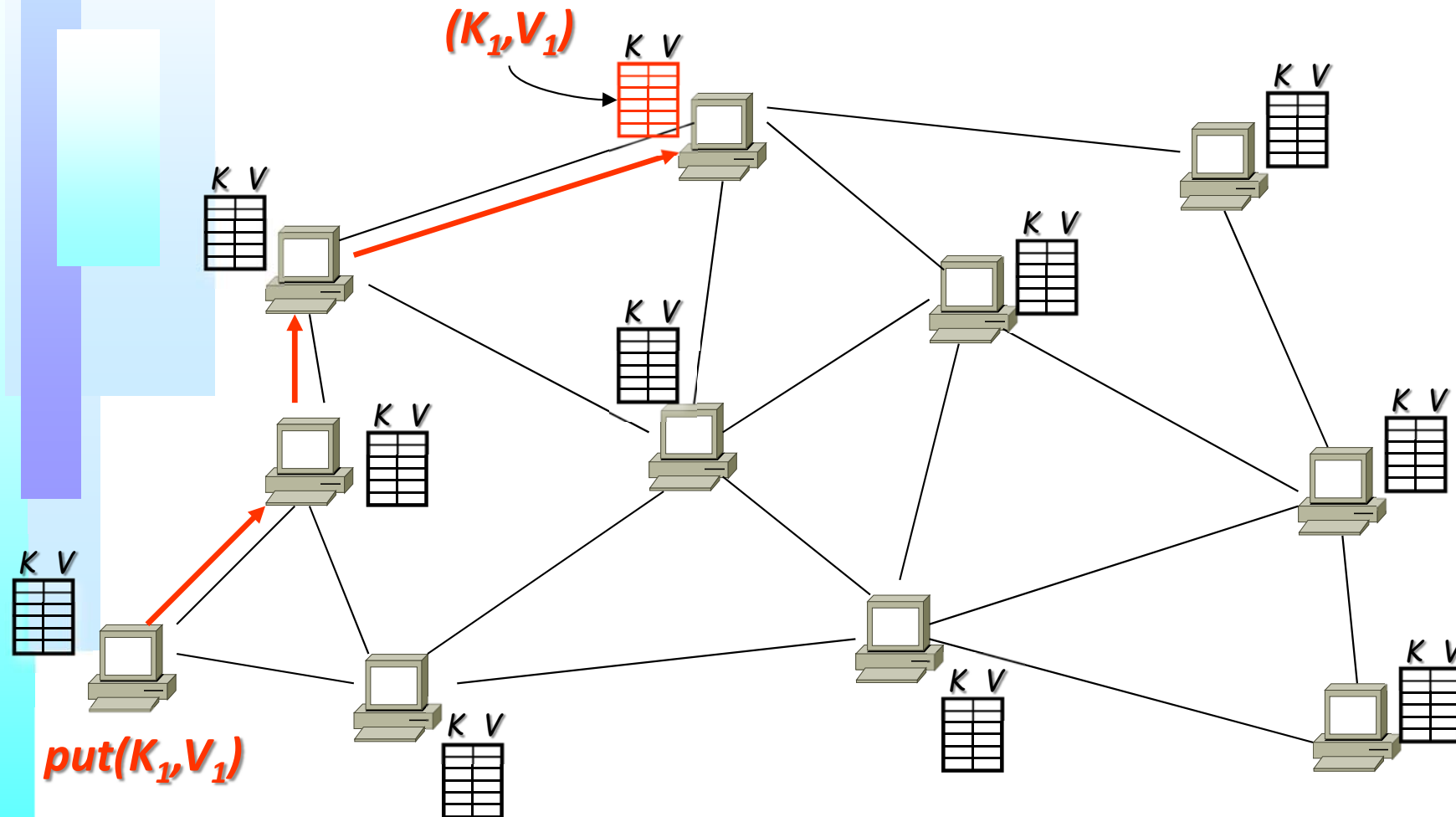
Operation: take key as input; route msgs to node holding key

