



Sistemi Collaborativi e di Protezione (SCP)

Corso di Laurea in Ingegneria

Part 1b (2013) –
sistemi di protezione e distribuzione

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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 multiplattforma
 - ♣ Content Production and workflow
- Distribuzione dei contenuti
 - ♣ Controlled P2P content Distribution
 - ♣ Content Distribution via Kiosks
 - ♣ Satellite broadcasting, Terrestrial Broadcasting
 - ♣ Cultural Heritage content distribution
 - ♣ Interoperabilità nel Backoffice
 - ♣ Integrazione con Portale di distribuzione
- DRM Reciprocal Trust via P2P





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



iTunes

mascagni

Cerca in Music Store Sfoglia

Sorgente

Libreria Radio Music Store Anni '60 Classifica I 25 più ascoltati Recenti

Search Results for: mascagni

Top Albums

- Cielo Di Toscana** Andrea Bocelli Genre: Vocal \$9.99 [BUY ALBUM](#)
- Mascagni: Cavalleria Rusticana** Pietro Mascagni & Plácido Do... Genre: Classical \$9.99 [BUY ALBUM](#)
- Lanza: Greatest Hits** Mario Lanza Genre: Vocal \$9.99 [BUY ALBUM](#)
- The Mario Lanza Collection** Mario Lanza Genre: Classical \$29.97 [BUY ALBUM](#)

Top Songs

- Mascagni
- Sancta Maria
- Cavalleria Rusticana \ ...
- Cavalleria Rusticana, In...
- Cavalleria Rusticana \ ...
- L'amico Fritz, Chi Mai S...
- Cavalleria Rusticana \ P...
- L'amico Fritz, Tu Sposi,...
- Cavalleria Rusticana \ ...
- Cavalleria Rusticana \ ...

Top Artists

- Pietro Mascagni
- Andrea Bocelli
- James Levine, Plácido ...
- James Levine, Jean Kr...
- Isola Jones, James Lev...
- James Levine, Jean Kr...
- Isola Jones, James Lev...
- James Levine, Pablo El...
- Isola Jones, James Lev...
- James Levine

Nome Brano	Tempo	Artista	Album	Prezzo	Importanza
Mascagni	4:12	Andrea Bocelli	Cielo Di Toscana	\$0,99	BUY SONG
Mascagni	4:12	Andrea Bocelli	Cielo Di Toscana...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Mamma, Mamm...	5:18	Anne Simon, Ja...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ a Casa, a Casa, ...	2:26	Isola Jones, Jam...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Intanto, Amici, ...	2:43	Isola Jones, Jam...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ a Voi Tutti Salute!	1:55	Isola Jones, Jam...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Fior Die Giaggio...	2:45	Isola Jones, Jam...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Preludio	2:23	James Levine	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Gli Aranci Olezz...	9:36	James Levine	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Intermezzo Sinf...	4:03	James Levine	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Il Cavallo Scalpita	2:07	James Levine & ...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ O Lola Chai La, Di Lat...	4:50	James Levine & ...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Dite, Mamma L...	3:02	James Levine, Je...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Regina Coeli, La...	6:15	James Levine, Je...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Voi Lo Sapete	5:36	James Levine, Je...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Beato Voi, Com...	0:50	James Levine, Je...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Compar Turiddu	2:54	James Levine, Pa...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Oh, Il Signore Vi...	0:58	James Levine, Pa...	Mascagni: Cavall...	\$0,99	BUY SONG
Cavalleria Rusticana \ Act \ Il Ver	4:10	James Levine, Pa...	Mascagni: Cavall...	\$0,99	BUY SONG

66 brani



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 «ripare» tale CD e' una violazione come ripare 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

E' Altri Metodi semplici:

- ♣ Masterizzare un CD e riparlo
- ♣ Usare un software di registrazione tramite:
 - il cosi' detto "analogHole"





The Interoperability Problem

¿ To play a downloaded title,

- ♣ the music player must be compatible with (or “read”) the DRM

¿ Music downloaded

- ♣ on Virgin-Mega.fr cannot be played – directly – on iPod
- ♣ from iTunes cannot be played – directly – on other music players

¿ Apple, as a vertically integrated firm, follows a well-known “closed” business model.

- ♣ DRM *FairPlay*.
- ♣ iPod, only reads “FairPlayed” files.
- ♣ Apple does not license the *FairPlay* technology to other online music shops.





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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'originale 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



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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 passare 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 Multi-channel Distribution*

www.axmedis.org

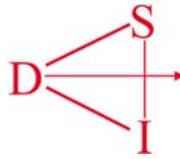
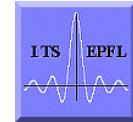
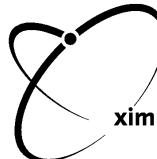
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Partners



                              	                 	   
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Partners Distribution





Perform research on enabling technologies to allow

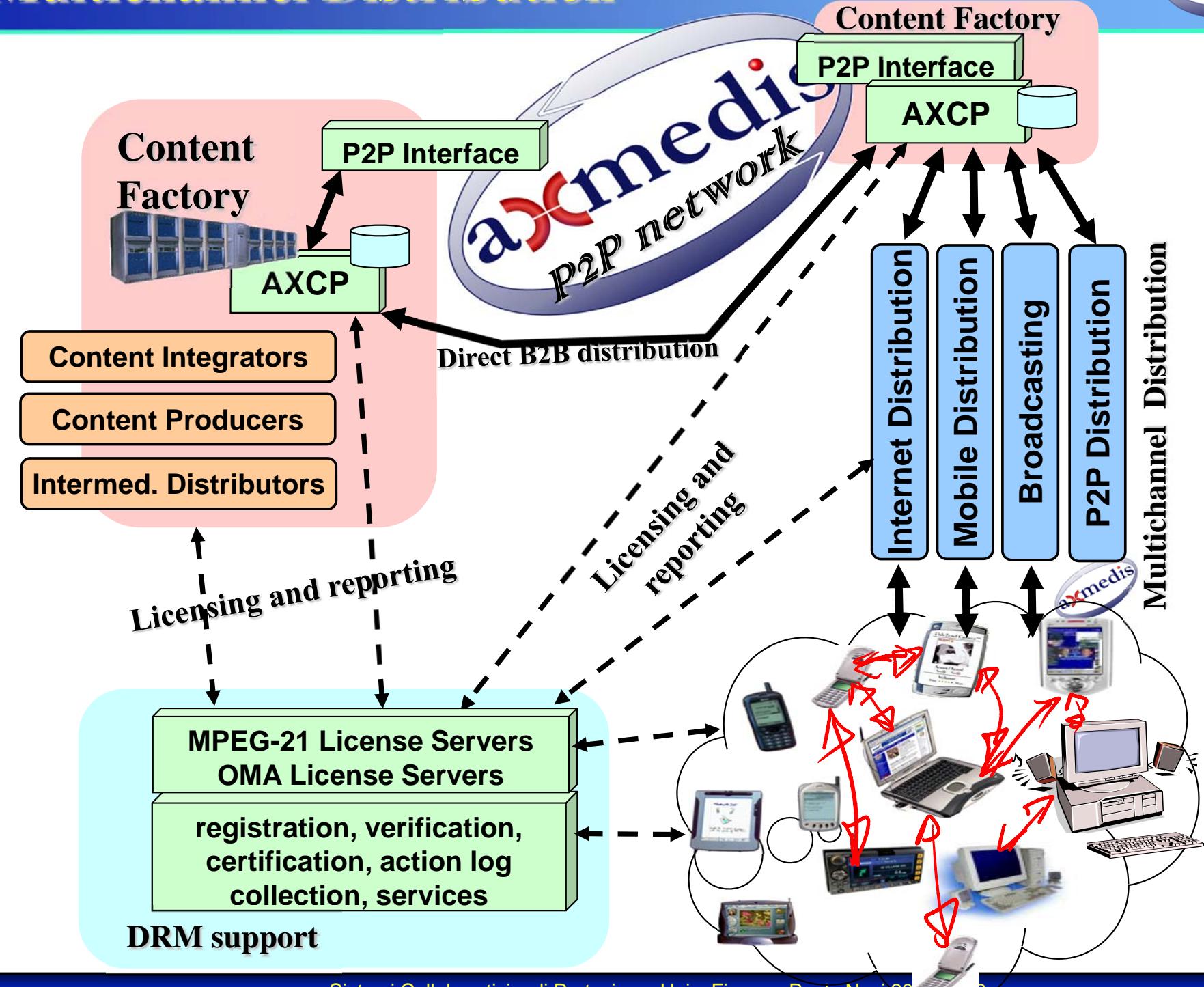
- ◆ reduction of distribution and aggregation costs for content production, protection and management
- ◆ using and exploiting new models, methods and tools for content production, protection and distribution



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



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

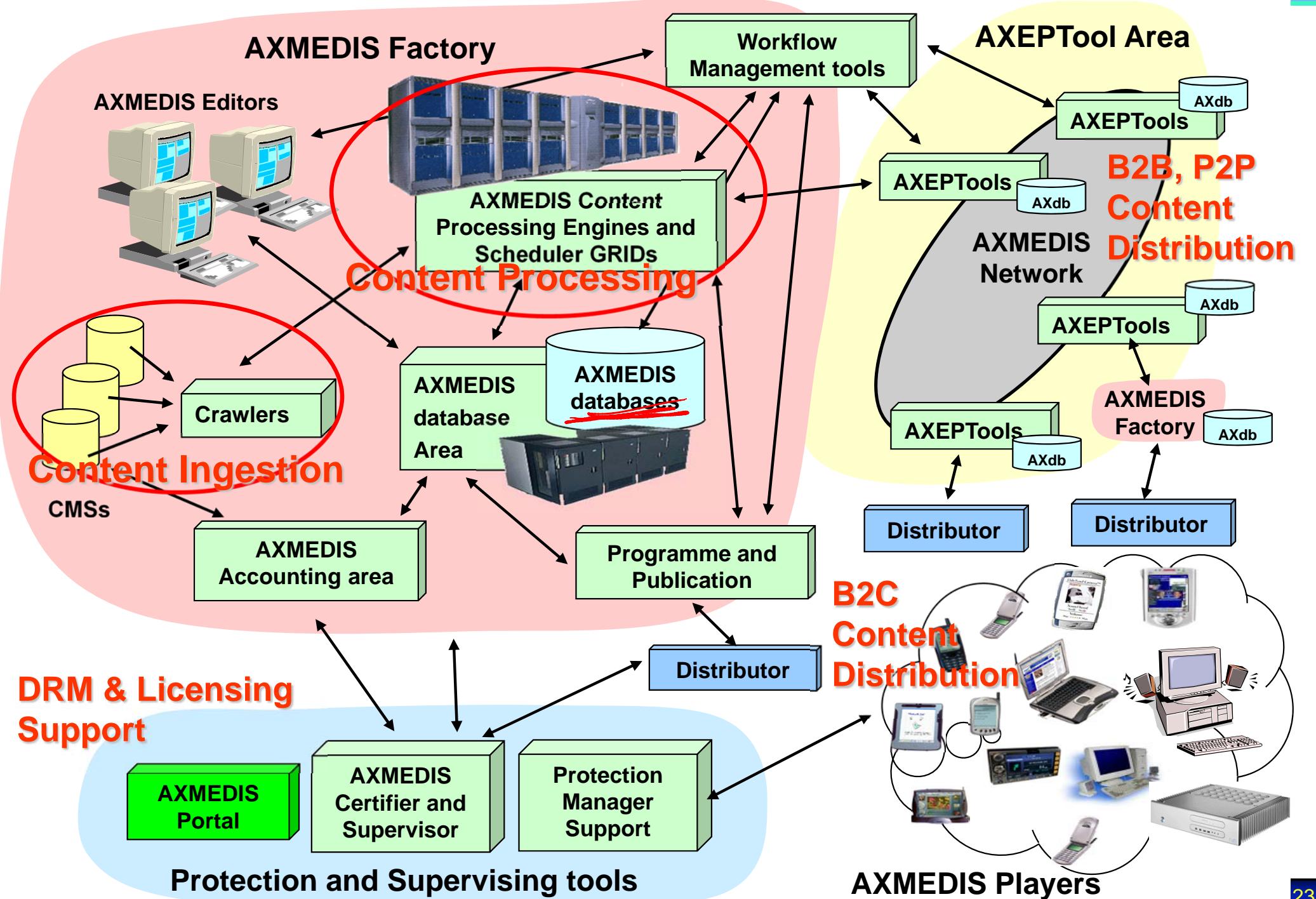
Technical solution for

- ◆ 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.

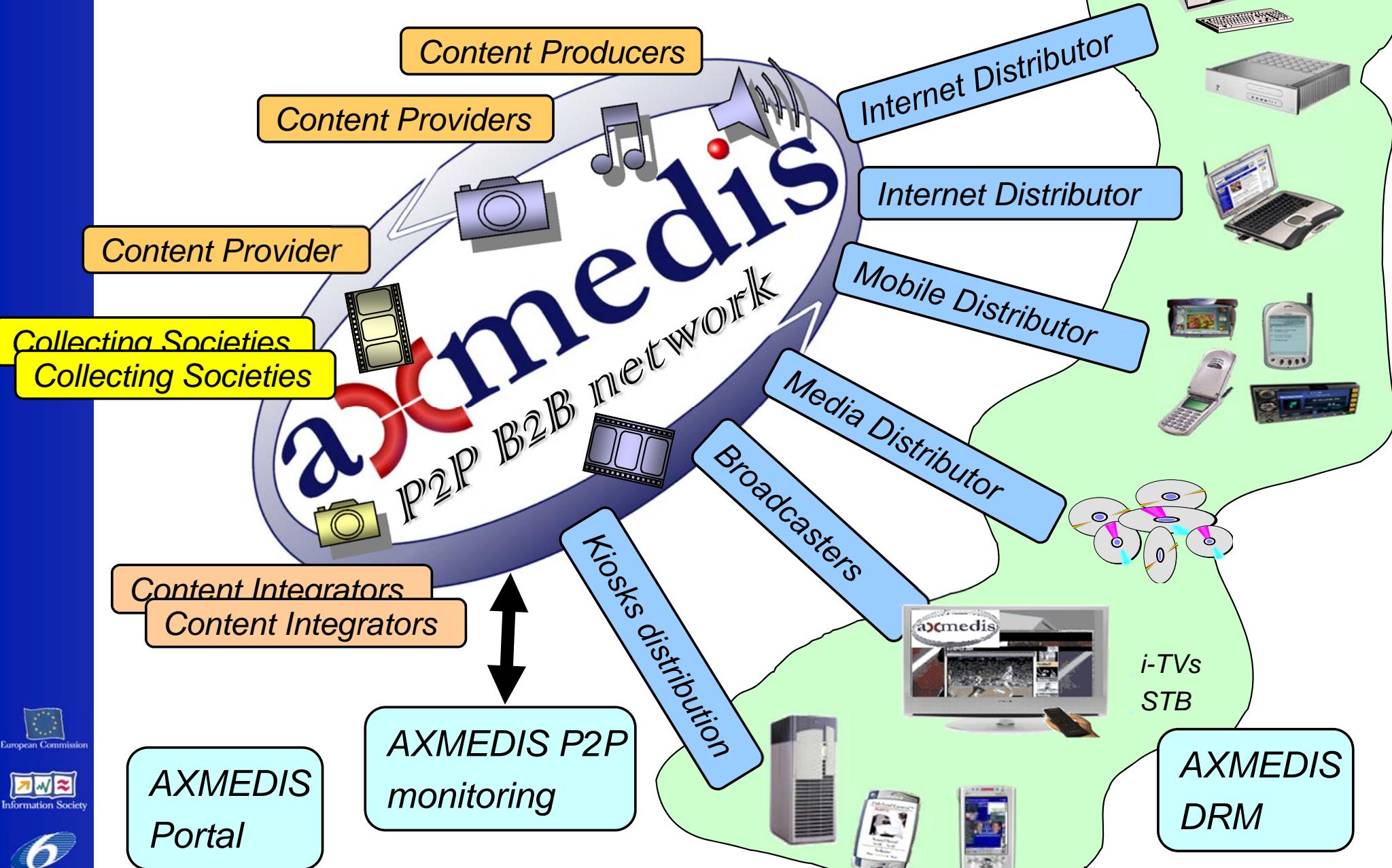
AXMEDIS Framework for all

- ◆ 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





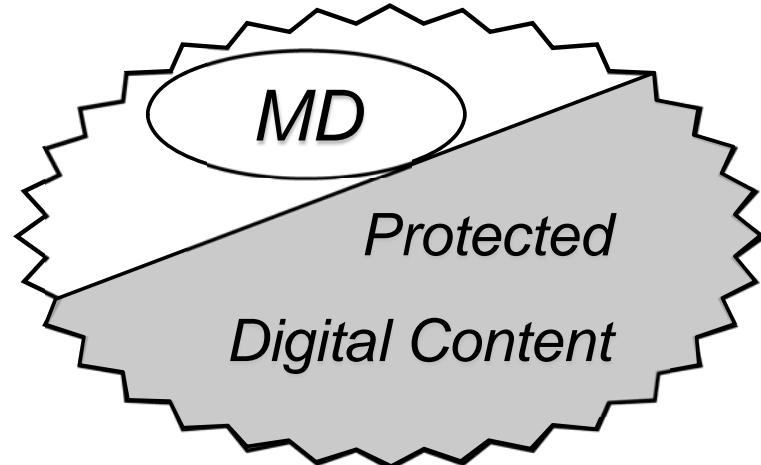
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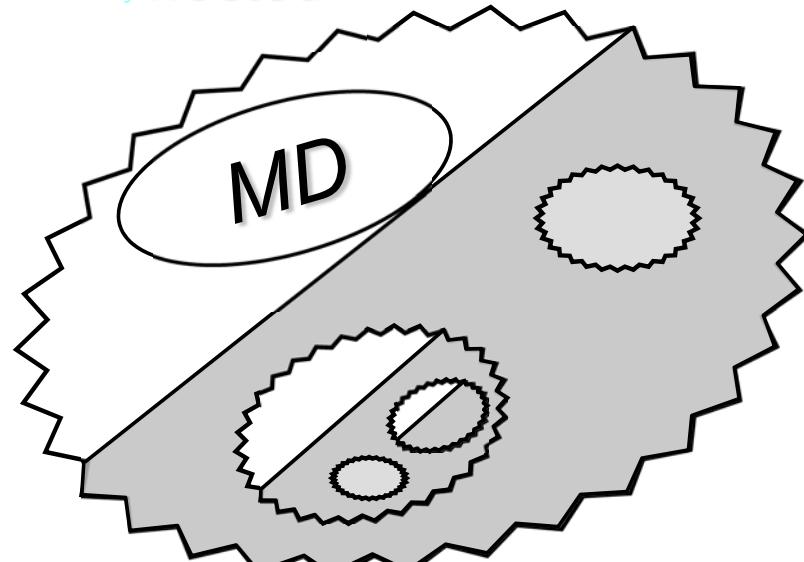
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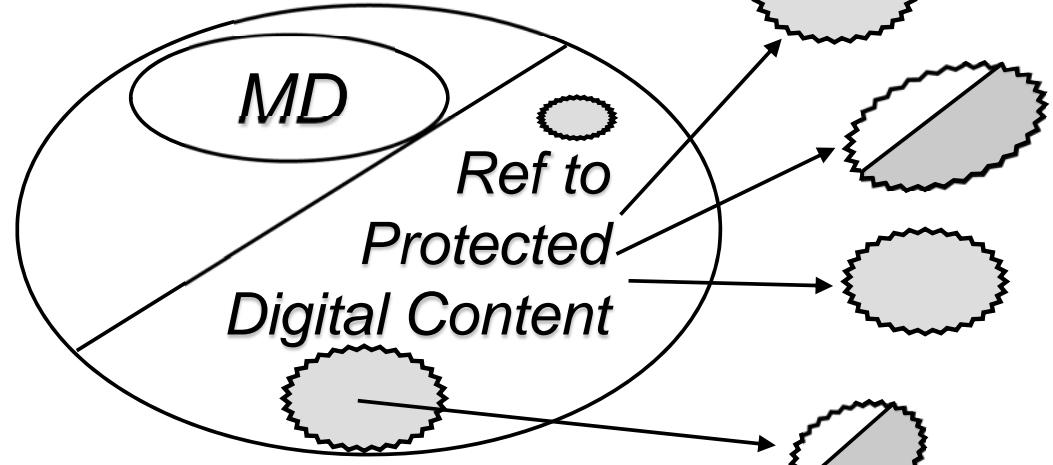
Examples of AXMEDIS objects