DHT in action: get()

get (K₁)
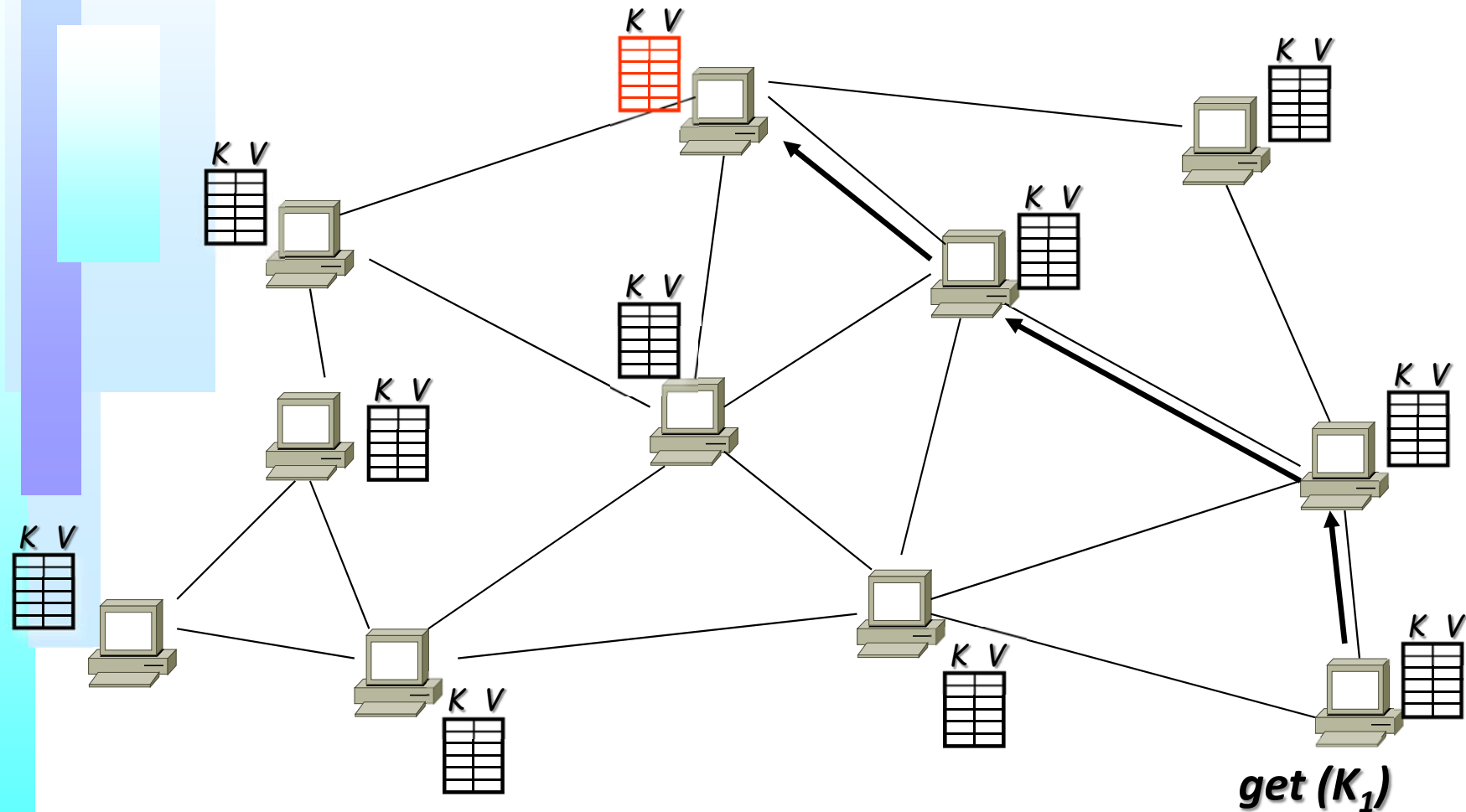
Operation: take key as input; route msgs to node holding key

¿ n keyspace composto da stringhe di 160 bit

♣ Al massimo di hanno u numero di hop pari al Log in base due di 160

♣ Costo della ricerca: O(log N)

¿ Se si vuole immettere nella DHT un contenuto caratterizzato dai parametri *filename* e *data*, viene inizialmente calcolato l'hash del filename, ad esempio tramite un algoritmo SHA

¿ Bamboo è un sistema peer to peer che riassume alcune delle caratteristiche di Chord e Tapestry. È stato scritto in Java da Sean Rhea della UC Berkeley, ma si basa fortemente sui progetti OceanStore e Libasync, ed è open source

Sicurezza dei dati

- ¿ Sicurezza ottenuta tramite meccanismi di crittazione: Blowfish e RSA.