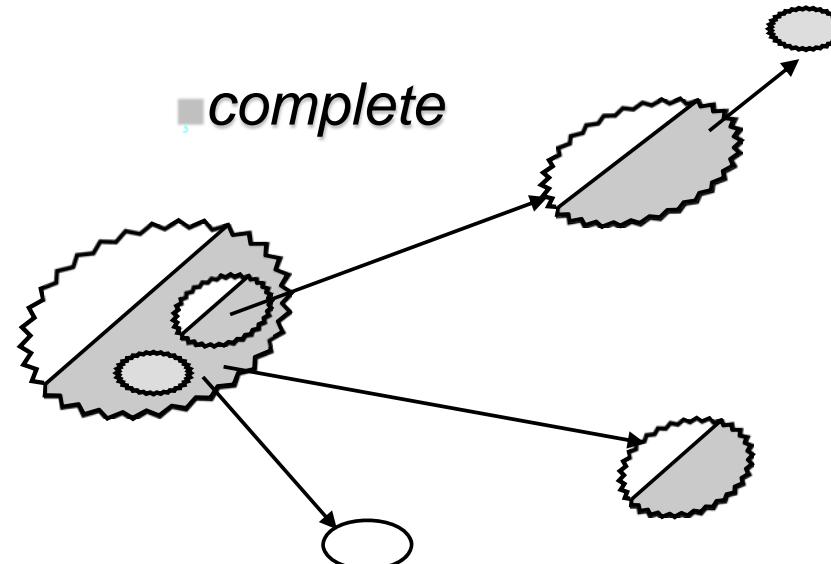
■ *nested*



■ *reference*



■ *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

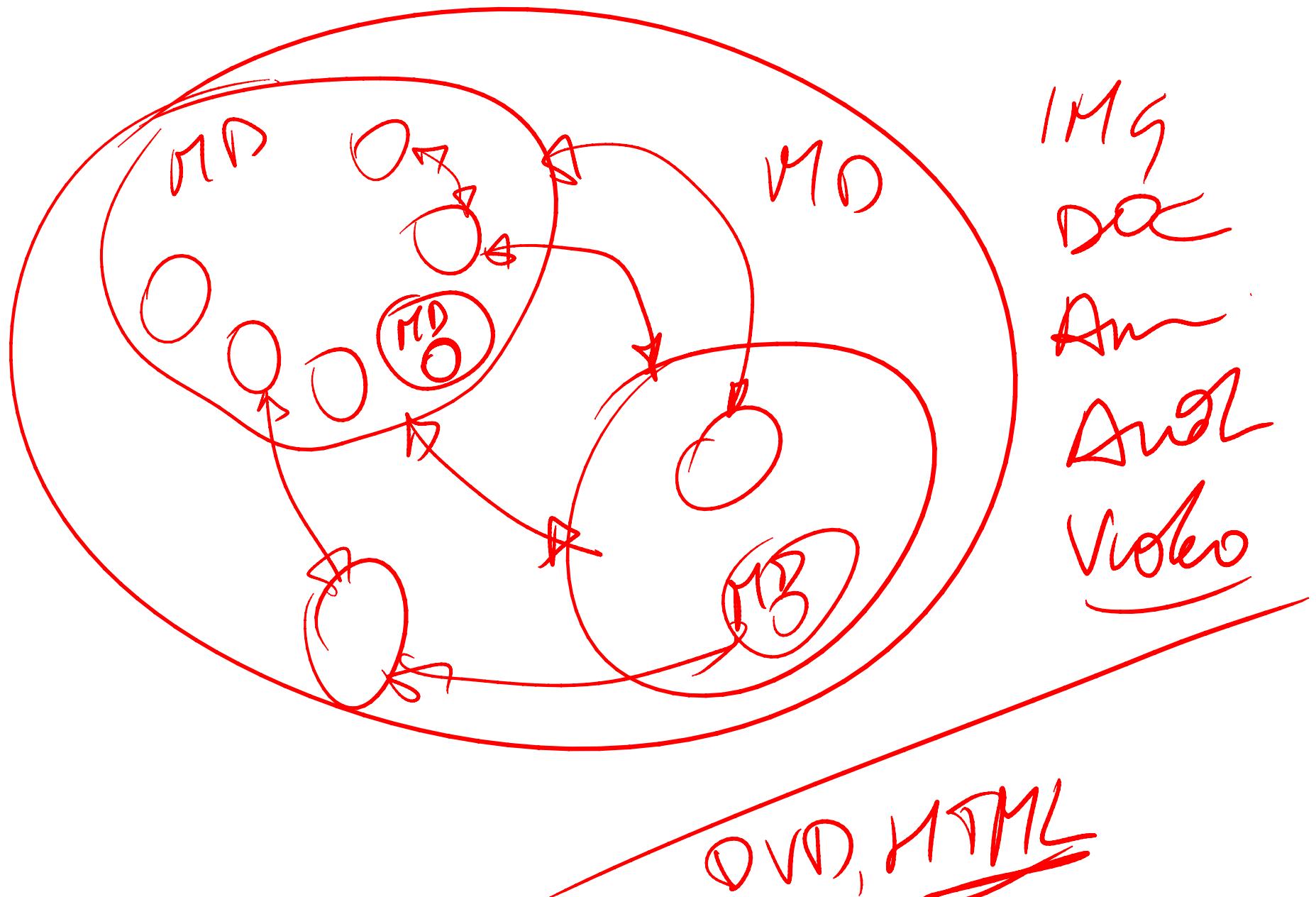
- ◆ Multimedia hierarchies of digital resources such as models based on:
 - ➔ HTML, SMIL, SCORM/IMS, WEDELMUSIC, MPEG-4, etc.
 - ➔ With internal and external links and relationships: *for example one HTML page may be build by using several images and audio files.*
- ◆ **Integration of docs, audio, video,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



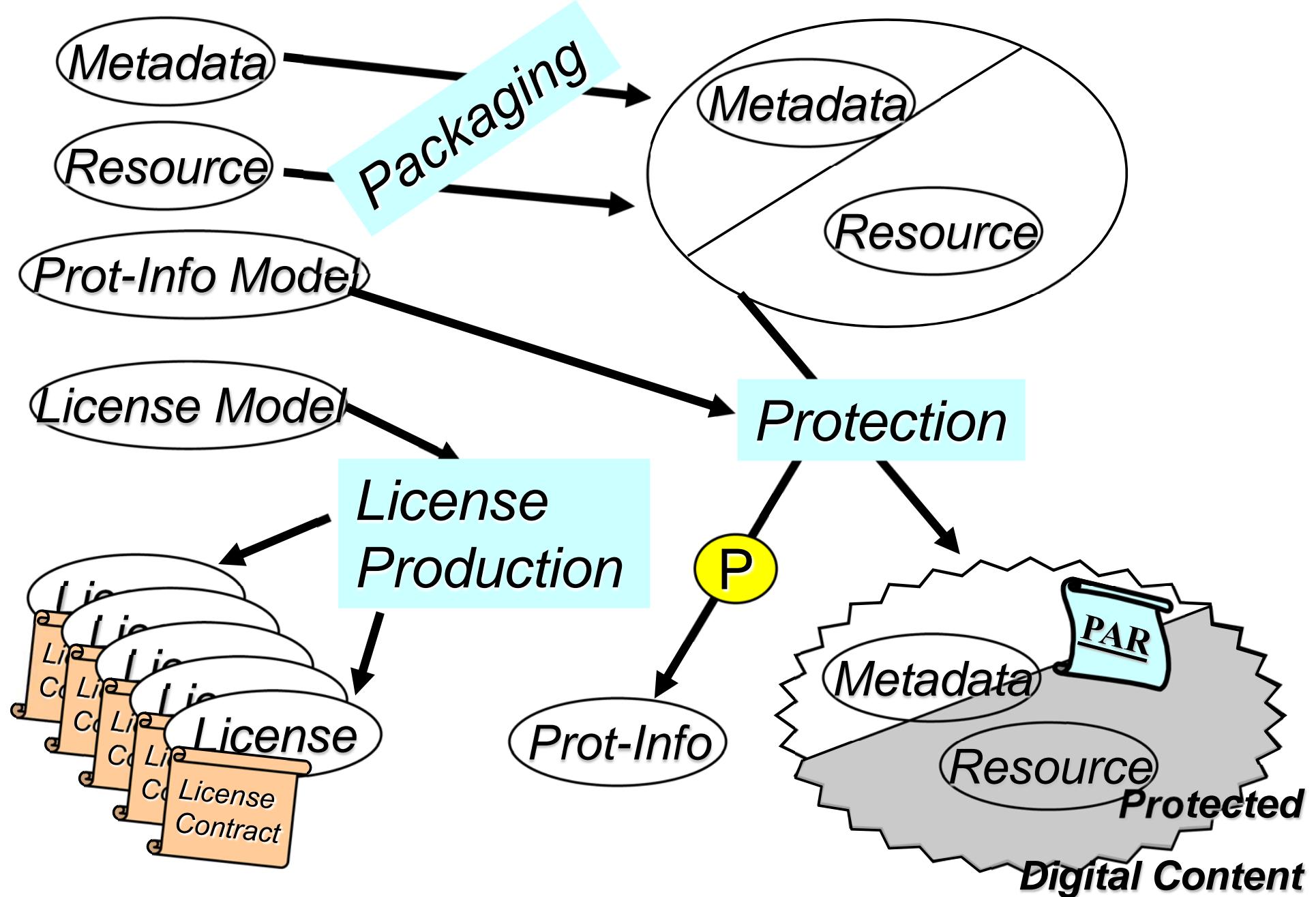
The Content Package in the hands of the final user to be used may need of the following information

- ◆ Metadata.....
- ◆ Digital Resources.....
- ◆ Protection Information....
- ◆ License.....

Cross media content



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:**

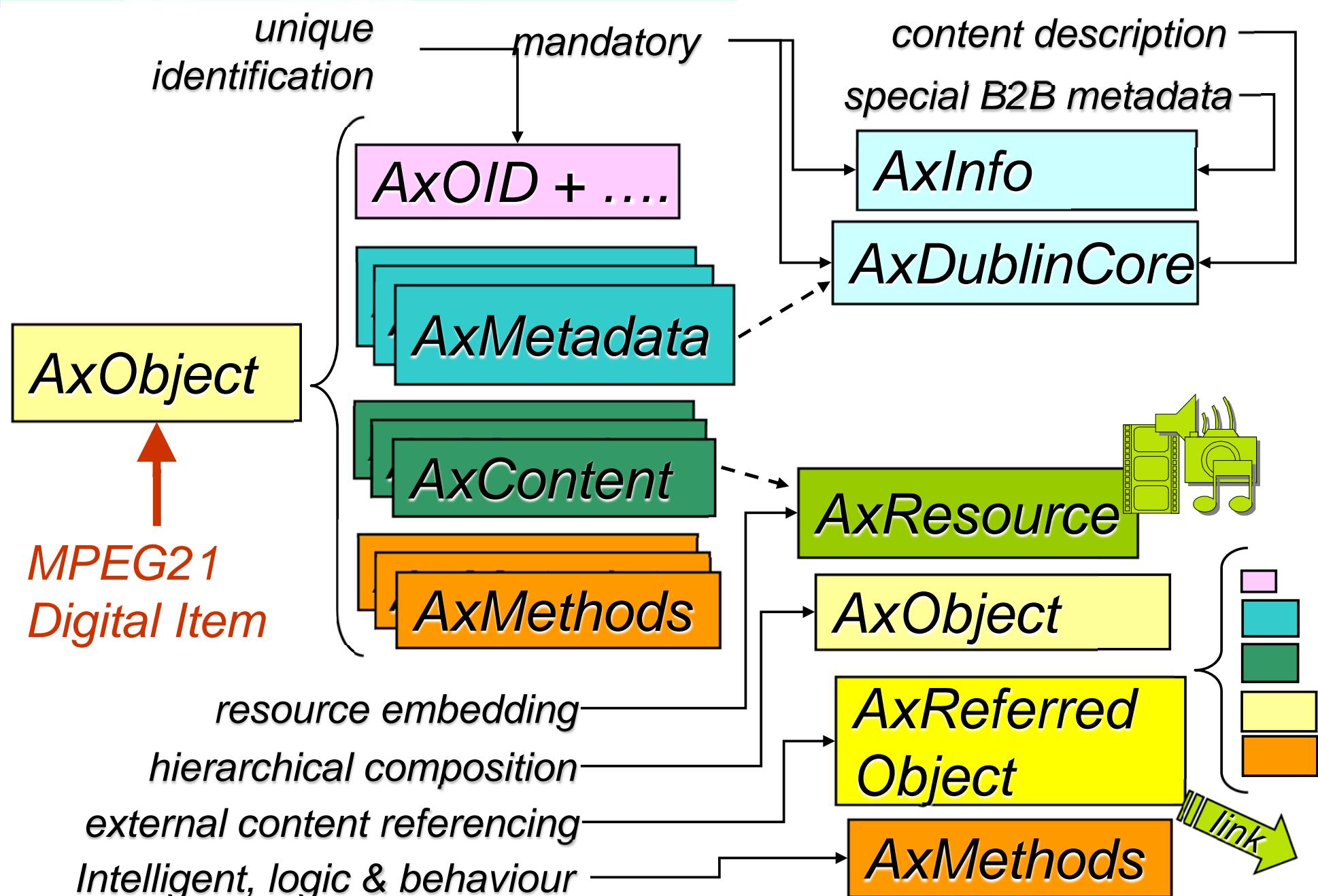
- ◆ Cross media:
 - any kind of metadata and any kind IDs
 - presentation and glue (e.g., HTML, SMIL, SVG), plus
 - digital resource images, documents, video, audio, games, MPEG-4, etc.;
- ◆ Content components: composition and reuse;
- ◆ DRM interoperability: MPEG-21 and OMA
- ◆ DRM Chain of licenses: 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**

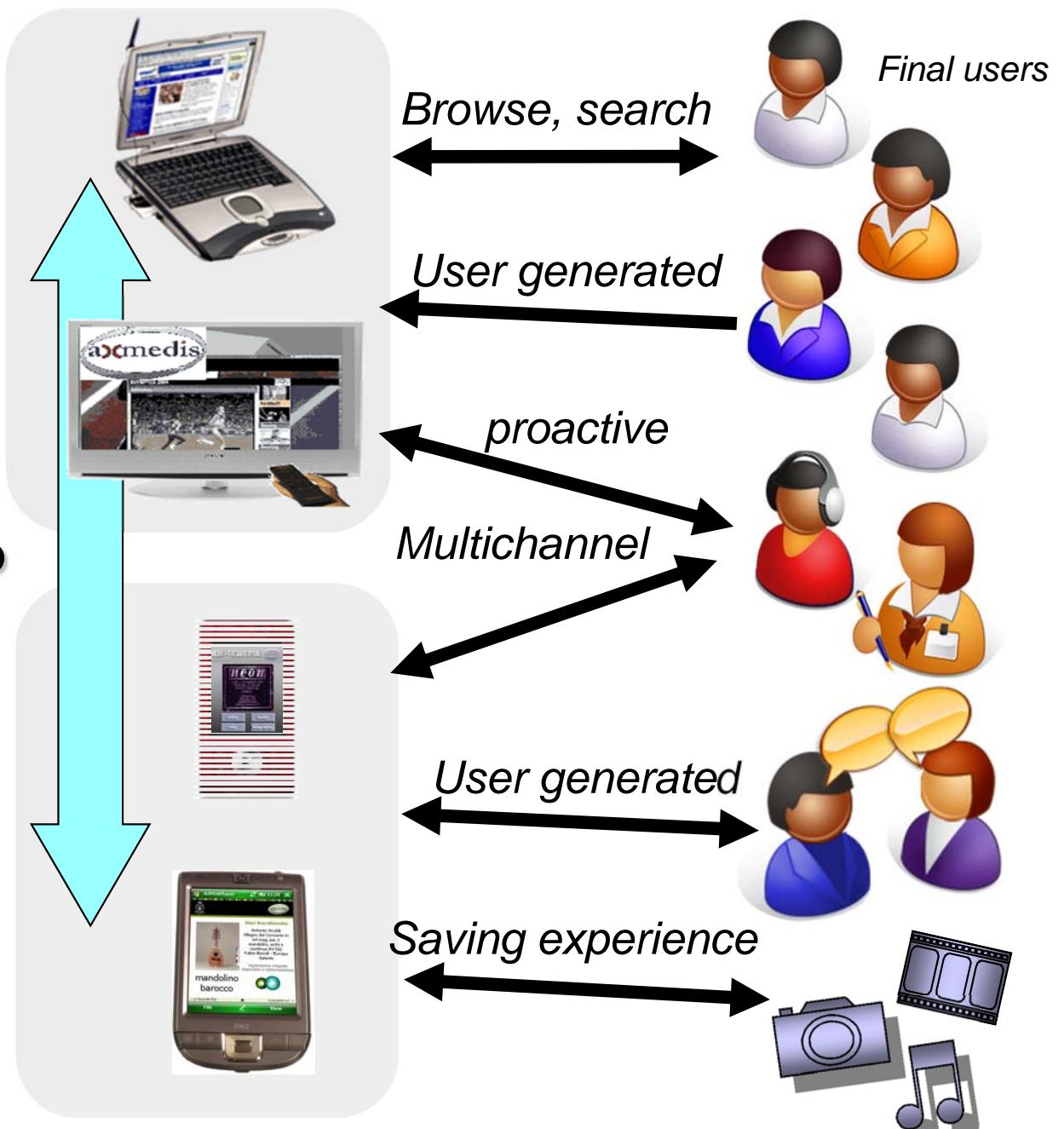
- ◆ legal/secure P2P for B2B and B2C/C2C
- ◆ B2B-B2C content production and transactions, for protected and non protected objects
- ◆ Multichannel distribution



Interactive and intelligent content

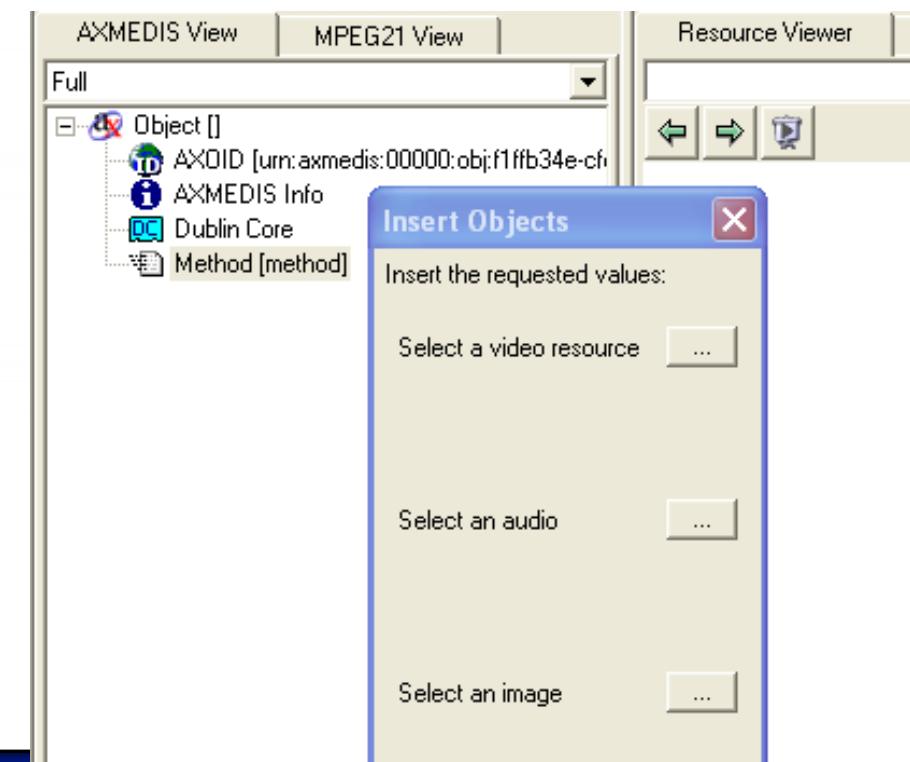


- integrated media info
- proactive with the users
- attractive experience
- personalized
- multichannel
- interoperable
- device interoperable



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

Music Album

AxInfo

- Rights Owner
- Producer
- Distributor

DublinCore

- Title
- Genre
- Authors

- Other Descriptions (e.g. MPEG7)

Album Cover

- Rights Owner
- Producer
- Distributor

- Image
- Author
- Size

Resource
JPG image

Album Lyrics

- Rights Owner
- Producer
- Distributor

- Doc
- Authors
- Format

Resource
PDF

Album Tracks

- Rights Owner
- Producer
- Distributor

- Audio collection
- Time length



Backstage Video

- Rights Owner
- Producer
- Distributor

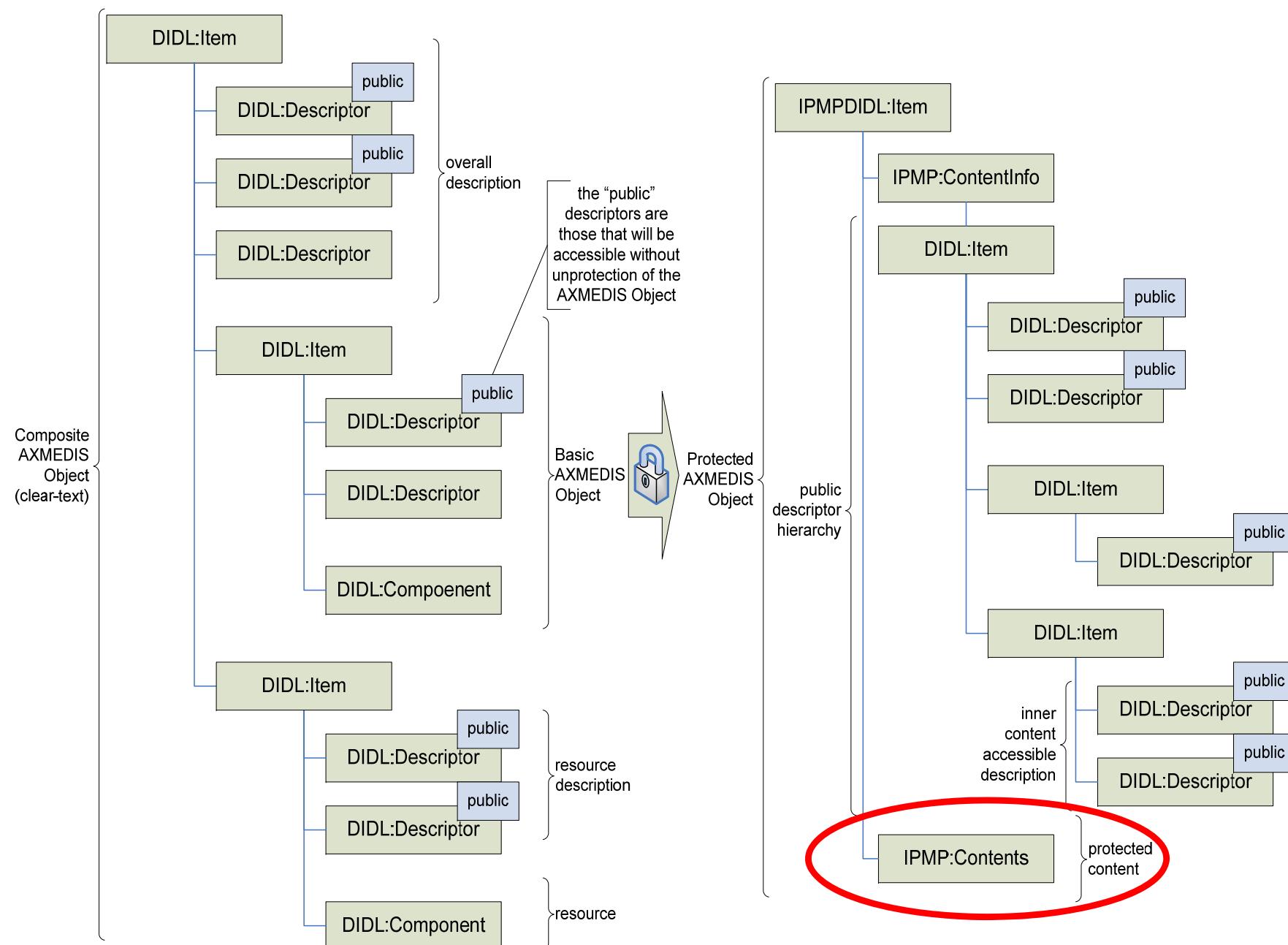
- Video
- Genre
- Authors

- Subtitles Languages
- Playing time
- Resolution

Resource
MPEG2 Video

**Metadata will be
always accessible
for indexing and
querying**

da DIDL a IPMPDIDL



Examples: Intelligent Content

Single Files:

- ◆ audio, video, documents, images, 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

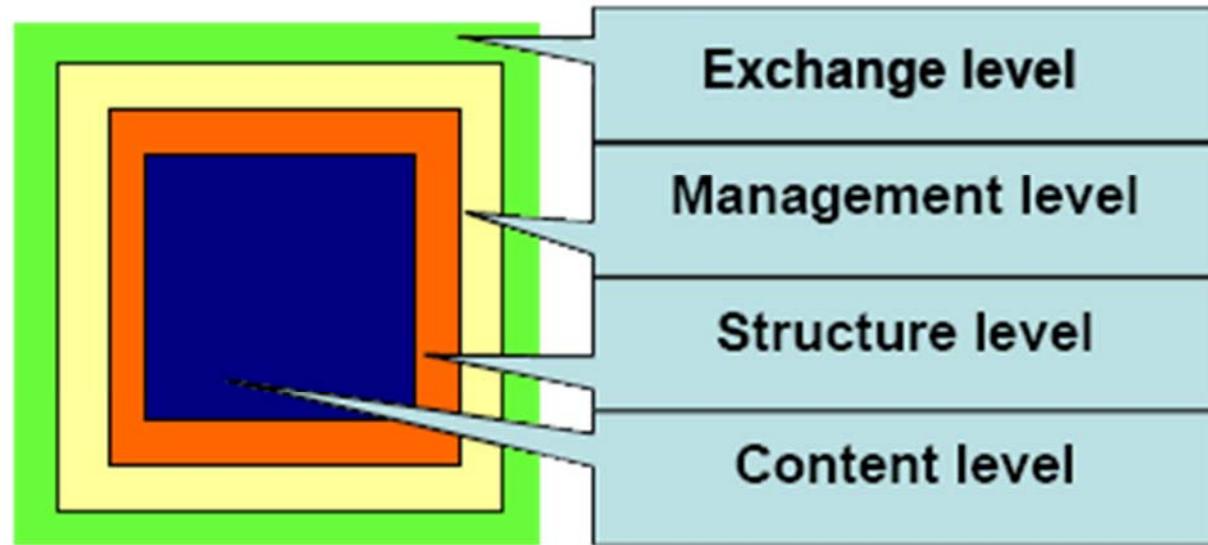
- A large number of cross media content formats: SCORM, MXF, NewsML, MPEG-21, Flash, HTML, etc.
- Major Issues for cross media content (DMS 2008):
 - ◆ Packaging:
 - Metadata and descriptors, Ids
 - Digital essences
 - ◆ Distribution: download, streaming, progressive, P2P
 - ◆ Protection: CAS vs DRM
 - ◆ 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.

- ¿ **Largely diffuse**
 - ◆ Archival and interchange format for news
 - ◆ Family: NewsML, NewsML2, SportML, etc.
- ¿ **Model based on XML (quite sophisticated)**
 - ◆ Classification metadata
 - ◆ Extension of metadata
 - ◆ Usage of dictionaries (*Topic, TopicSet, Catalog*)
 - ◆ Etc.
- ¿ **Packaging with ZIP**
 - ◆ All the files are simply referred from the XML, rarely are encapsulated
- ¿ **Protection: missing**
- ¿ **Distribution: only download**

Structure of the NewsML

■ NewsML : File XML with metadati + resources

*XML structure of
a NewsML
document*



Content Level

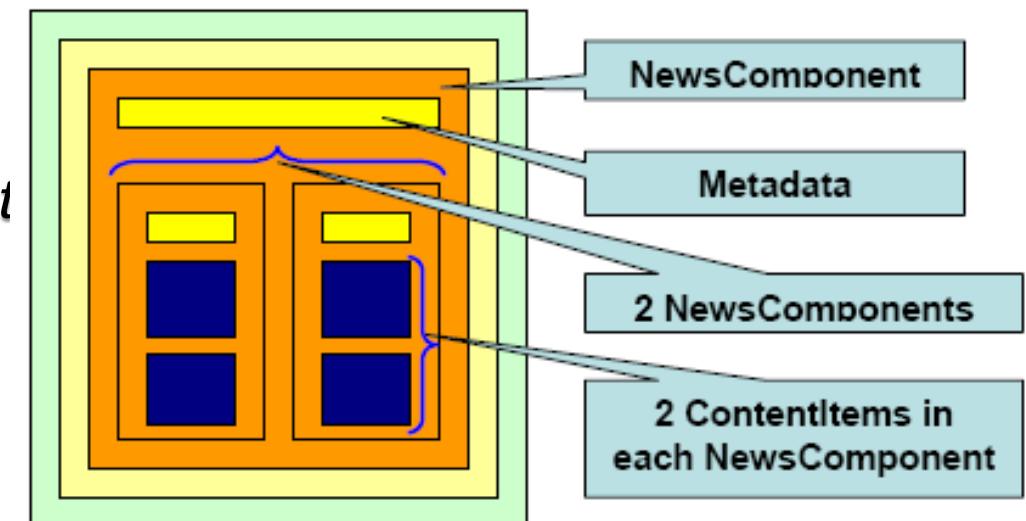
→ *ContentItem*

Structure Level

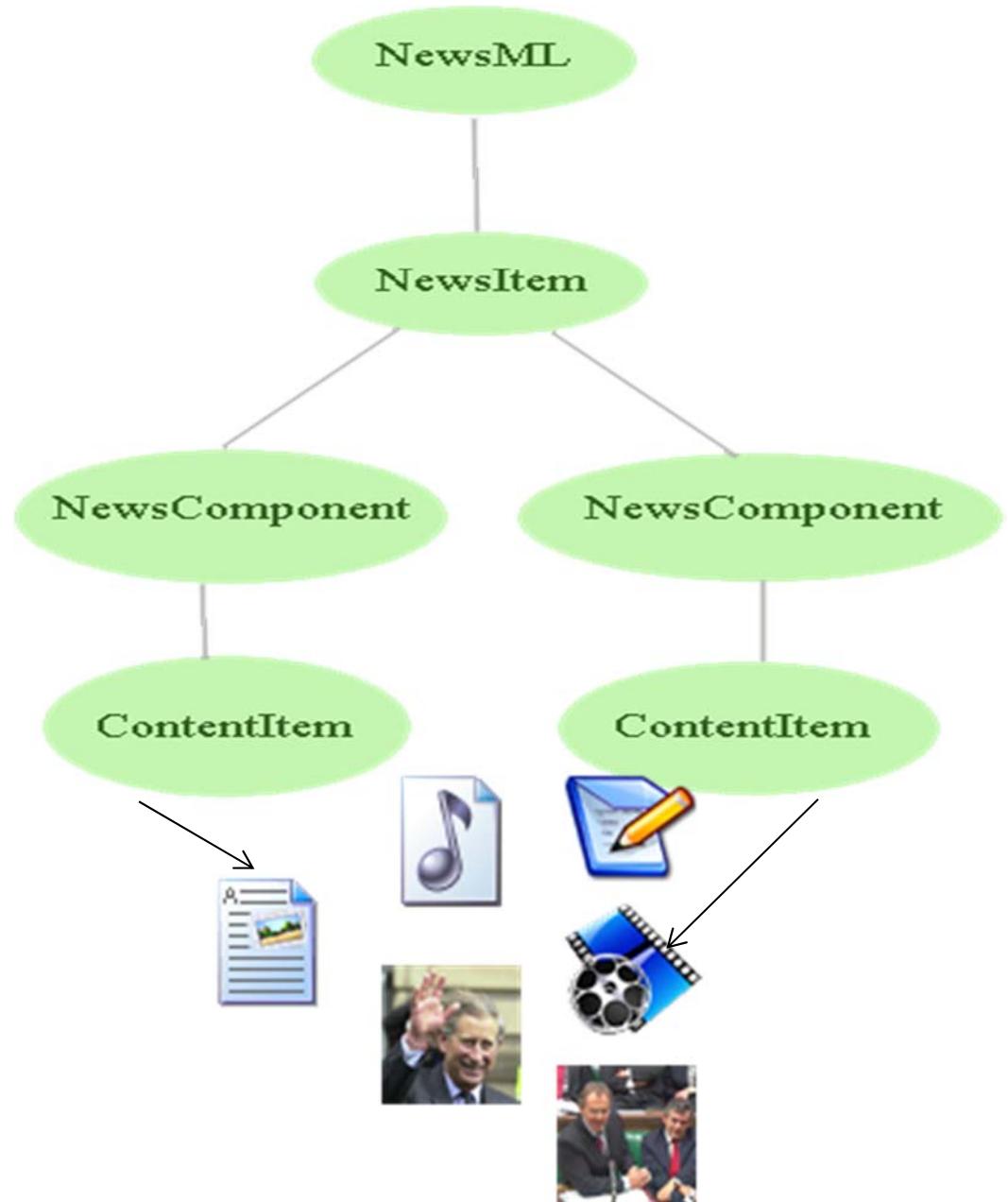
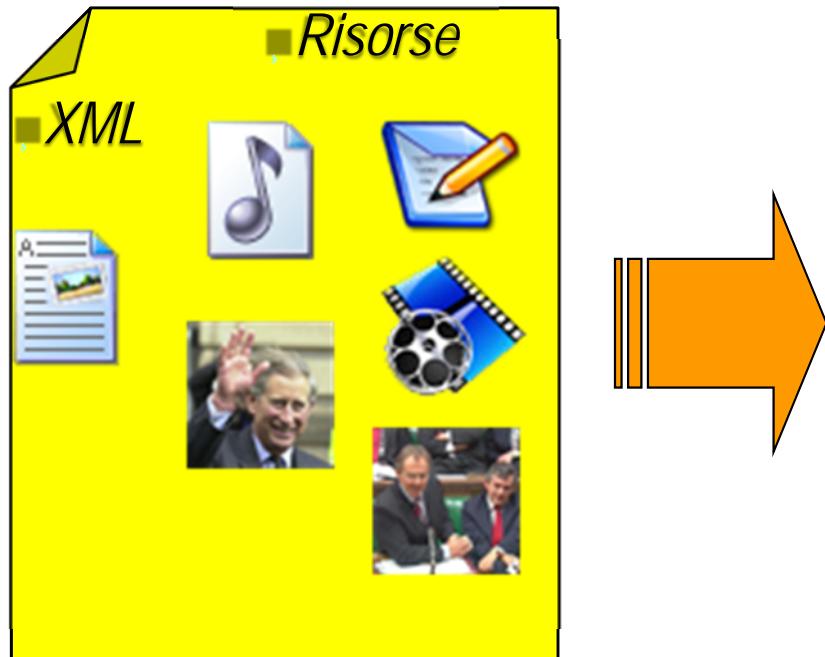
→ *NewsComponent*

Management Level → *NewsItem*

Exchange Level → *NewsML*



Example of NewsML



Problems of NewsML

Packaging: zip

- ◆ All the files are simply referred from the XML, rarely encapsulated
- ◆ Consistency and Completeness of the PACK is has to verify since the digital essences are only referred with some IDs or file names that may be changed, lost, etc...

Protection: simple CAS

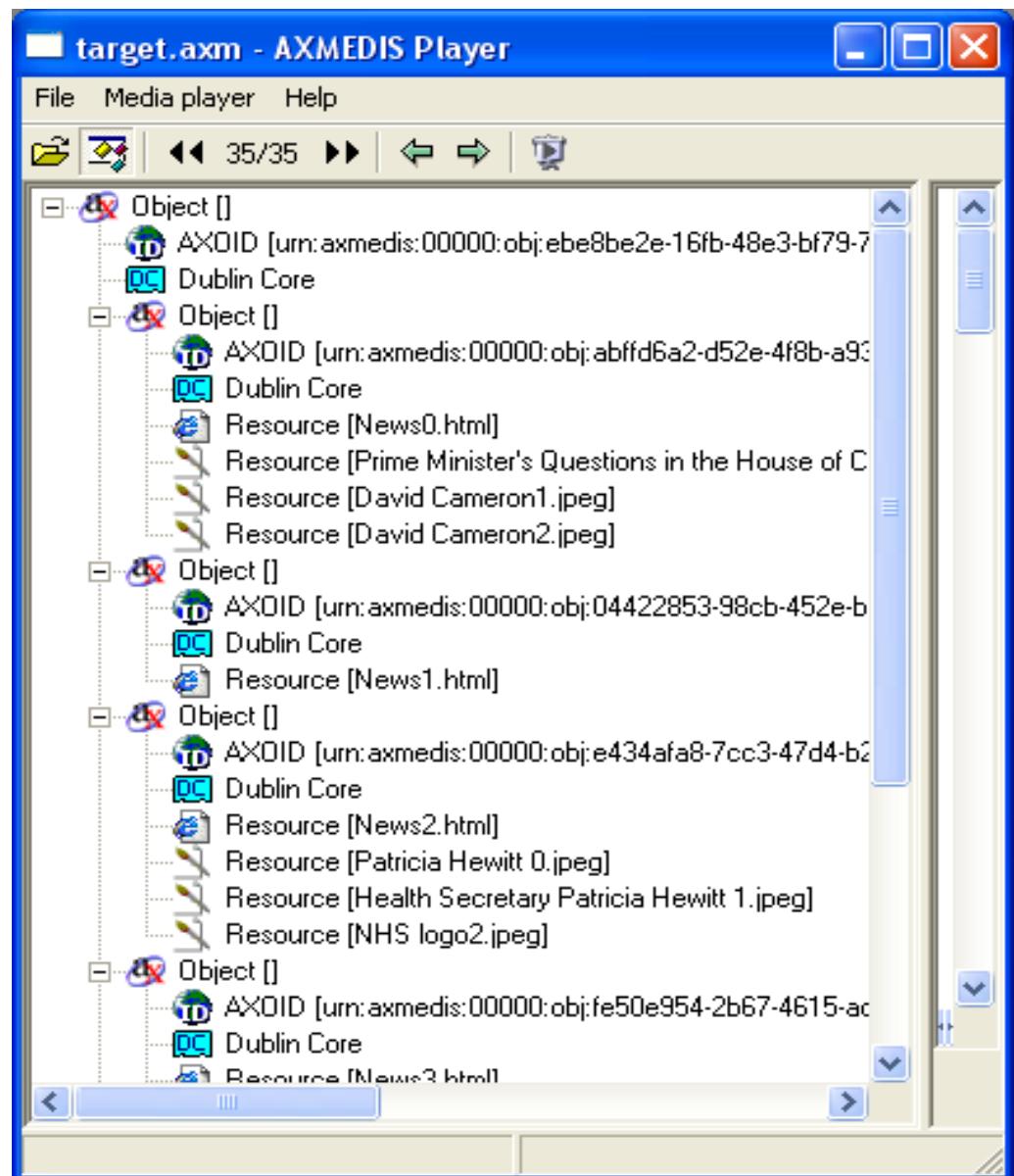
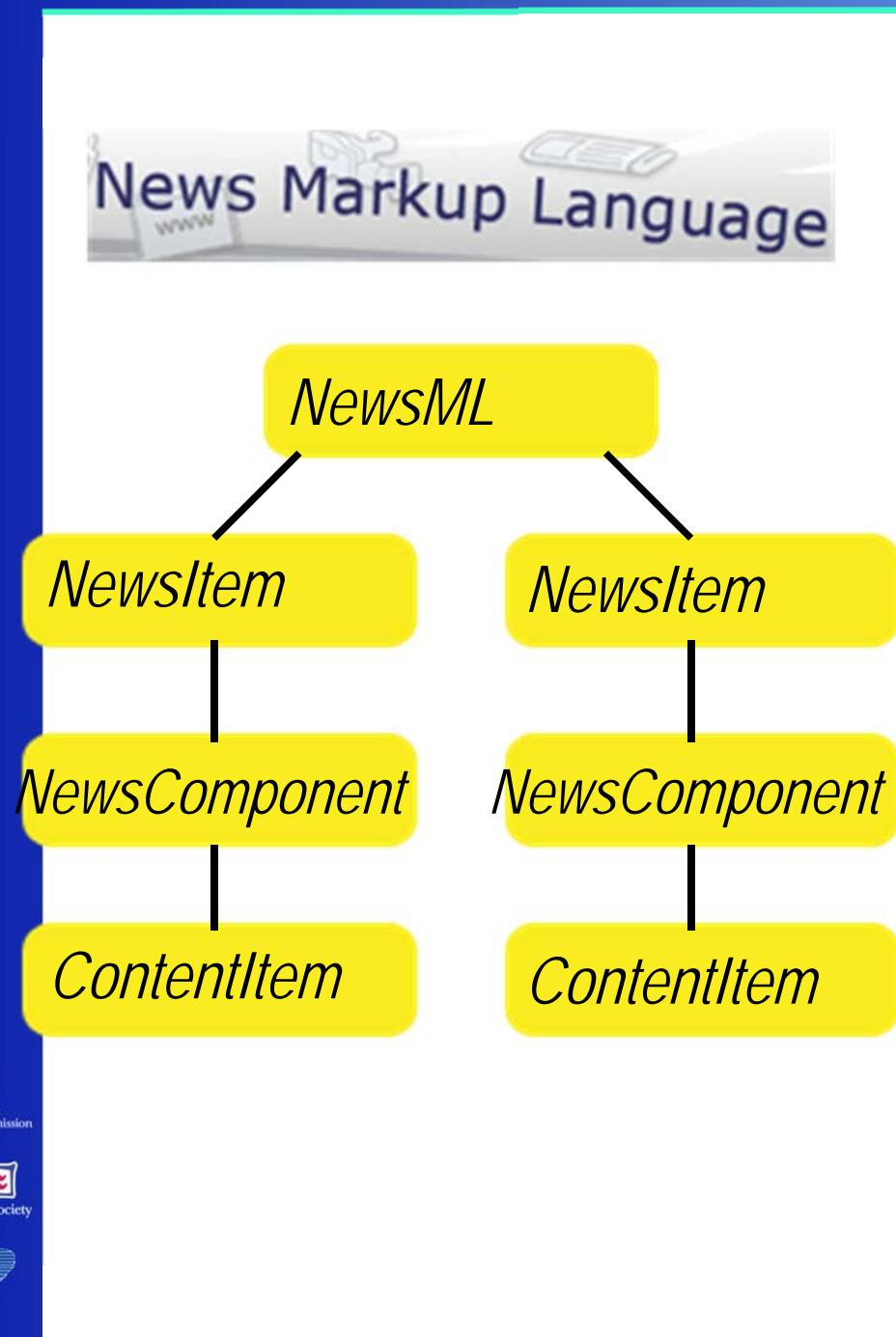
- ◆ Possibly to use come CAS on ZIP based on password
- ◆ no IPR formalization of rights, no licensing models and tools
- ◆ no protection and no enforcement into players/editors/tools