- ¿ Si ottiene quindi un doppio sistema di cifratura, che impedisce agli utenti non autorizzati l'utilizzo delle informazioni riservate.

DHT key

DHT Value

Per la licenza

AXUID	AXOID	Right

➡ | Blowfish key | Protection Key |

per verifica

AXTID

➡ | Blowfish key | Enabling Code |

Criptato con chiave pubblica utente

Criptato con Blowfish

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Scenario di test (1)

AXMEDIS Player

PrivateKey

Utente finale

Bamboo DHT

Licensor

AXMEDIS DRM

PMS Server

PubKey

DB

AXCS

DB

CA

Analoga procedura usata per la certificazione e verifica del tool

Collegamento a PMSD.exe

```
16-09-10 17:50:46: AC from 192.168.0.35 sock=144
16-09-10 17:50:46: AC from 192.168.0.35 sock=172
16-09-10 17:51:15: AC from 192.168.0.35 sock=160
certify
DHT connection established
CertInfo stored in Bamboo DHT
16-09-10 17:51:27: AC from 192.168.0.35 sock=180
16-09-10 17:51:27: AC from 192.168.0.35 sock=164
16-09-10 17:55:41: AC from 192.168.0.35 sock=176
16-09-10 17:55:41: AC from 192.168.0.35 sock=160
16-09-10 18:04:57: AC from 192.168.0.35 sock=204
Ping
16-09-10 18:04:58: AC from 192.168.0.35 sock=172
sendLicense

Validated?1
16-09-10 18:10:32: AC from 192.168.0.35 sock=224
Ping
16-09-10 18:10:34: AC from 192.168.0.35 sock=176
sendLicense

Validated?1
DHT connection established
License stored in Bamboo DHT
```

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Scenario di test (2)

Bamboo DHT

AXMEDIS
Player

Licensor

Utente finale

AXMEDIS DRM

PMS Server

PubKey

AXCS

CA

DB

DB

```
Collegamento a PMSD.exe
16-09-10 18:04:58: AC from 192.168.0.35 sock=172
sendLicense

Validated?1
16-09-10 18:10:32: AC from 192.168.0.35 sock=224
Ping
16-09-10 18:10:34: AC from 192.168.0.35 sock=176
sendLicense

Validated?1
DHT connection established
License stored in Bamboo DHT
16-09-10 18:19:38: AC from 192.168.0.35 sock=232
16-09-10 18:19:39: AC from 192.168.0.35 sock=172
16-09-10 18:21:54: AC from 192.168.0.35 sock=200
Ping
verify
DHT connection established
CertInfo stored in Bamboo DHT
16-09-10 18:21:57: AC from 192.168.0.35 sock=168
authorise
DHT connection established
License stored in Bamboo DHT
```

Considerazioni su P2P DRM

	DRM AXMEDIS TRADIZIONALE	DRM P2P
SICUREZZA	SI	SI
TRUST MANAGEMENT	SI	SI
RIDONDANZA DEI DATI	NO	SI
SCALABILITA'	NO	SI
EFFICIENZA	Lineare	Logaritmica
Costo di storage	O(L=C*U)	O(L=C*U) + duplications on DHT
Costo di accesso, transazione	O(U*devices), caso peggiore	O(1) → O(U*D) sul server oppure su DHT O(Log2 N)
FAULT TOLERANCE	NO	SI

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| Parameter	Description	Range of values
L	Size of the leaf node list	8-400
Ltime	Time to update the leaf node list	25-250s
K	Number of replicas per node	4-200
N	Number of nodes involved in the network	1000-10000
Delay	Delay of transmission	30-50 ms
Jitter	variability over time of the packet latency across a network	10%
SendQueueLengh	Max dimension of the output buffer	0.5 Mbyte