Distribution: only download

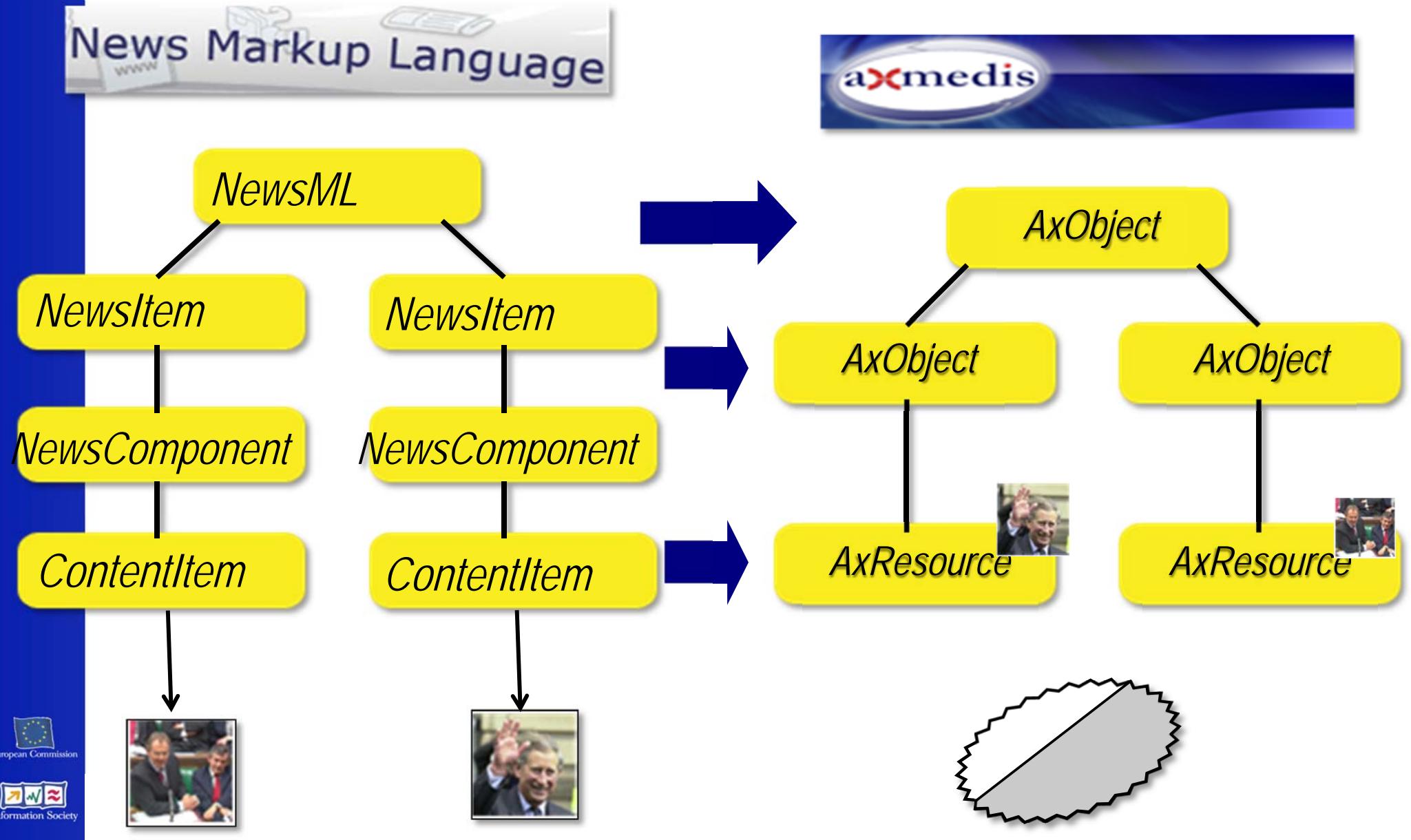
- ◆ Impossible for large file that have to opened to play them,
- ◆ for example: *to access at a news with a video of 500 Mbyte one has to fully download, unpack and then to play the video.*

Intelligence: missing

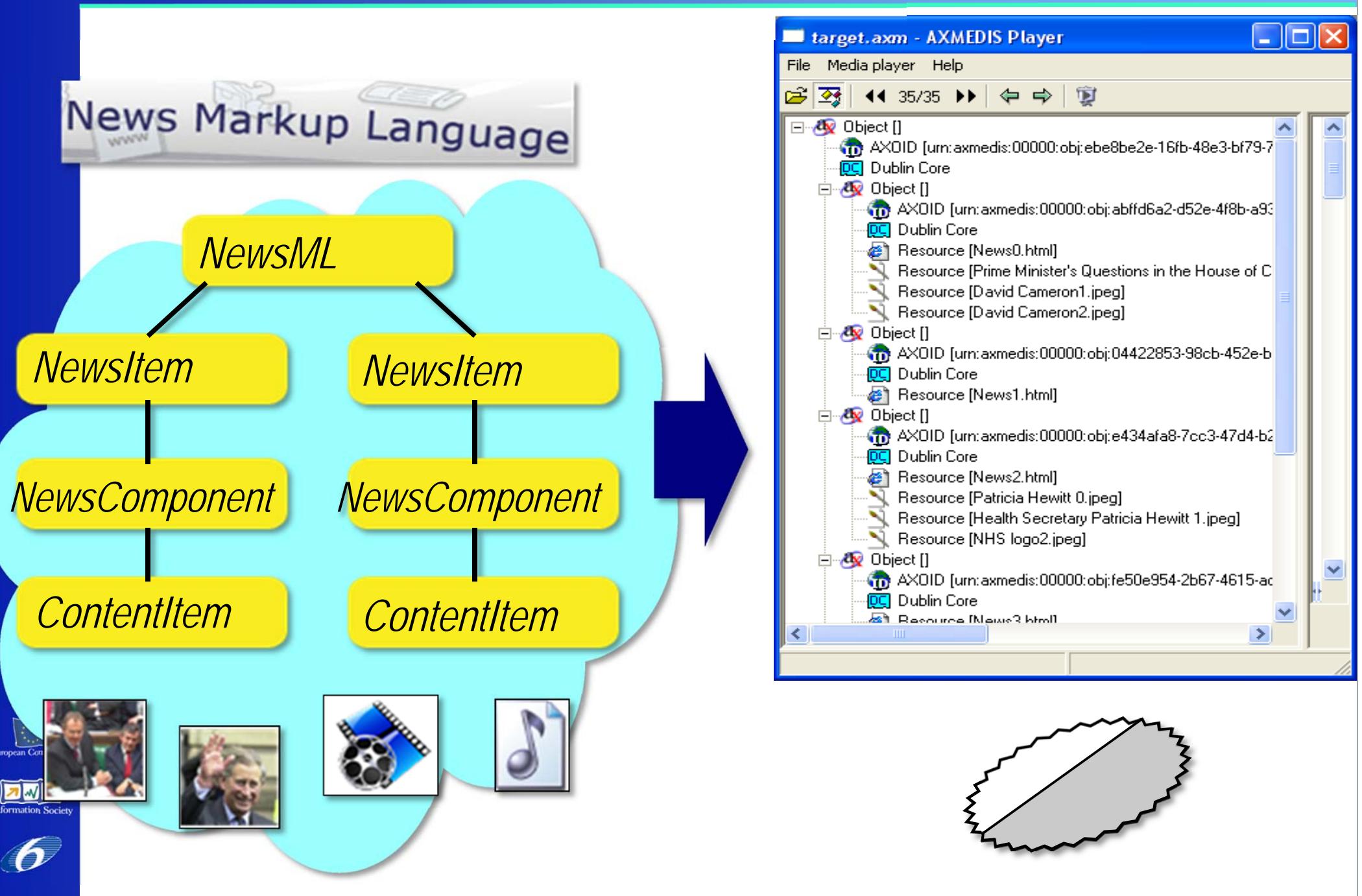
- ◆ No content behavior, no profile/descriptors taken into account, etc.
- ◆ No proactive with Users
- ◆ For instance: internal search into the notice, extraction of elements on the basis of rights, etc.



From NewsML to AXMEDIS



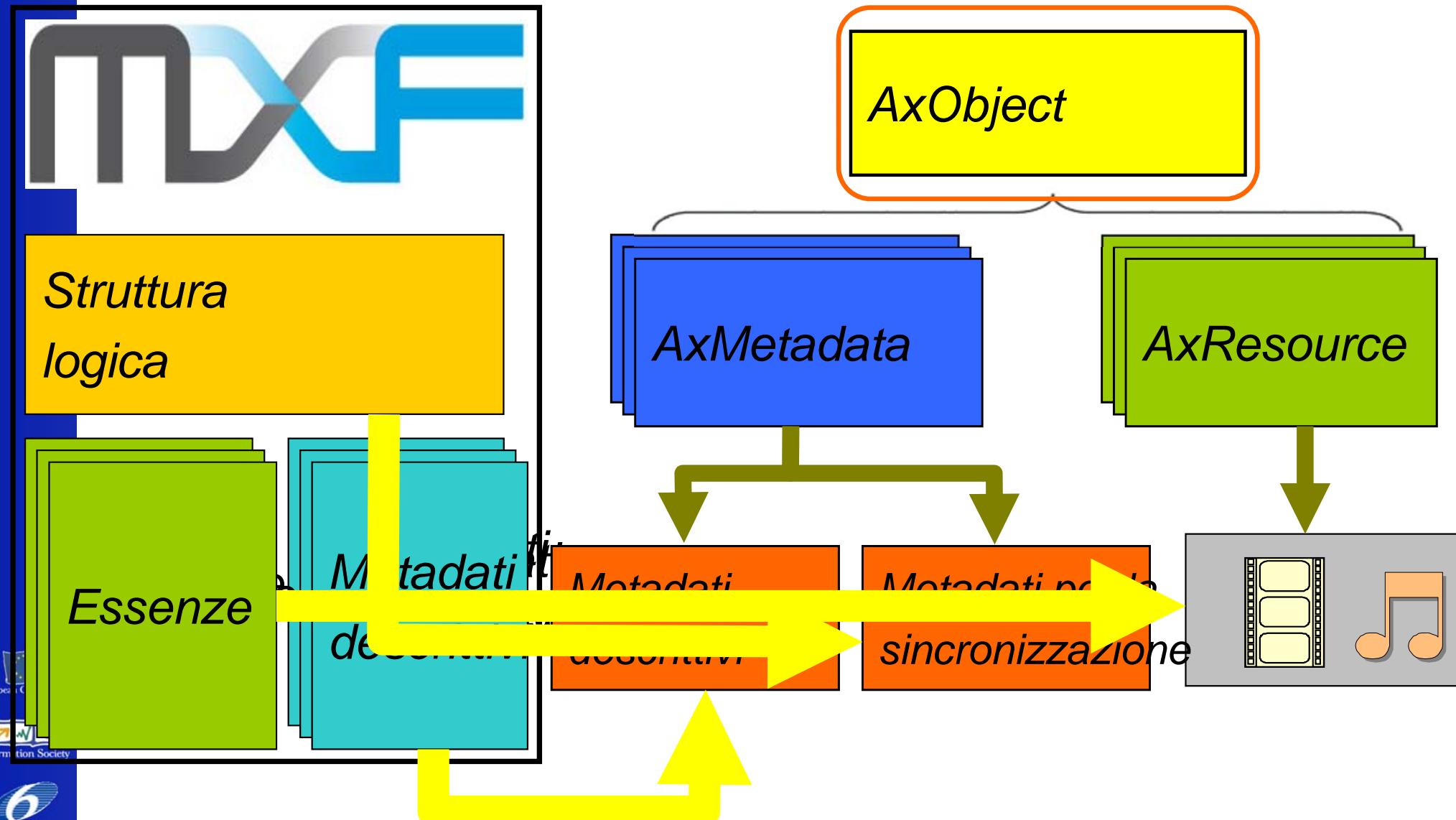
From NewsML to AXMEDIS



Conversione MXF→AxObject



ogni elemento di MXF viene convertito in un elemento dell'AxObject, quindi non c'è perdita di informazioni.



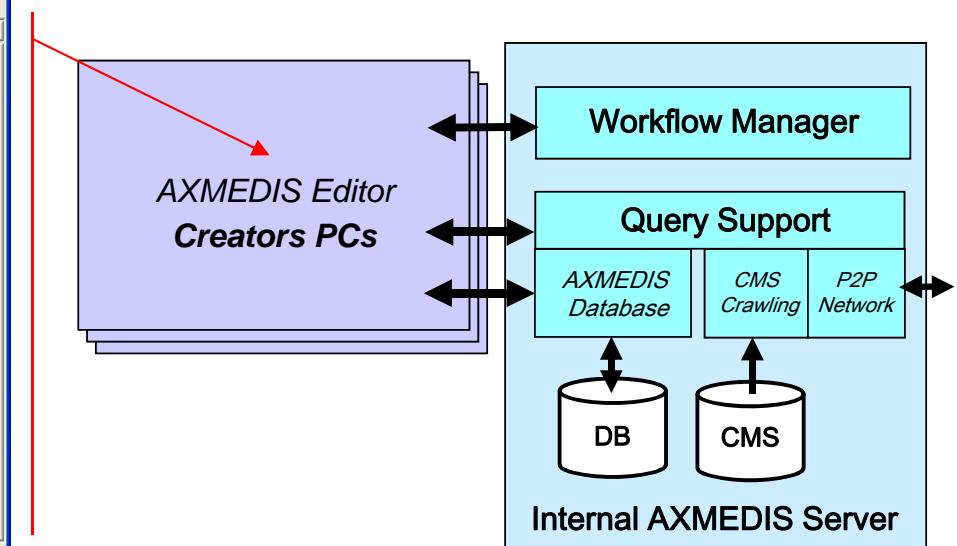
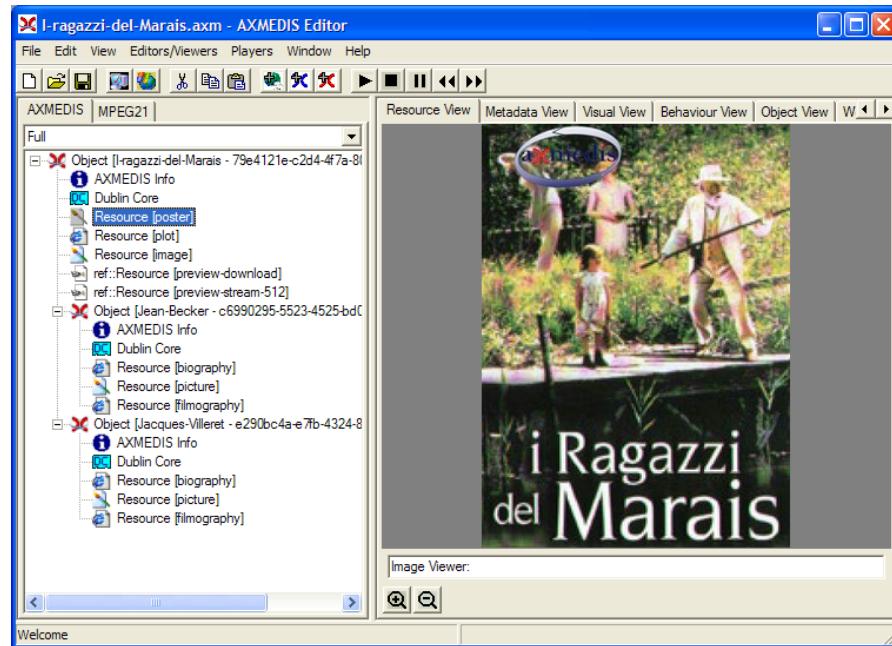
Major Tools

- **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



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



- **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**

AXMEDIS Content Model

AxObject

AXOID

AxInfo

Dublin Core Metadata

AxMetadata (any text or XML)

AxResource (any digital resource)

AxObject

AxMethod

AxAnnotation



Metadata

***any number of
AxResource, AxObject or
AxProtectedObject***

the AxObject “intelligence”

*Annotations of
internal/external resources*

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

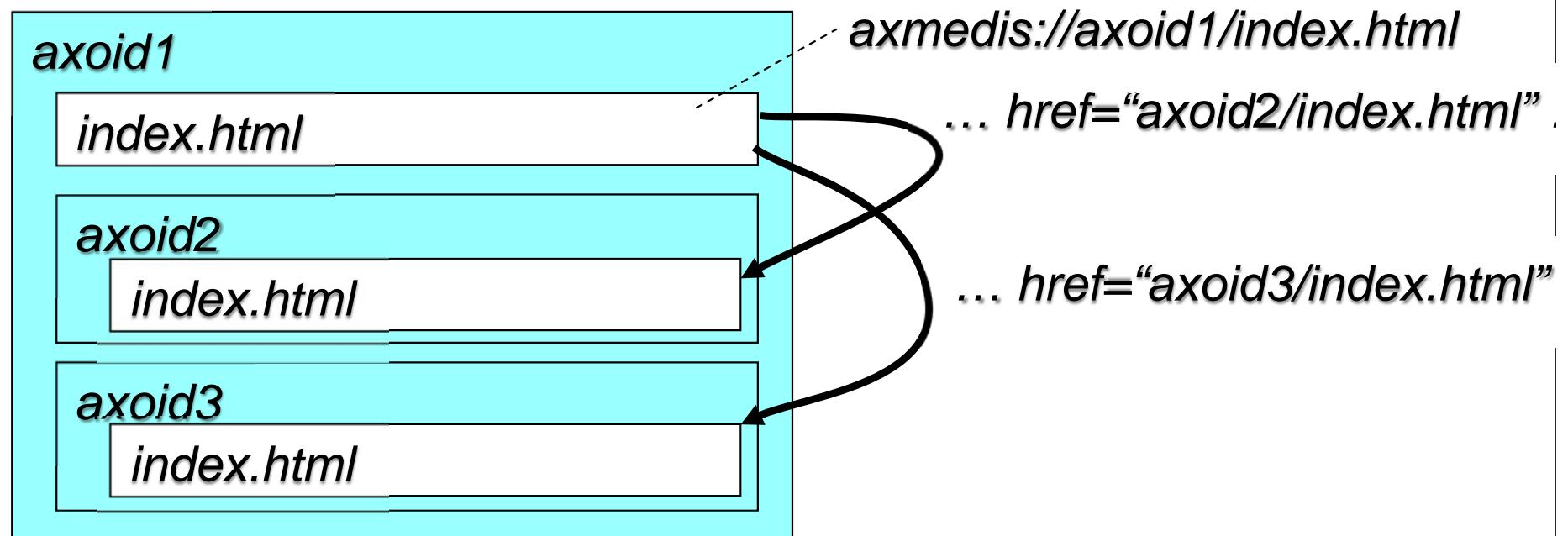
```
function index() {  
    var c=axDocument.getContent()  
    var html="<html><body>"  
    foreach(r in c) {  
        if(c[r] instanceof AxResource)  
            html+="<a href=\""+  
            "+c[r].localPath+"\">Resource</a><br>"  
    }  
    html+="</body></html>"  
    var axr=new AxResource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

2 URL to locate an AxResource

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

3 URL to locate an AxMethod

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



Example

Actors-Collection-DIP-TEST.axm - AXMEDIS Player

File Media player Help

Object [] AXOID [um:axmedis:00000:obj:c679fc5] Dublin Core

Object [Aaron-Hamick] AXOID [um:axmedis:00000:obj:c679fc5] Dublin Core

Dublin Core

Resource [Aaron-Hamick/biograph

Resource [Aaron-Hamick/pictur

Resource [Aaron-Hamick/filmog

Object [Alfred-Abel]

Object [Anders-W.-Berthelsen]

Object [Andrea-Renzi]

Object [Anna-Levine]

Object [Anne-Baxter]

Object [Ayesha-Dharker]

Object [Aylin-Yay]

Object [Barbara-Bates]

Object [Barbara-Stanwyck]

Object [Bary-Sullivan]

Object [August-Diehl]

Resource [test-get.html]

Method [findAutor]

Method [filmography]

Method [findautorGET]

Actors-Collection-DIP-TEST.axm - AXMEDIS Player

File Media player Help

Object [] AXOID [um:axmedis:00000:obj:c679fc5] Dublin Core

Object [Aaron-Hamick] AXOID [um:axmedis:00000:obj:c679fc5] Dublin Core

Dublin Core

Resource [Aaron-Hamick/biograph

Resource [Aaron-Hamick/pictur

Resource [Aaron-Hamick/filmog

Object [Alfred-Abel]

Object [Anders-W.-Berthelsen]

Object [Andrea-Renzi]

Object [Anna-Levine]

Object [Anne-Baxter]

Object [Ayesha-Dharker]

Object [Aylin-Yay]

Object [Barbara-Bates]

Object [Barbara-Stanwyck]

Object [Bary-Sullivan]

Object [August-Diehl]

Resource [test-get.html]

Method [findAutor]

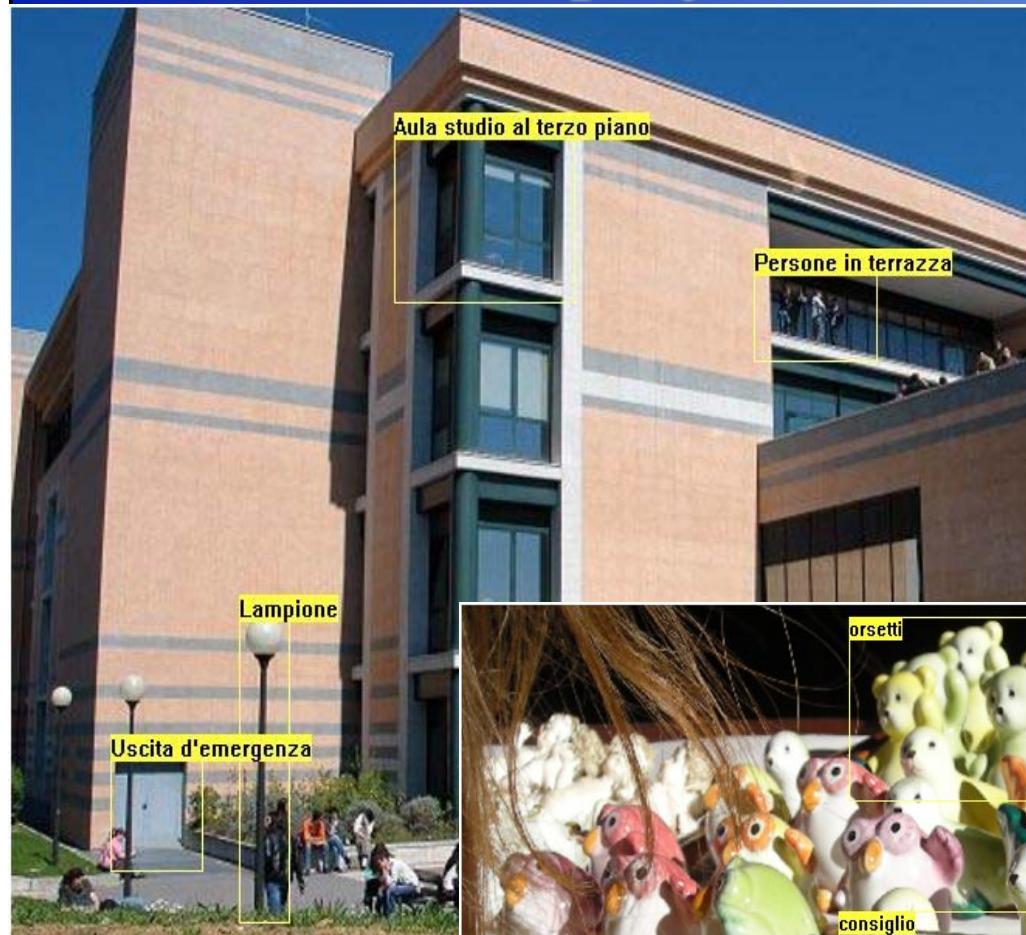
Method [filmography]

Method [findautorGET]

Search Results for: 'an':

	Anders W. Berthelsen:
<ul style="list-style-type: none">Anders-W.-Berthelsen/filmography	
	Andrea Renzi :
<ul style="list-style-type: none">Andrea-Renzi-/biographyAndrea-Renzi-/filmography	
	Anna Levine:
<ul style="list-style-type: none">Anna-Levine/biographyAnna-Levine/filmography	

AXMEDIS player with annotations



object_test.axm - AXMEDIS Player

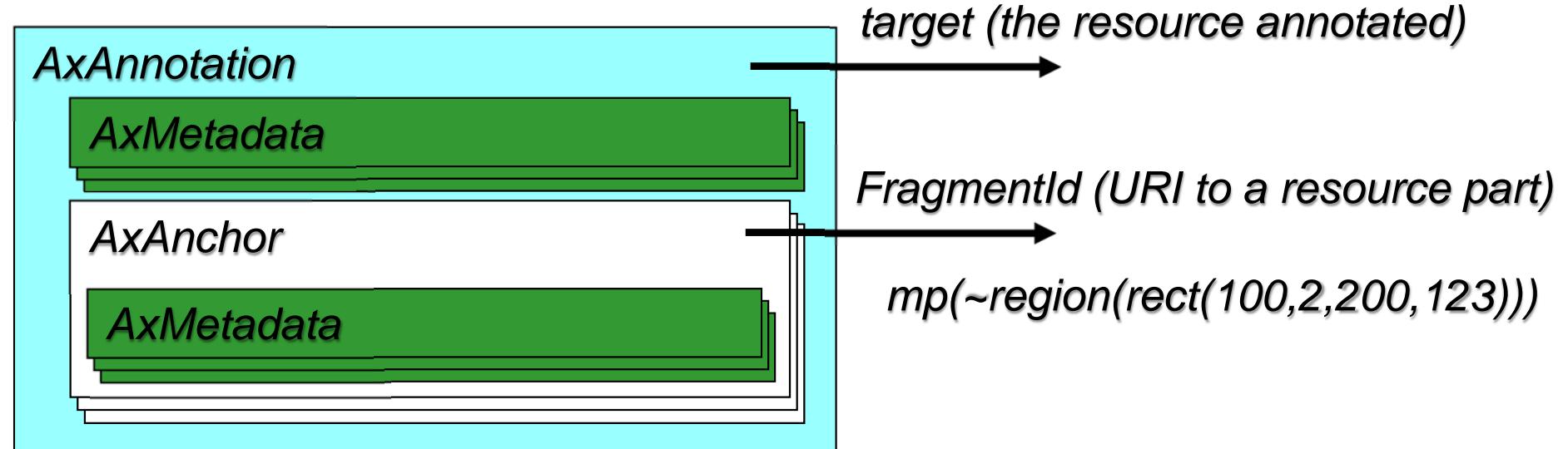
File Play Resource panel Help

Load... Ctrl+L
Fit Alt+F
Zoom in Ctrl+I
Zoom out Alt+U
Zoom
Auto Fit Alt+A
Fullscreen Ctrl+F
Set background color...
Rotate figure
Mirror figure
Select region
Show annotations
Add annotation...
Remove annotation...
Edit annotation...
Save region to file...
Copy region
Show controls
Player/Viewers