(a) L=200, K=100;
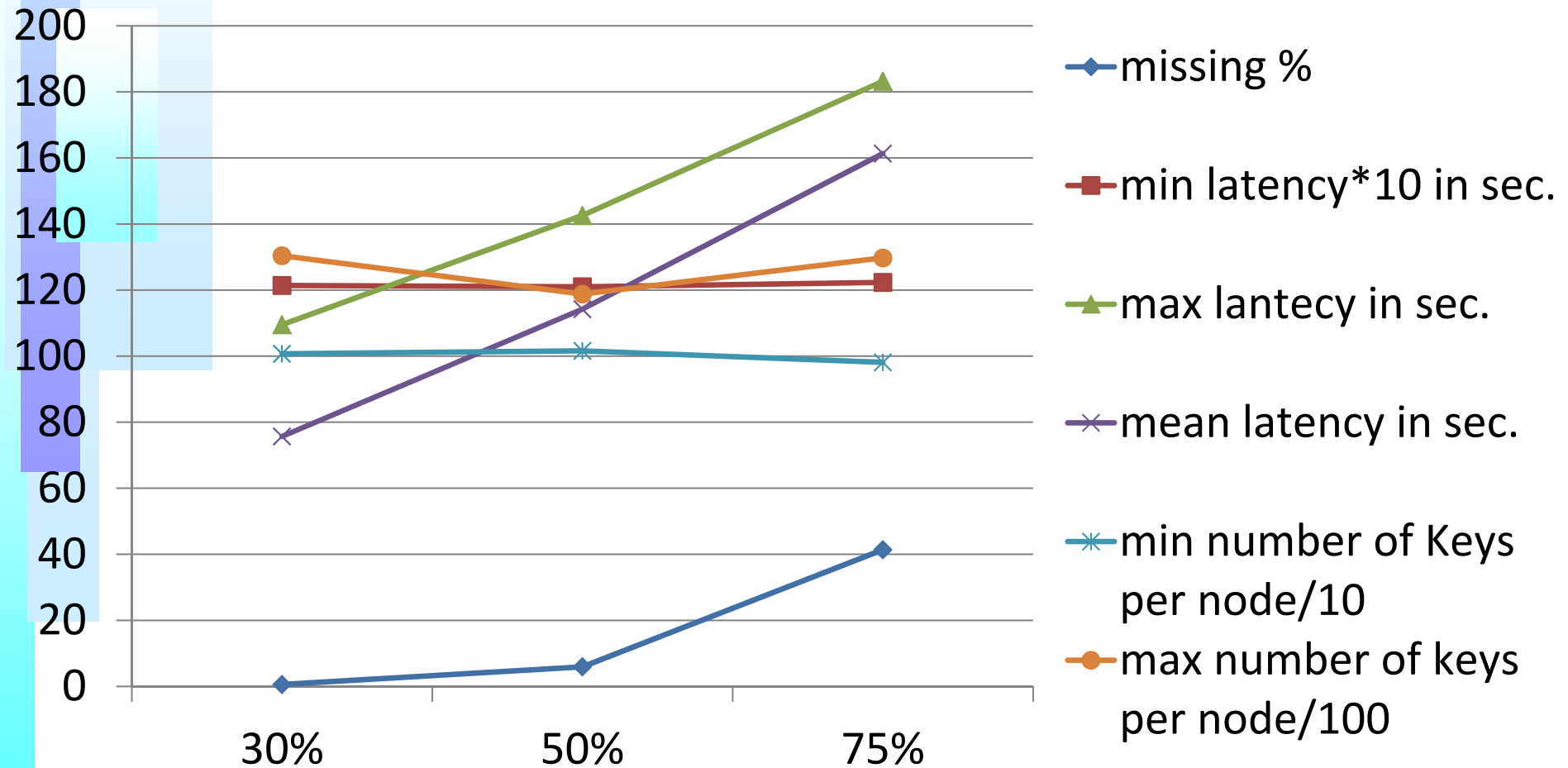
Trend of the percentage of missing estimated on the DHT P2P for the cases of a churn of 30%, 50% and 75%, and K equal to 100, 150, and 200.
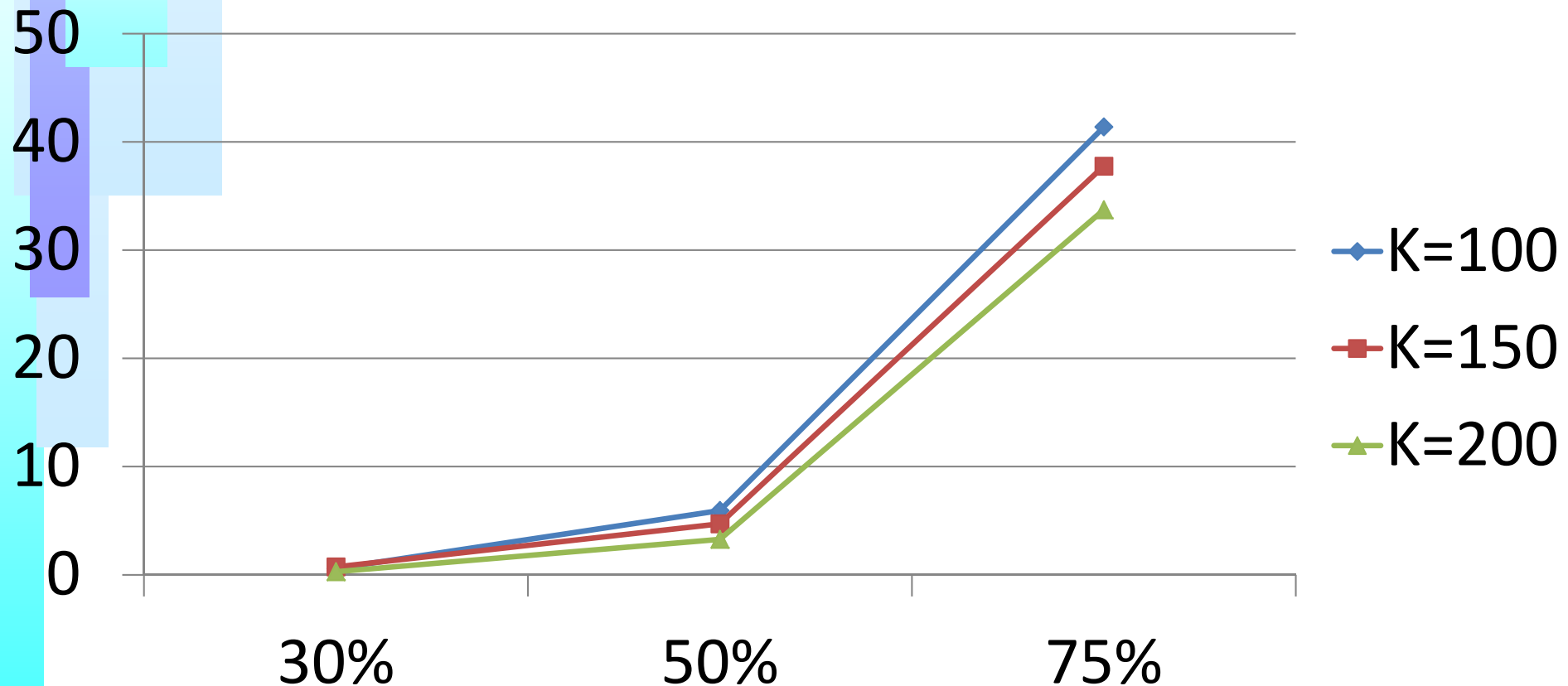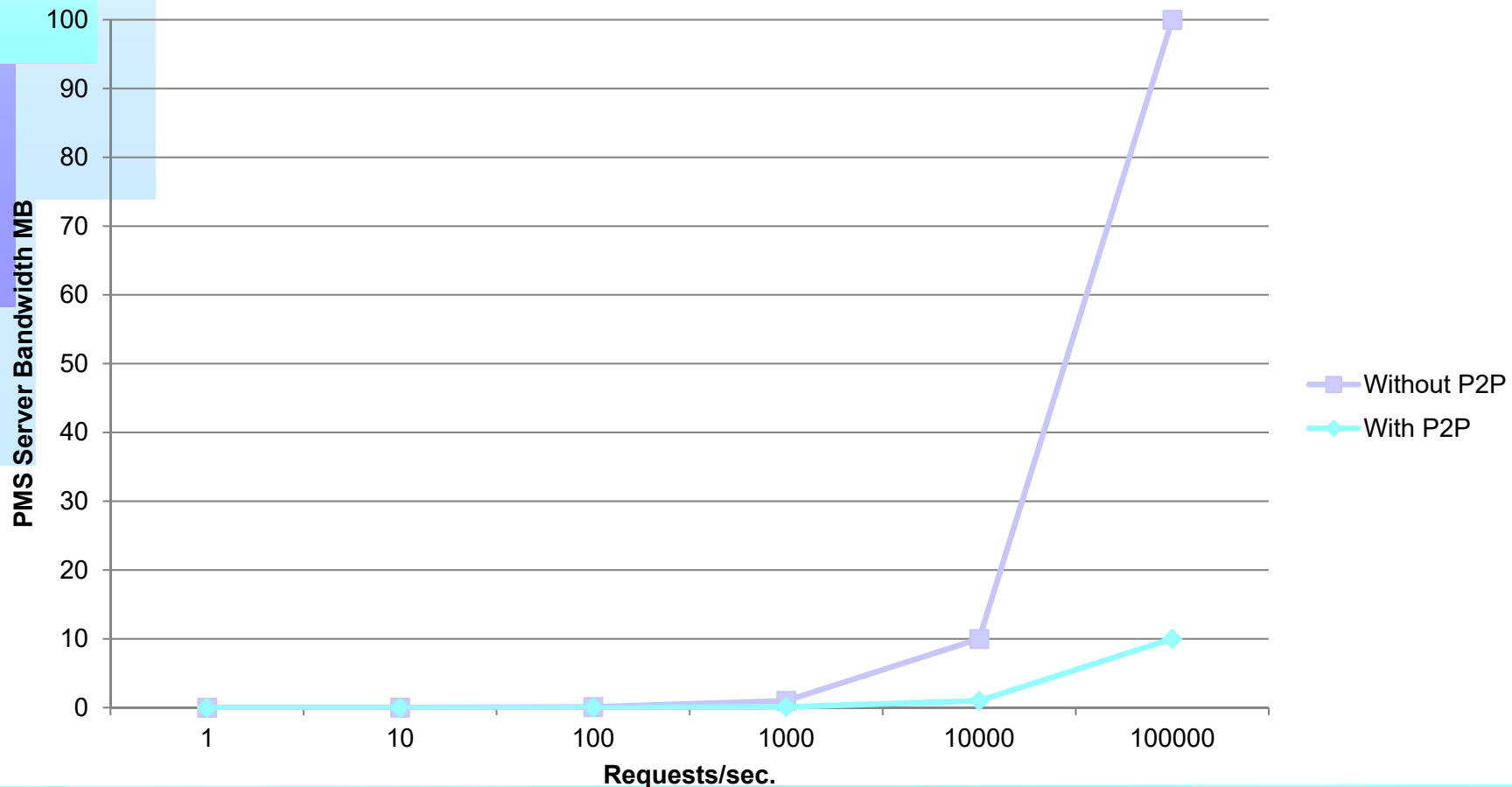
Trend of the percentage of missing estimated on the DHT P2P with respect to