The screenshot shows the AXMEDIS Player interface with a menu on the right side listing various functions with their keyboard shortcuts. The 'Select region' and 'Show annotations' options are checked. The main window displays a photograph of a display of colorful owl figurines and a sign that reads "E' MEGLIO NON TOCCARE" and "DON'T TOUCH PLEASE".

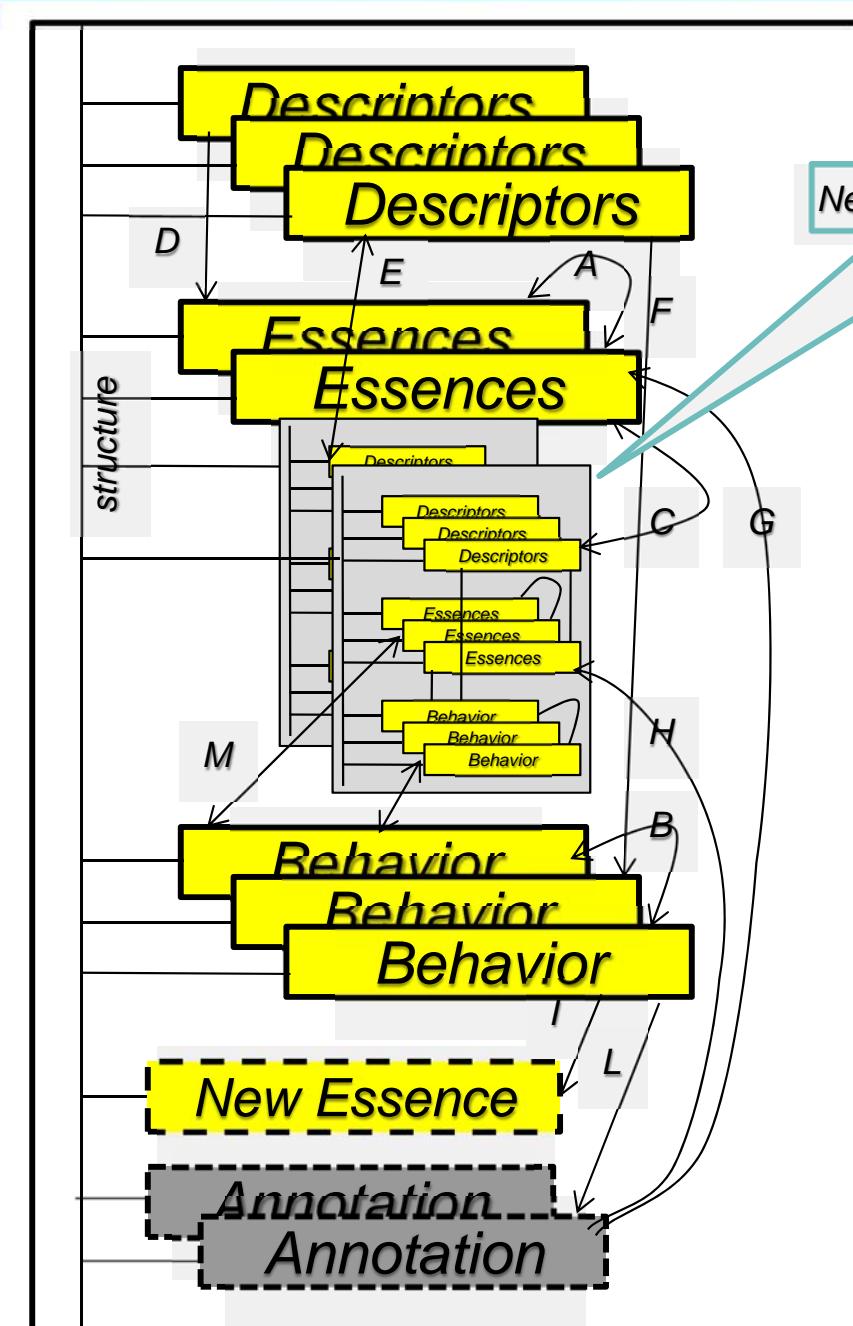


- AxAnnotation element uses MPEG21 DIDLAnnotation element

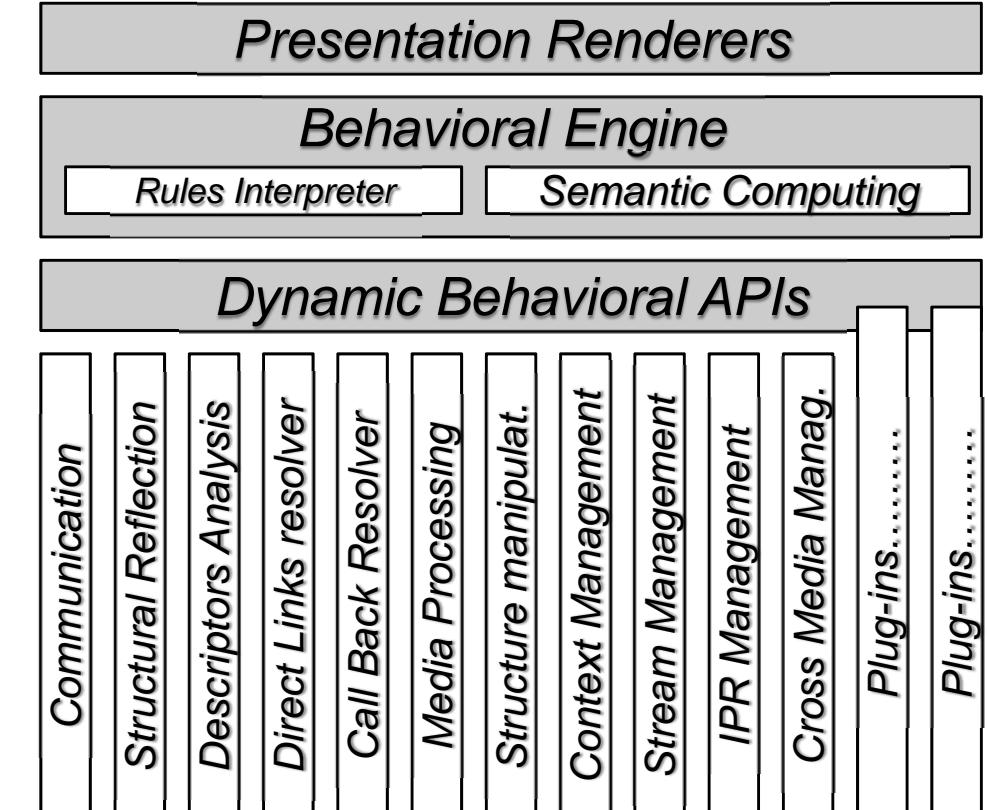


- An annotation can be saved internally or externally (in another AxObject) allowing to annotate also protected content

Different relationships and player architecture



Nested Intelligent Content





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 multiplataforma
- Content Production and workflow
- Distribuzione dei contenuti
 - ♣ Controlled P2P content Distribution
 - ♣ Content Distribution via Kiosks
 - ♣ Satellite broadcasting, Terrestrial Broadcasting
 - ♣ Cultural Heritage content distribution
 - ♣ Interoperabilità nel Backoffice
 - ♣ Integrazione con Portale di distribuzione
- DRM Reciprocal Trust via P2P

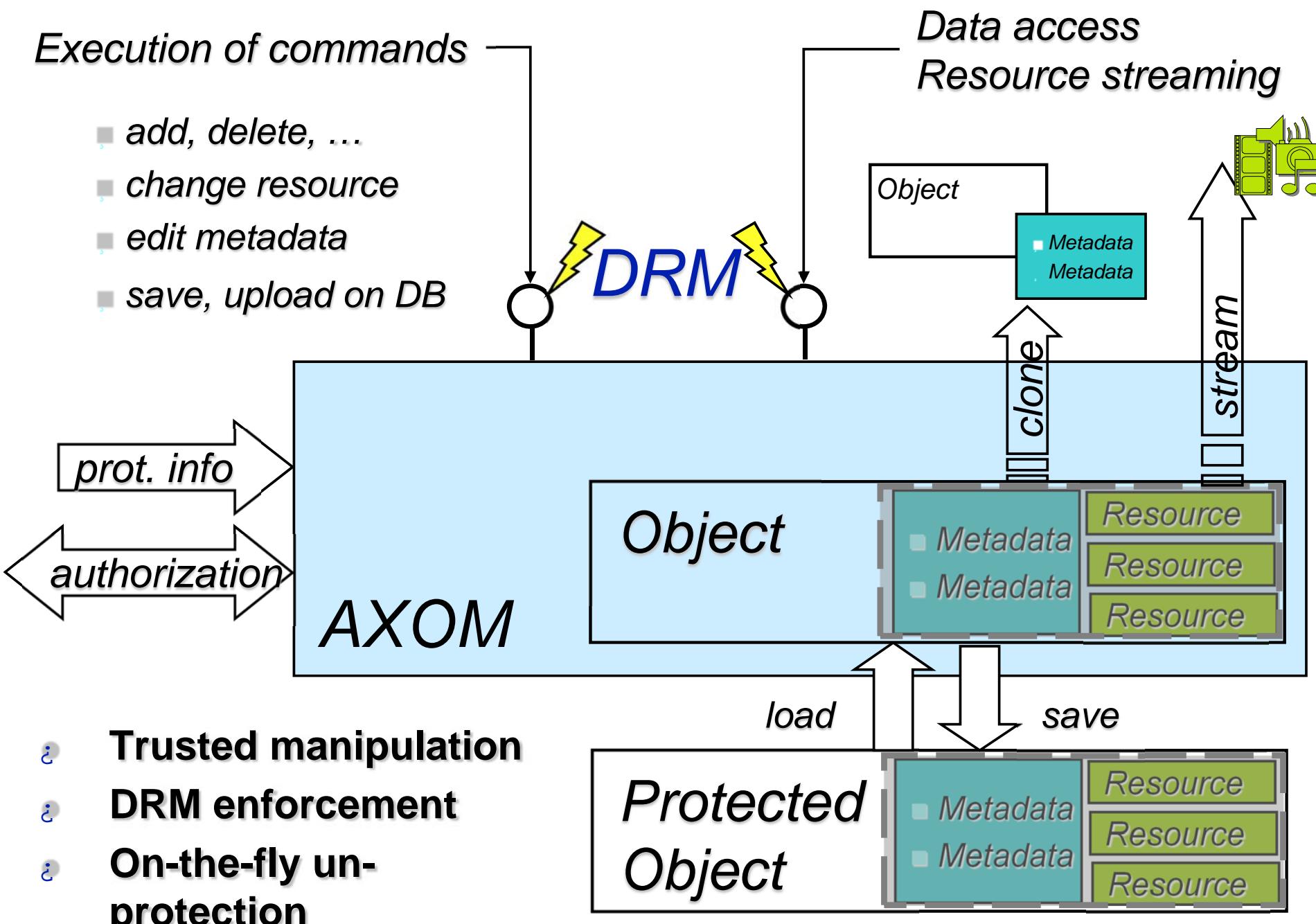




- To allow exploiting the digital content functionalities (rights) in a controlled manner
 - ◆ To who has been registered the first time and continuously: **authenticated and certified**
 - ◆ To do what is defined in a **license** (to allow exploiting the rights)
 - ◆ By using technologies to **protect content** (e.g., encryption, fingerprint, watermark, etc.)
 - ◆ **Verifying/Control/Supervise** if the above conditions and others are respected

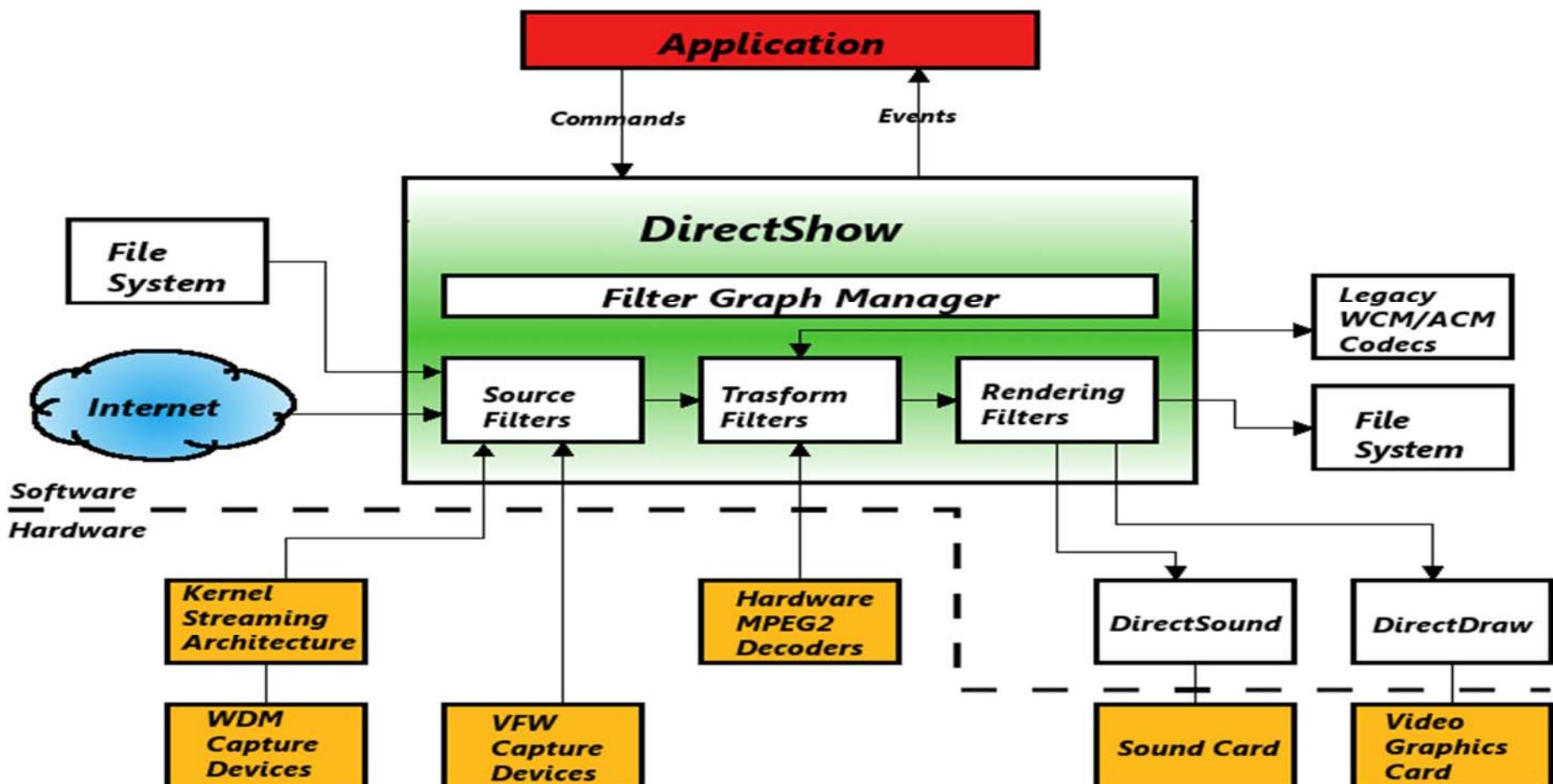
Execution of commands

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



Microsoft DirectShow, direct X

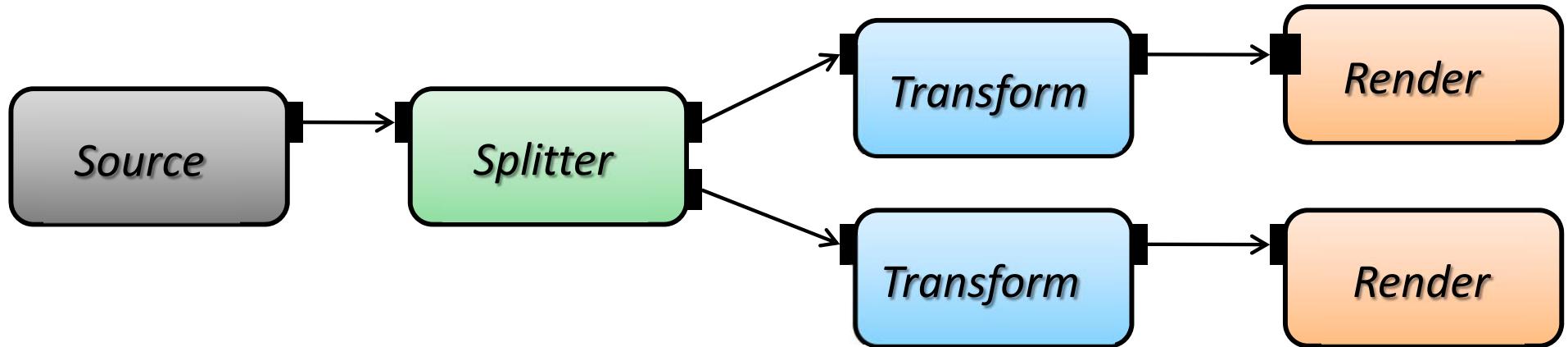
- *Basato sul concetto di Filtro.*
- *Isolamento dell'applicazione dall'Hardware a disposizione.*
- *Supporto ad un gran numero di formati e possibilità di estensione.*



- *Categoria di appartenenza (Source, Splitter, Transform, Mux e Render).*
- *Identificazione: GUID. Istanziato tramite CLSID.*
- *Numero di Pin variabile.*
- *Descrittore formati supportati: MediaType.*



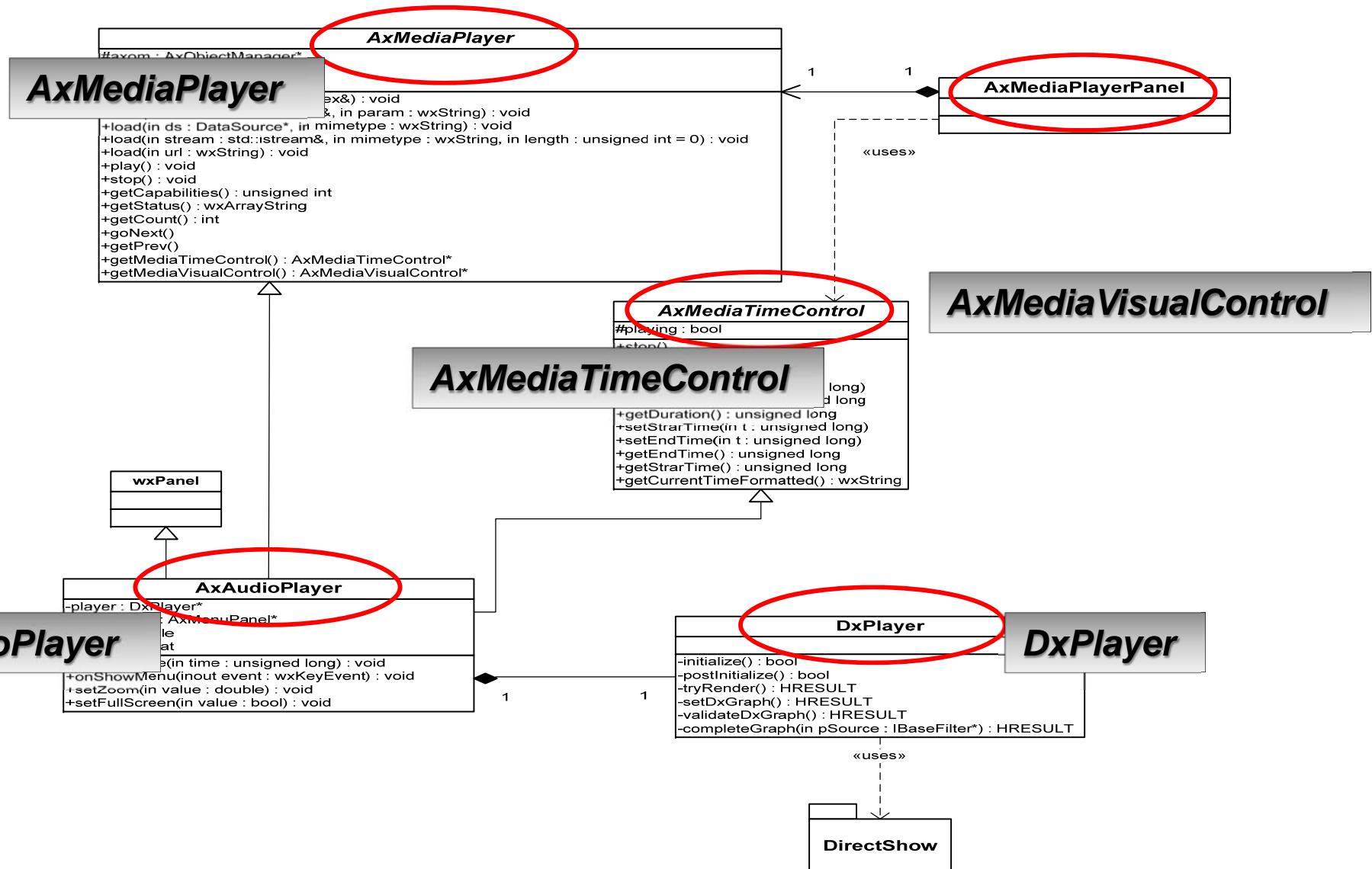
- *Verifica dei filtri DirectShow*
- *Utilizzo dei DRM e costruzione controllata dei Grafi*



- *Fingerprint del filtro attraverso una funzione di Hash*

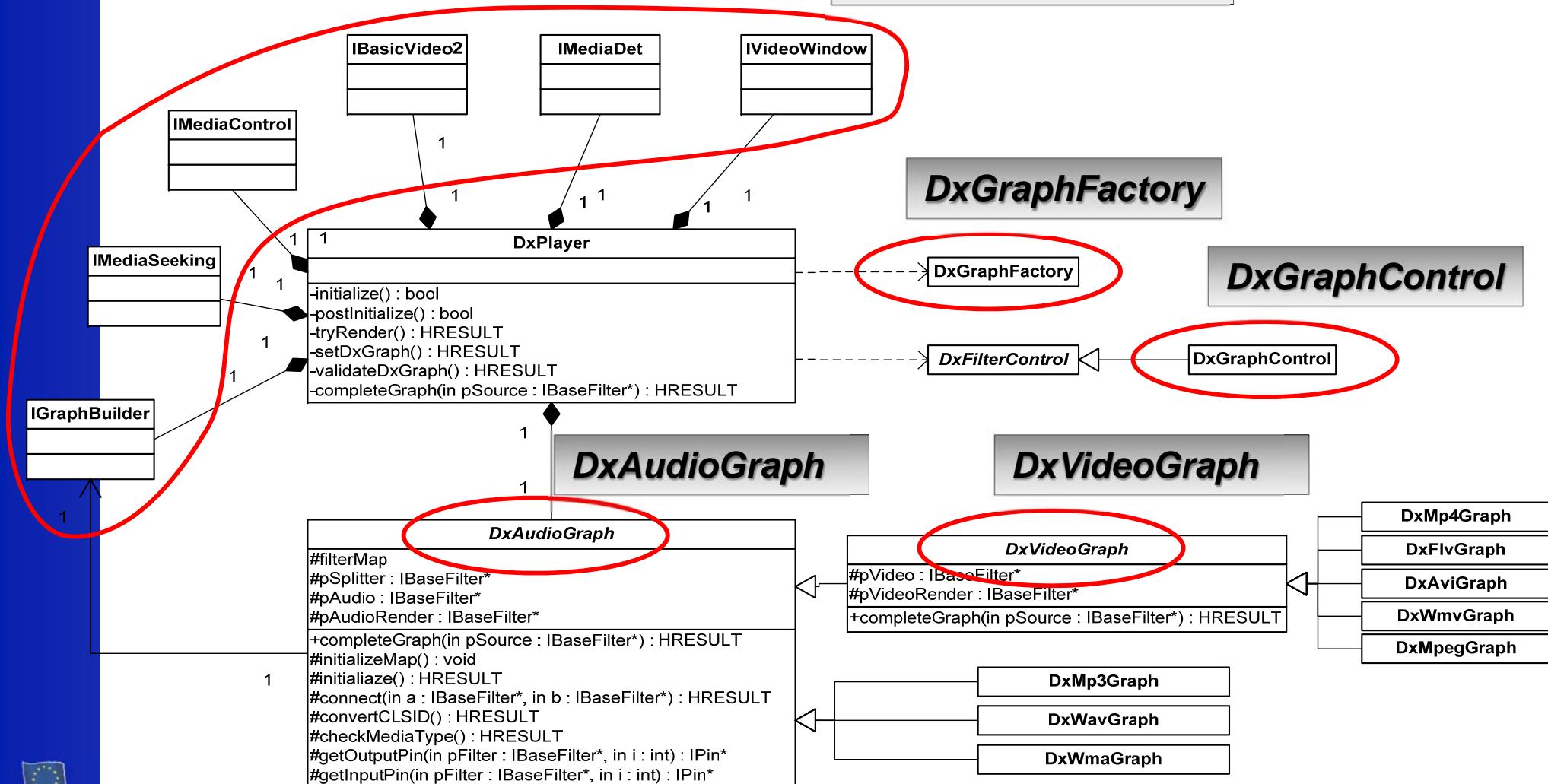


Internal Audio/Video Player



Classe DxPlayer

DirectShow Interface



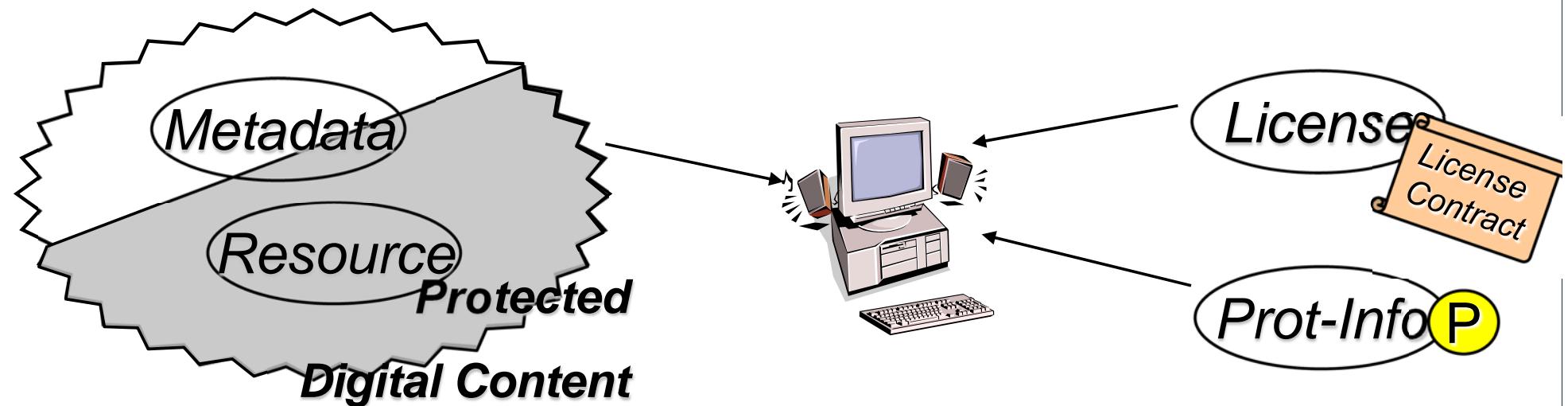


Part 1b: Sistemi di protezione e distribuzione



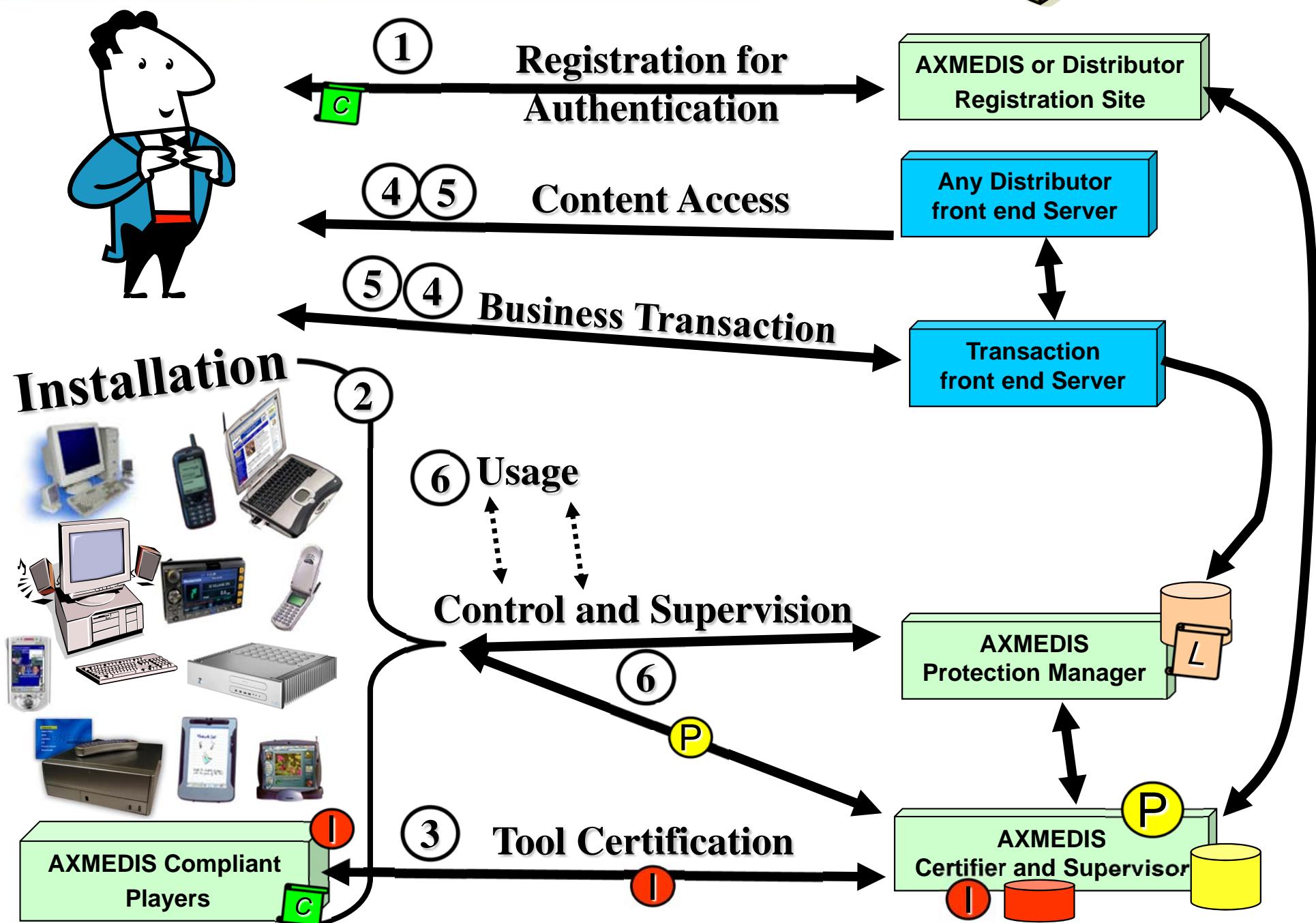
- Apple I-Tune DRM
- Definizioni
 - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
- Architettura AXMEDIS overview
- Package MPEG-21 e AXMEDIS
 - ♣ AXMEDIS, NewsML, MXF
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 - ♣ AXMEDIS player multiplataforma
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 - ♣ Controlled P2P content Distribution
 - ♣ Content Distribution via Kiosks
 - ♣ Satellite broadcasting, Terrestrial Broadcasting
 - ♣ Cultural Heritage content distribution