different percentage of churn, for *K* equal to 20, 16 and 8
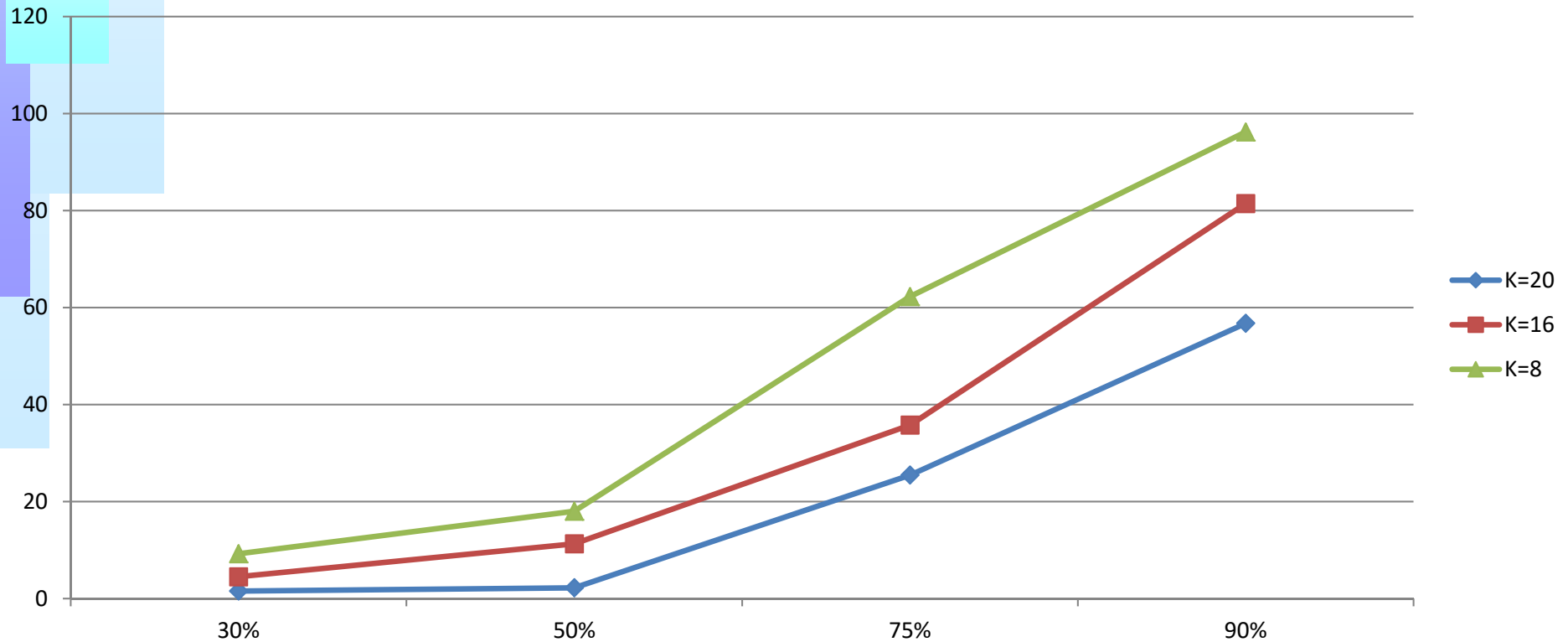
Trend of needed bandwidth for the PMS Server with respect to the number of requests per second of verification/authentication coming from the clients both with and without P2P solution, for K=100.

Part 1b: Sistemi di protezione e distribuzione

- ¿ Apple I-Tune DRM
- ¿ Definizioni
  - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- ¿ Architettura AXMEDIS overview
- ¿ Package MPEG-21 e AXMEDIS
  - ♣ AXMEDIS, NewsML, MXF
  - ♣ Intelligent content, Behavior e annotazioni
- ¿ Player AXMEDIS e DirectX
- ¿ Aspetti di DRM avanzati
- ¿ AXMEDIS Major Tools
  - ♣ AXMEDIS player multipiattaforma
  - ♣ Content Production and workflow
- ¿ Distribuzione dei contenuti
  - ♣ Controlled P2P content Distribution
  - ♣ Content Distribution via Kiosks
  - ♣ Satellite broadcasting, Terrestrial Broadcasting
  - ♣ Cultural Heritage content distribution
  - ♣ Interoperabilita' nel Backoffice
  - ♣ Integrazione con Portale di distribuzione
- ¿ DRM Reciprocal Trust via P2P