 - ♣ Interoperabilità 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

The Protection and Control Process

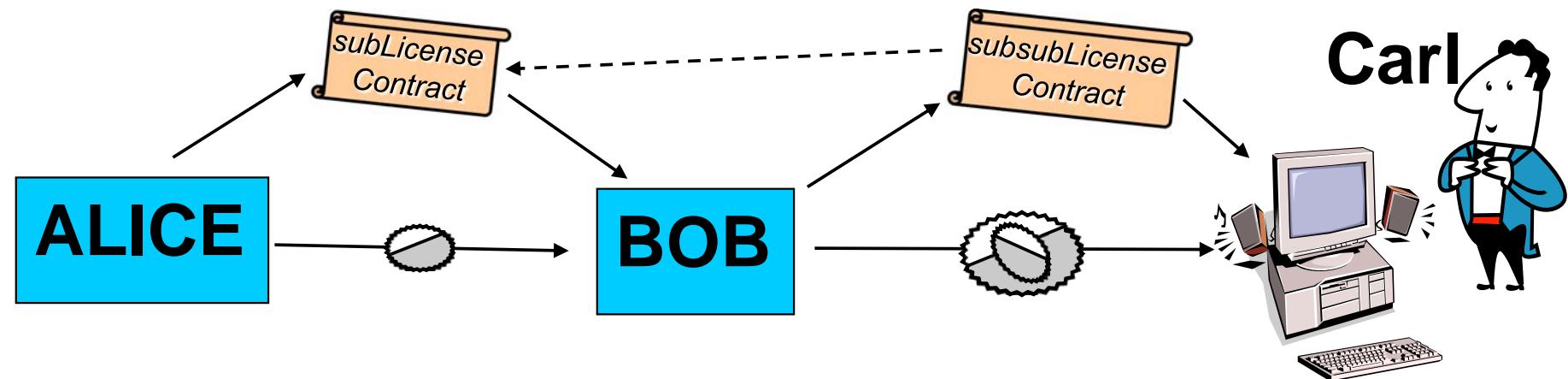




License:



- ◆ 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.

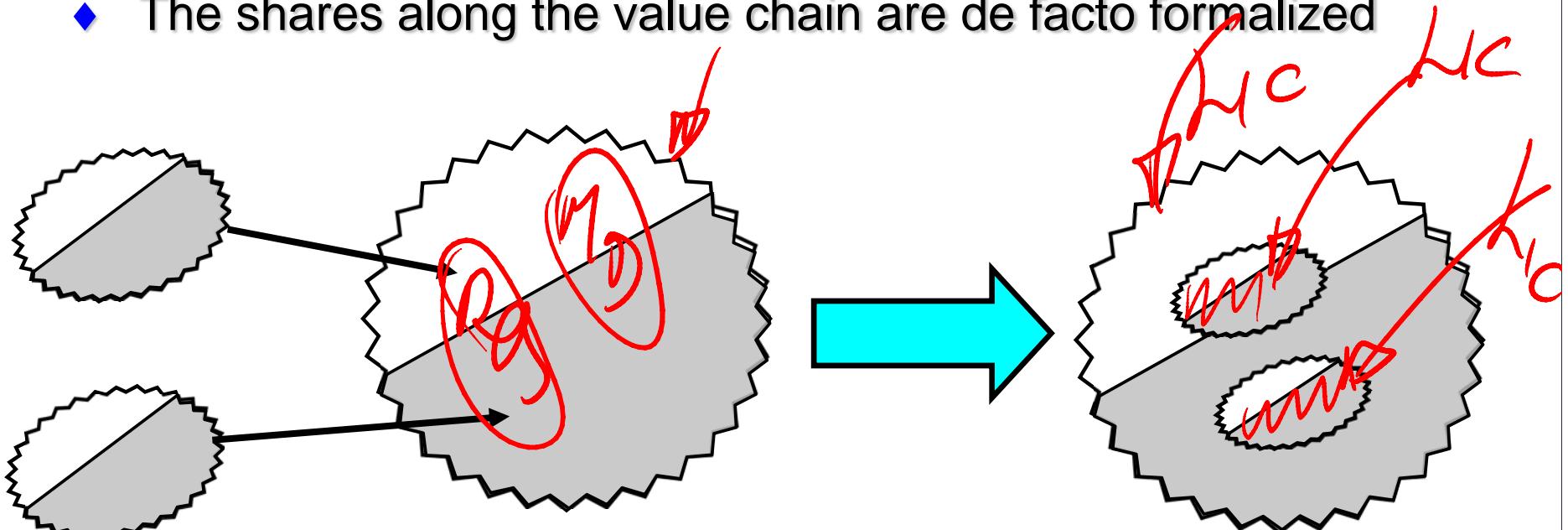


- **Alice states,** “**Bob** has the right to issue a license to anyone to print the book in Italy”
- **Bob states,** “**Carl** has the right to print the book in Italy”
- To solve the SubSubLicense for Carl all the connected Licenses are needed
- Licenses have to be accessible on Processing Engine
- Alice can revoke the license to Bob

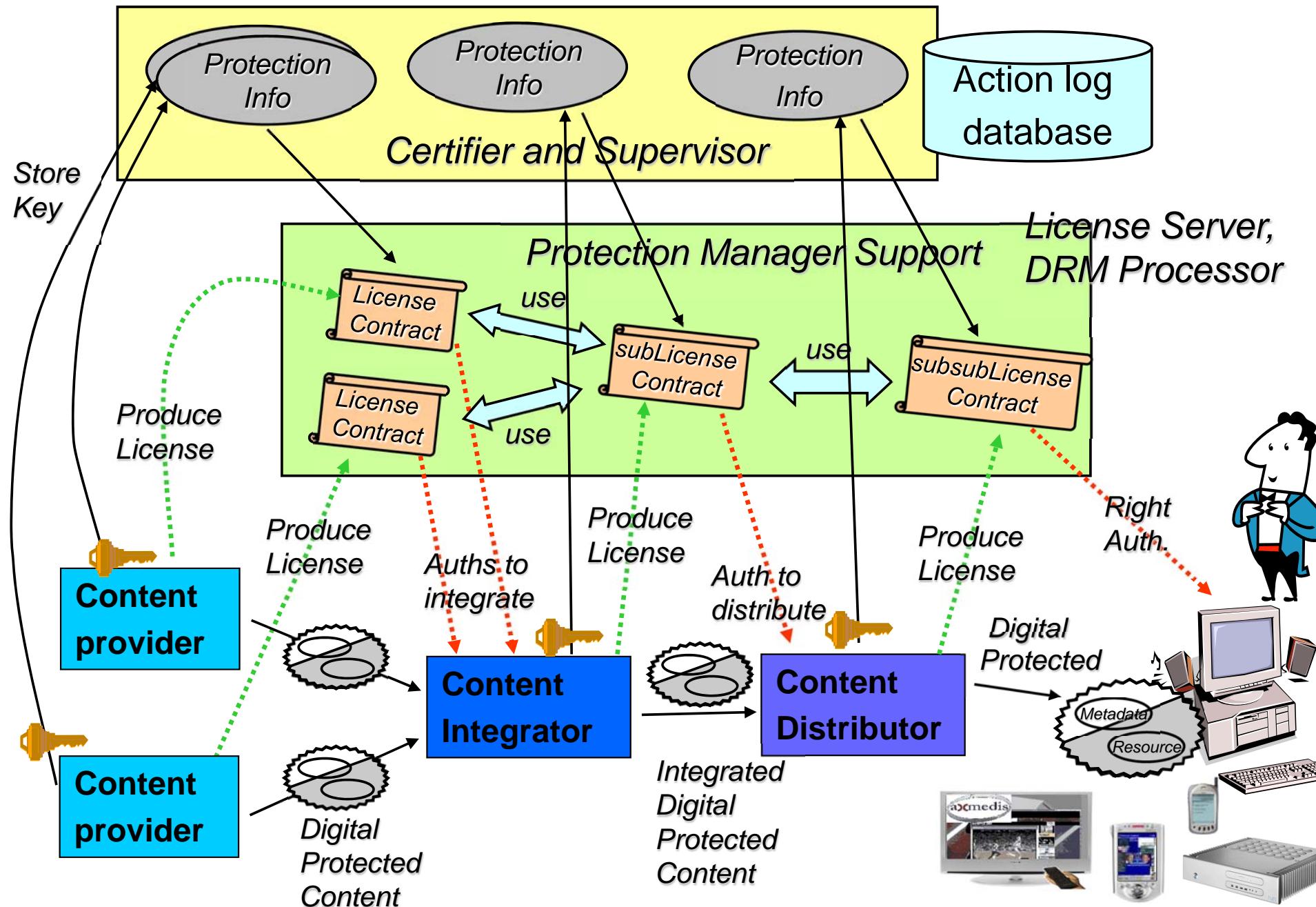


Cross media content and composition

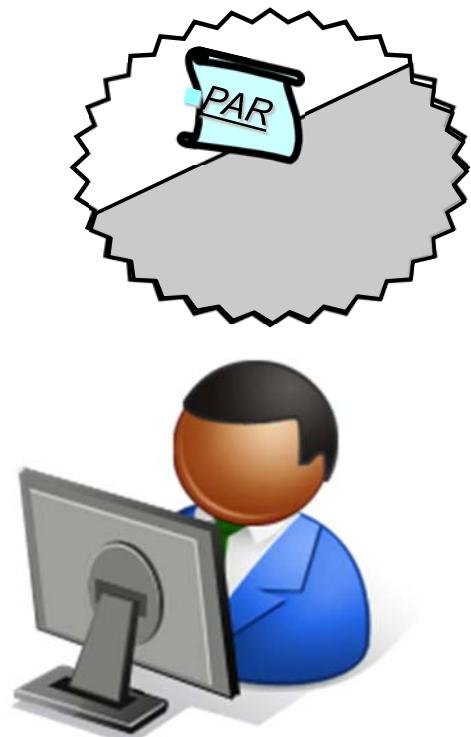
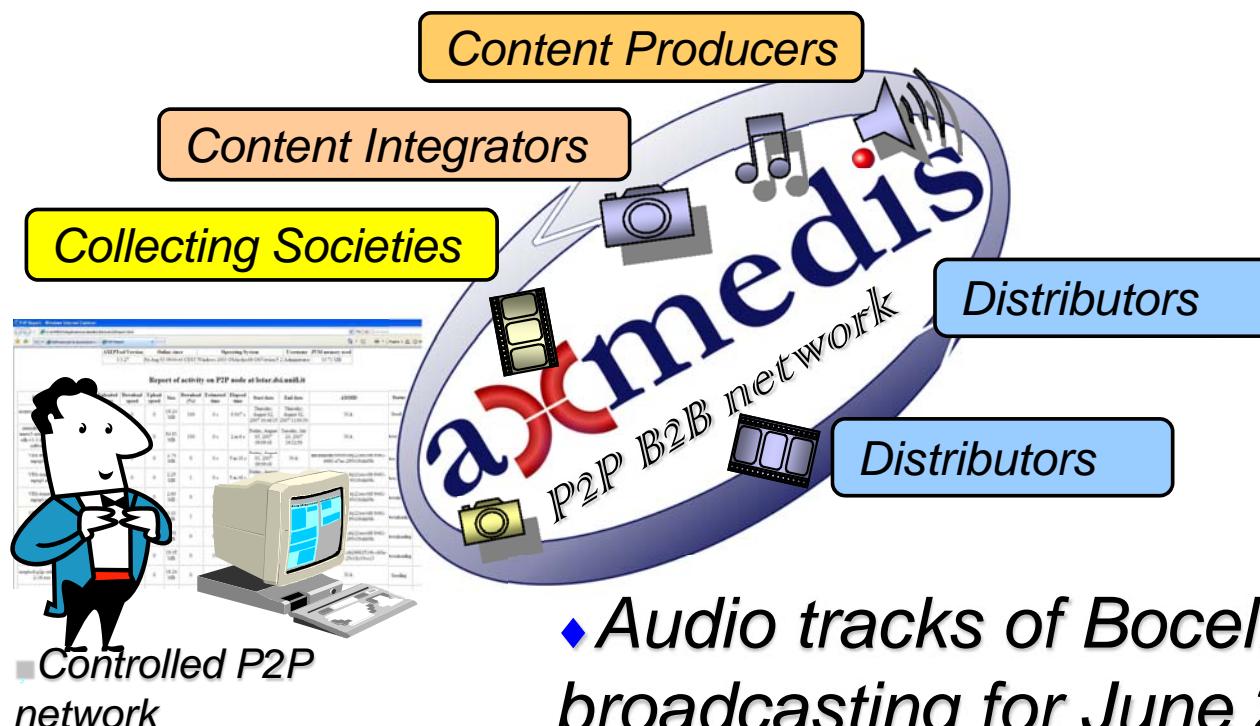
- AXMEDIS objects can be used as components for creating other added values AXMEDIS objects
 - ◆ Allowing the production added value object for composition or integration of protected content
 - Who is composing can add its own protection and licensing
 - ◆ Allowing the Rights Management Of Composition,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



Managing License Chain and Protection Information

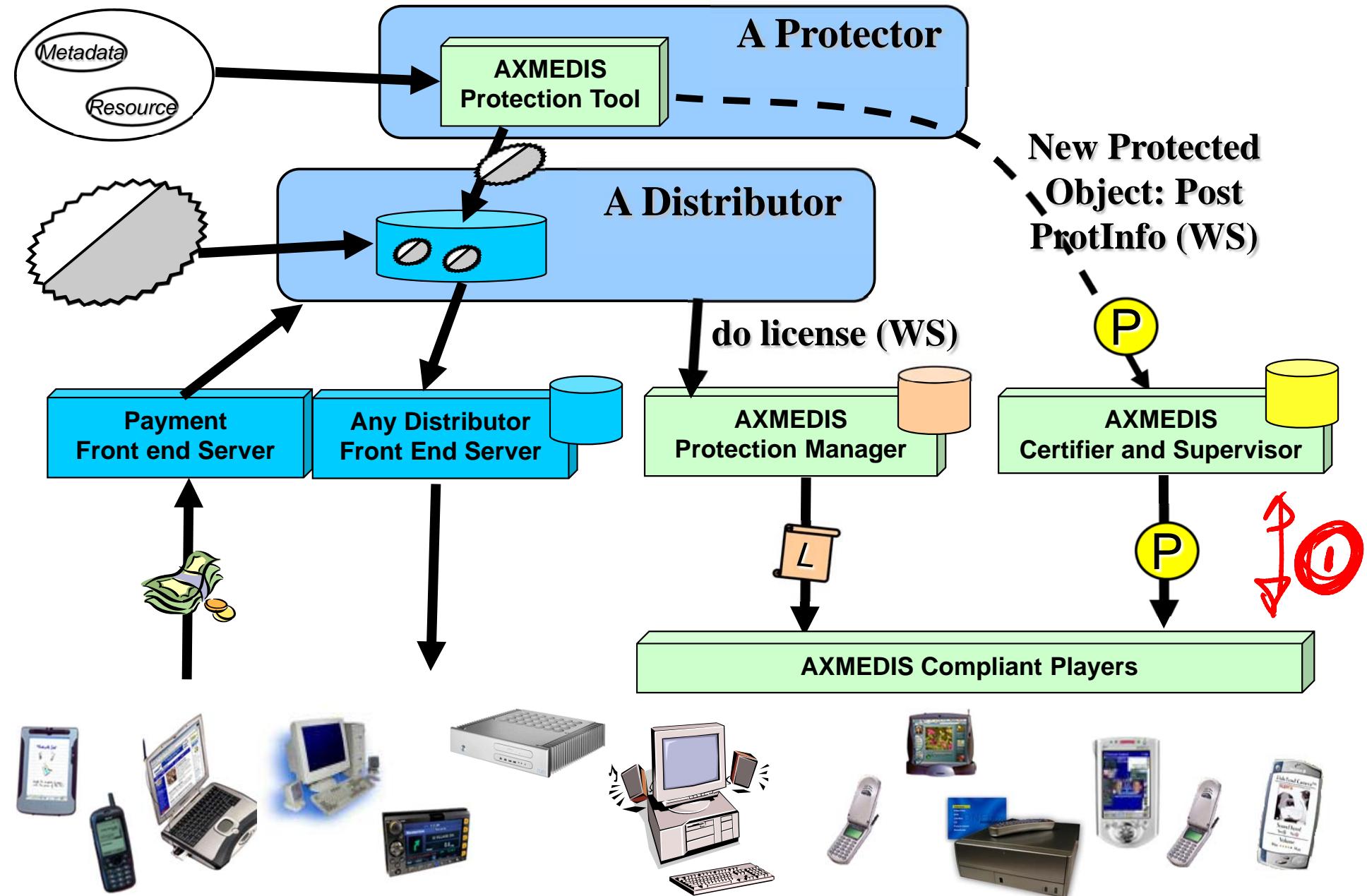


- PAR: Potentially Available Rights into AXMEDIS objects
- The PAR can be used to make queries
 - PARs based content trading, Customers may know directly which rights they could buy and by who
 - PARs may be used to harmonize and automate B2B and B2C



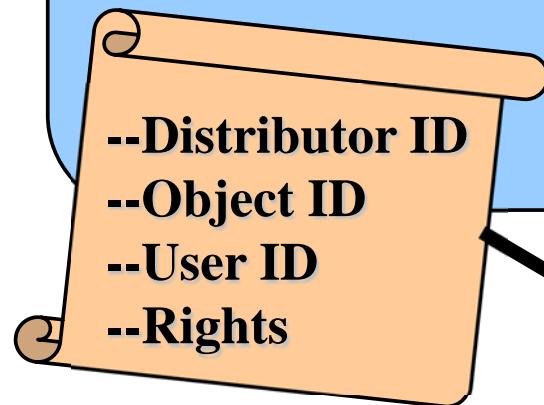
- ♦ Audio tracks of Bocelli for Audio broadcasting for June 2008 in Germany?

AXMEDIS The Protection and Control Process

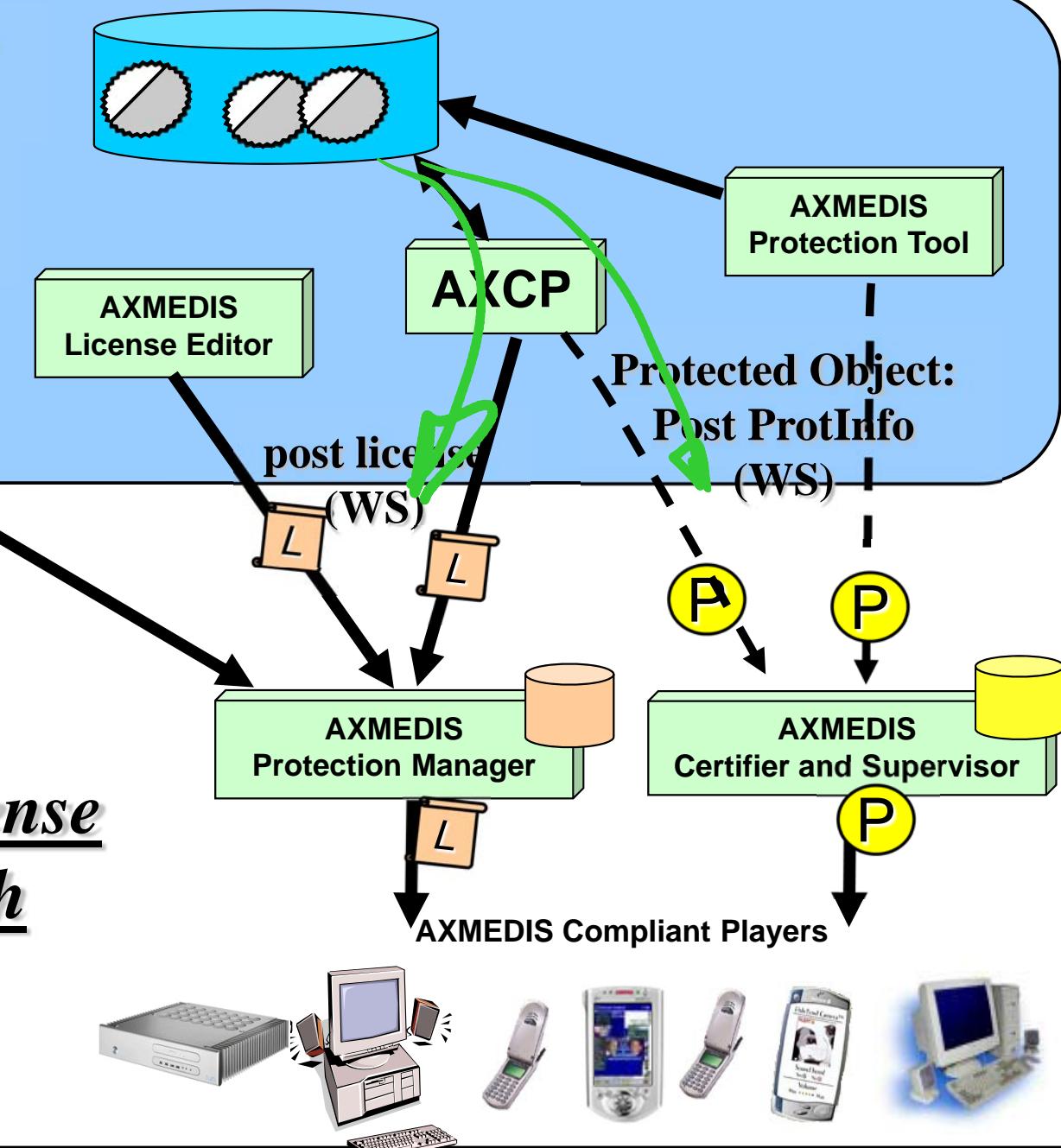


A Distributor

Requesting license
Production (WS):

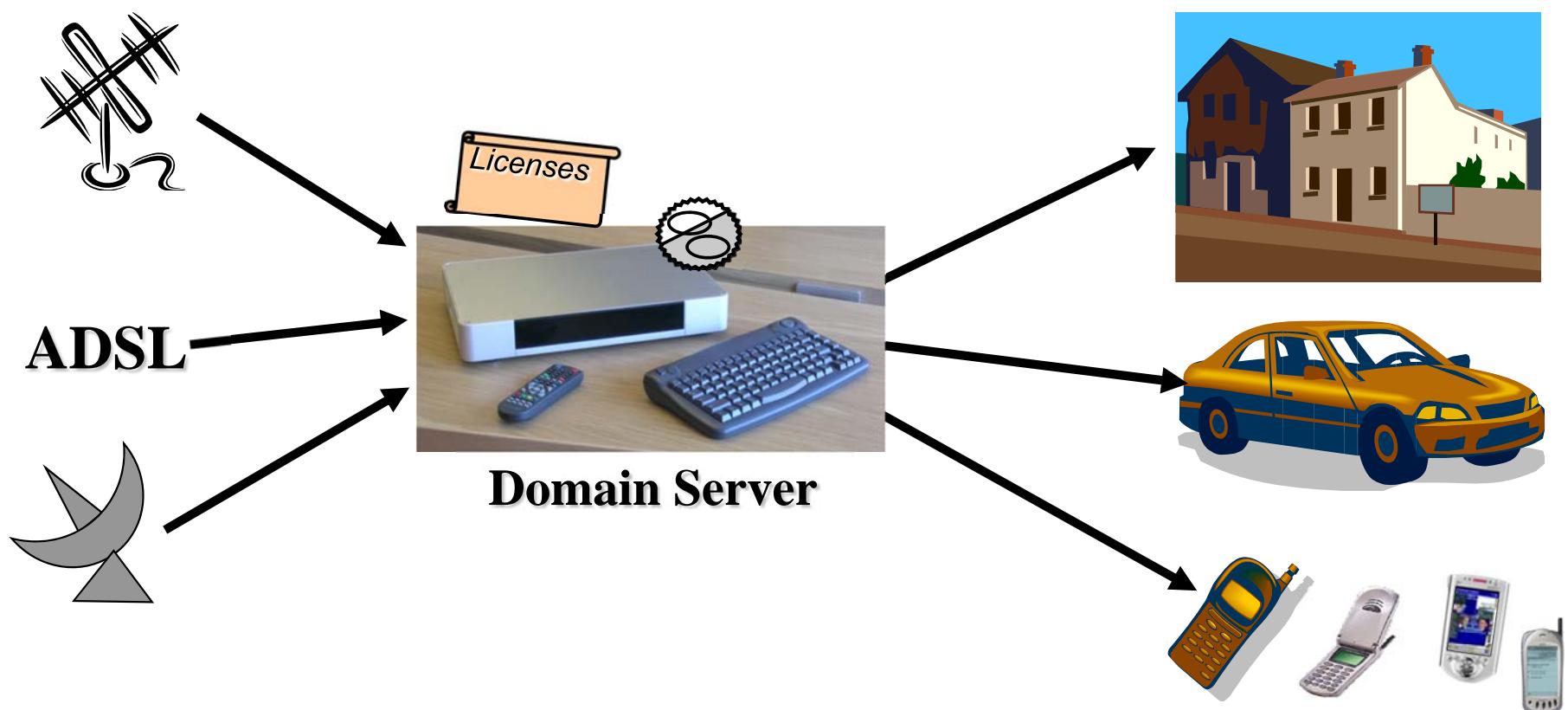


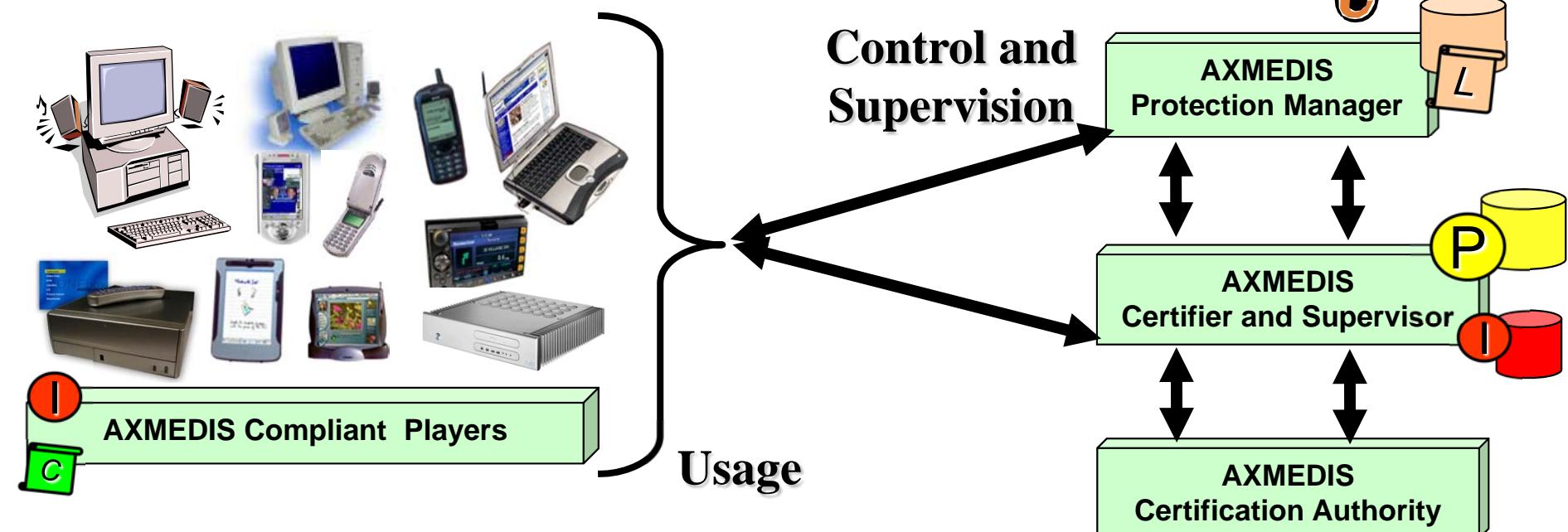
Need of Massive
Production: one License
X each user X each
resource



DRM and Domain Management

- >User 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

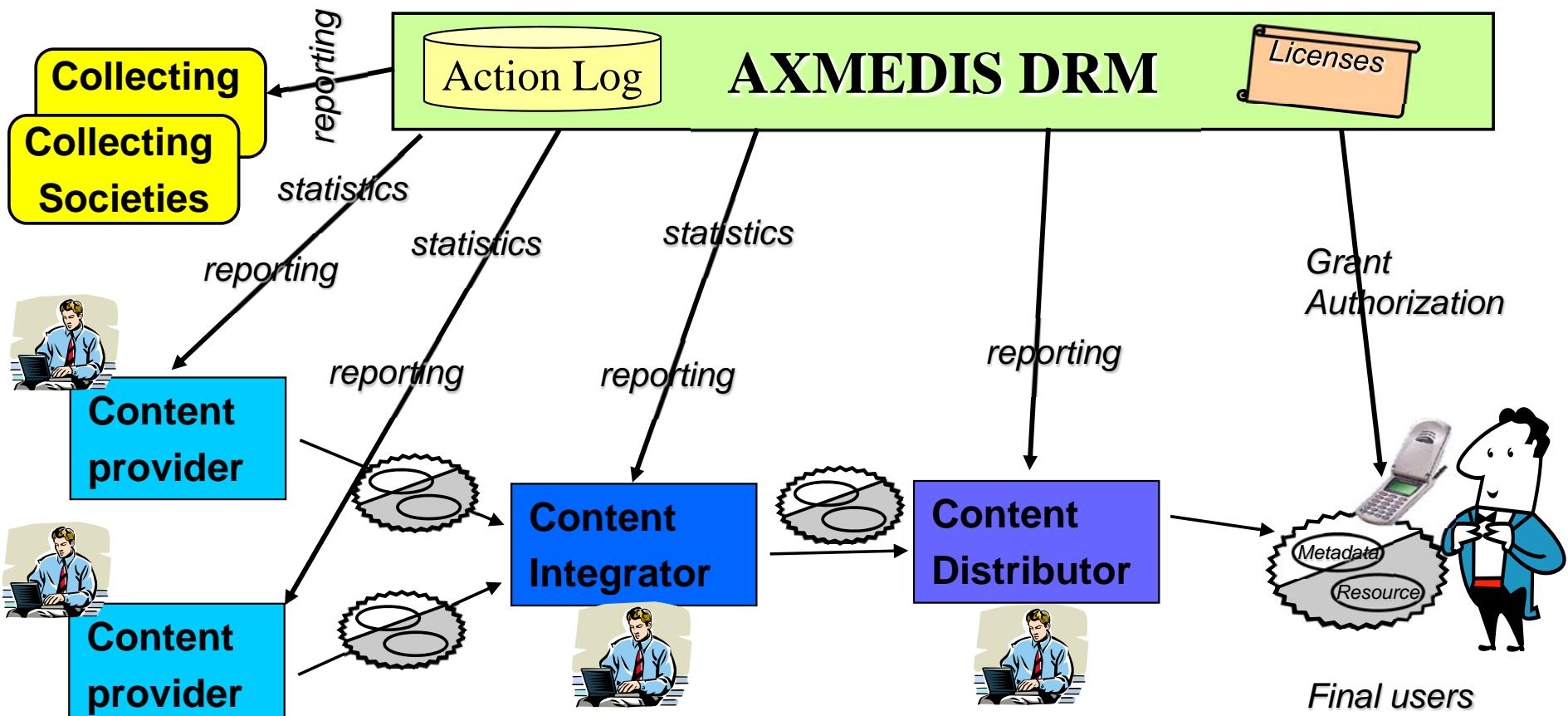


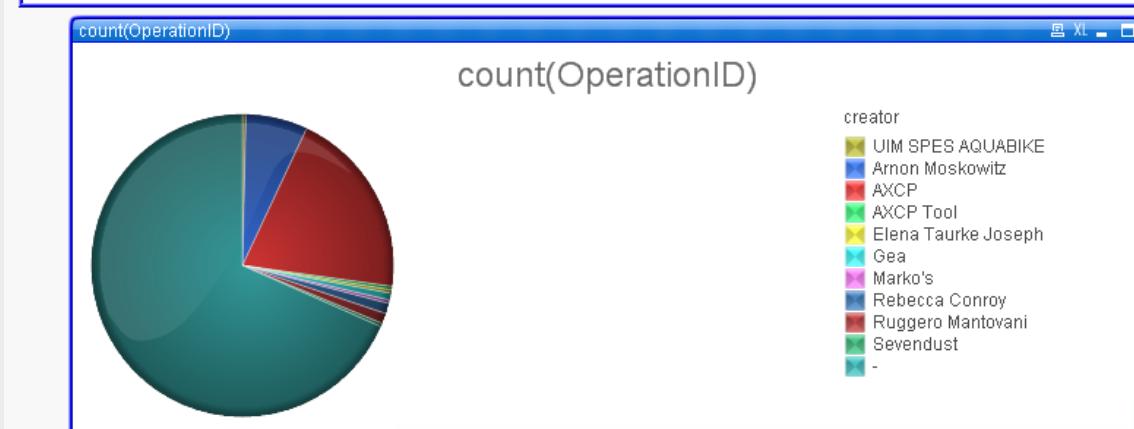
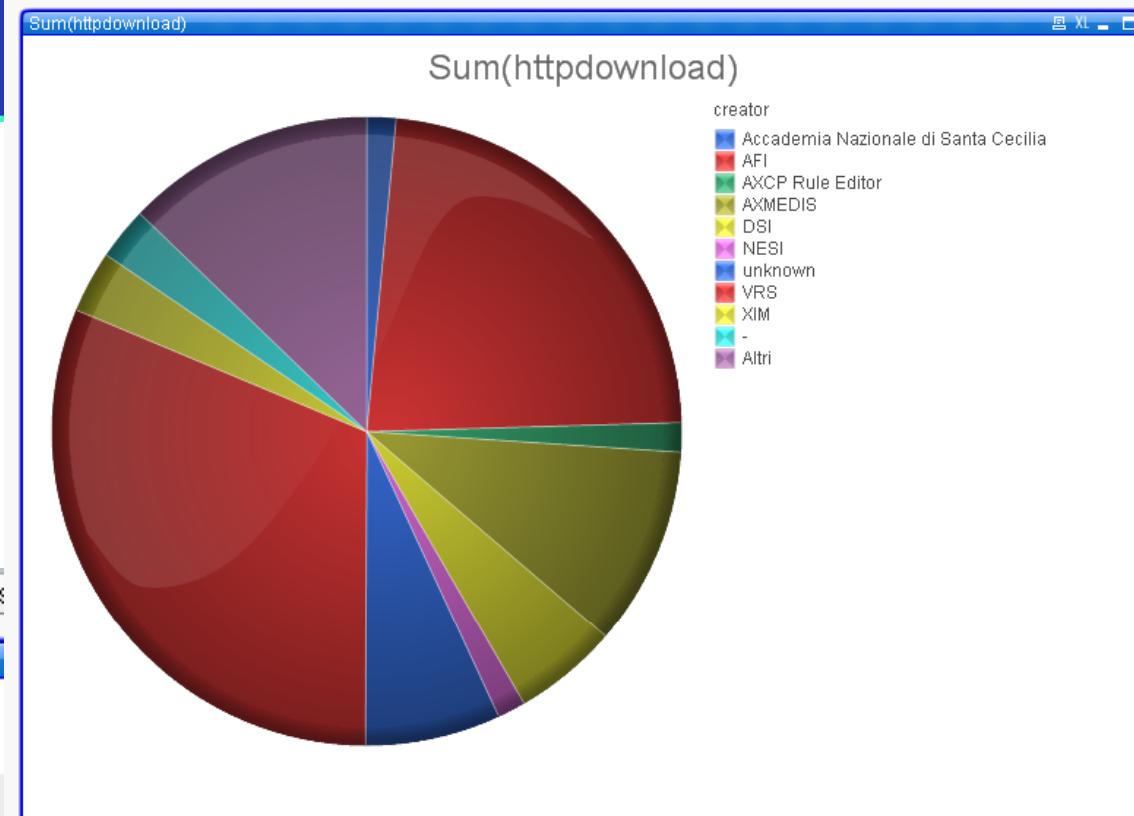


- Performed by the: **AXCS and AXMEDIS PMS**
- Continuously verify and certify the trusting level of the Tool/Device/Terminal and of the User
- Collect Action Logs (event logs) related to rights exploitation and thus to License usage
- Allow the implementation of black lists for Users, Tools, Devices/Terminals, 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





Per ottenere la Guida, premere F1

creator		
Accademia Nazionale...	DSI	Mice Parade
AFI	dsl	Micheline Durocher
Alexander Robotnick	Electric Six	MobileFeeder
AlÙ BabÙ	Elena Taurke Joseph	MotorShow
Amanda Baker	ELION, Telecom Esto...	MUSICNETWORK
Amy McCosh Leonard	FNB IMAESTRO DEDI...	NASA
Andre Scucato and Cr...	Fondazione Museo D...	nasa
Andrea Fieschi	Fritz Lang	Neal Dhand
ANSC	Funkstörung	NESI
ANSC and ILABS	Gea	Ninfa
ANSC with Axmedis A...	Gianni Morandi	pa.press.net
Arnon Moskowitz	GIUNTI	Promedia
Ax4Home client recor...	Grip Inc	Rebecca Conroy
AXCP	HD	Roberto Minervini
AXCP Rule Editor	i-Maestro EC IST proj...	Ronnie Cramer
AXCP Tool	ILABS	Ruggero Mantovani
AXMEDIS	ILABS through AXCP ...	Sara Purgatorio
axmedis	IMAESTRO	Sevendust
AXMEDIS MobileFeeder	Ivan Bruno	SIAE
BBC	Jeppo Rubino	Sigur Ros
biagi	Joe Medeiros	Silvia Mancini
Biagi & Bruno	Kaleidoscopio	Simone De Ascentis
Bocelli	Kataklysm	Sunrise Production
Christoph Hoerner	Kyung Lee	TEO
CocoRosie	Luigi Speranza e Iko ...	The Grimm Sisters
Danny Losito	Madrugada	The Suntrack
David Wilson	Maler	The Zen Circus
Digichannel	Maria Kowalski	UIM SPES AQUABIKE
DISIT	Marko's	Unearth
disit	Martin Solveig	unifi

Total downloads: 11004

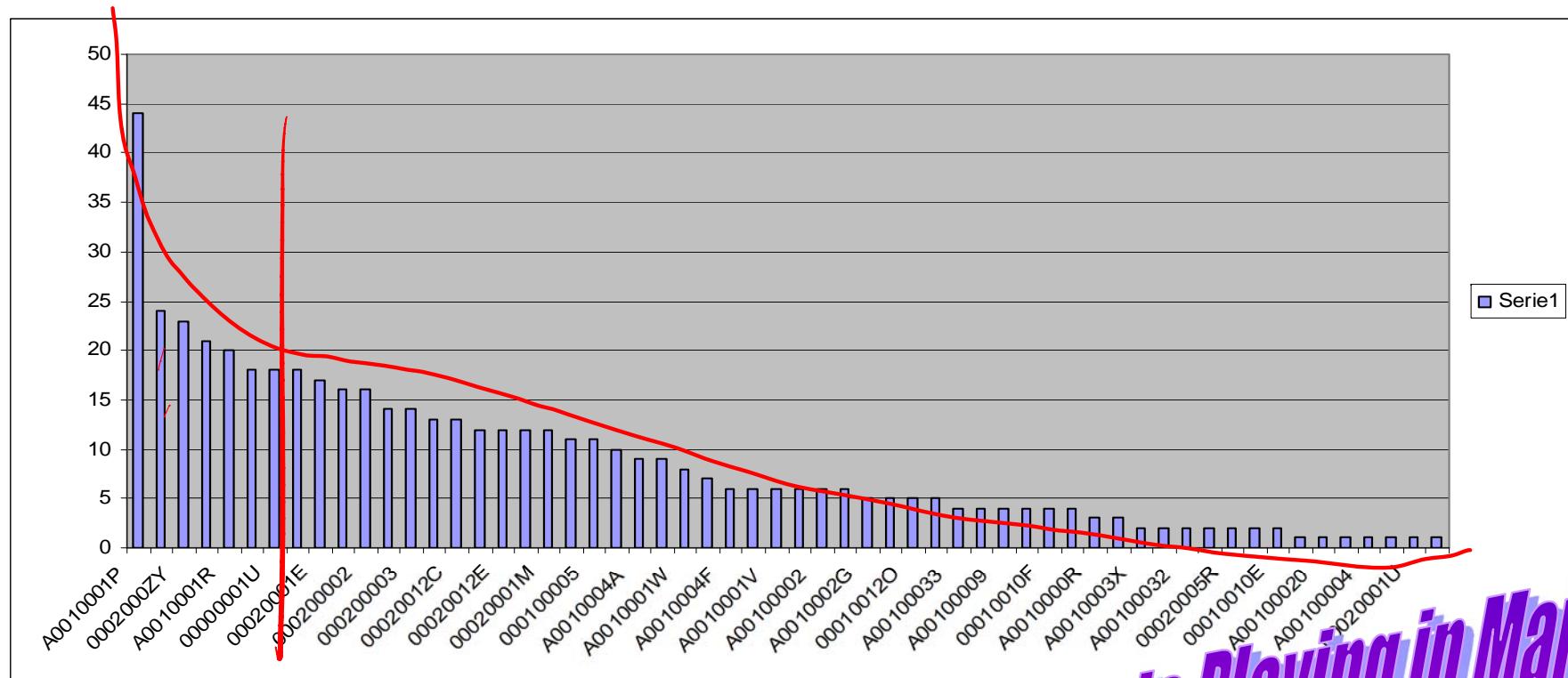
Total rights exp.: 272

Total Objects: 1038

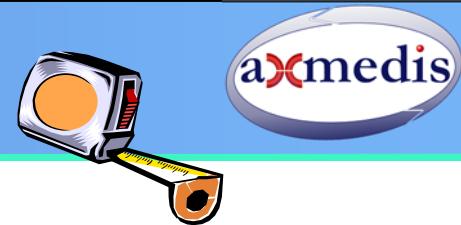


Distribution of exploited objects Playing in March

- 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

- **DRM, Digital Rights Management**
 - ◆ Digital management of rights
- **Proprietary DRM solutions are**
 - ◆ based on *proprietary* formats for content and licenses, protection information, control messages, and reporting, etc.
- **DRM Interoperable (e.g., DMP, OMA)**
 - ◆ based on a **UNIQUE Standard** format for content and licenses, protection information, control messages, and reporting, etc.
 - ➔ Extensions are not accepted if not decided by the standard body
 - ➔ Standards are becoming obsolete in short time, patent pending is blocking the market
- **DRM Interoperable “a la AXMEDIS”**
 - ◆ based on **SEVERAL standard formats (now MPEG-21 e OMA) e/o proprietary** for content and licenses, protection information, control messages, and reporting, etc.
 - ◆ Interoperable on the B2B and B2C areas
 - ◆ It can be extended to accept other *solutions* for example MS Windows DRM, i-Tune, or more, etc.

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 Accessible
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



European Commission



Information Society





Part 1b: Sistemi di protezione e distribuzione



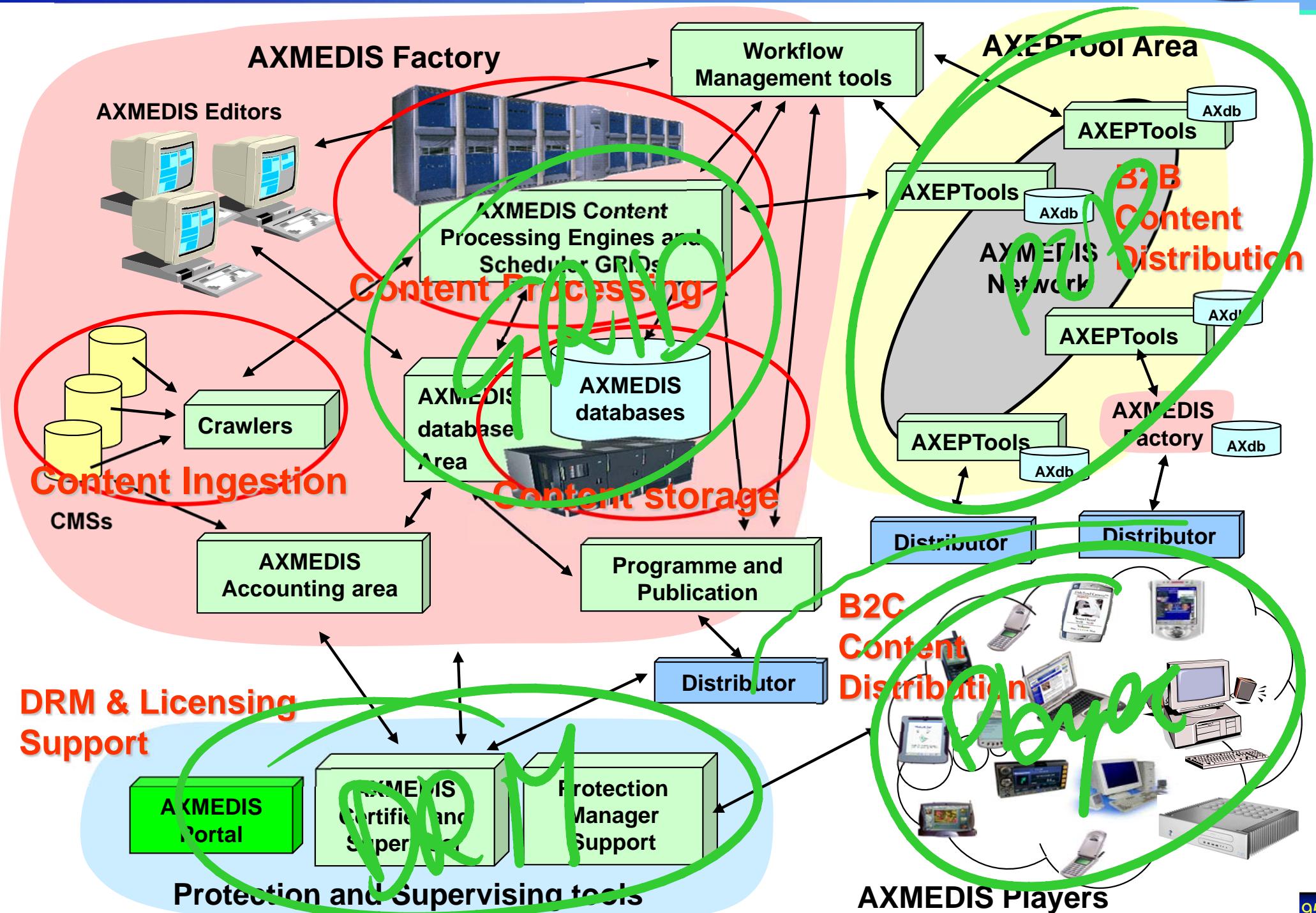
- Apple I-Tune DRM
- Definizioni
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- Package MPEG-21 e AXMEDIS
 - ♣ AXMEDIS, NewsML, MXF
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 - ♣ Integrazione con Portale di distribuzione
- DRM Reciprocal Trust via P2P



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/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



The top screenshot shows a player window with a guitar-themed skin, displaying three guitars and a large building in the background. The middle screenshot shows a player window for a Botticelli painting, 'The Allegory of Spring', with detailed text about the artwork. The bottom screenshot shows a player window for another Botticelli painting, 'The Adoration of the Magi', also with descriptive text.

Chitarra battente

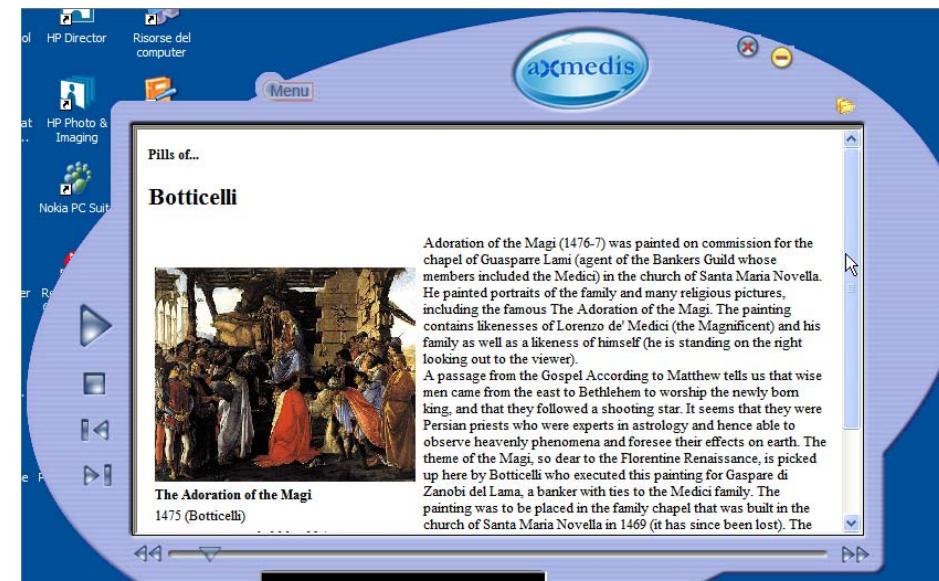
Botticelli

This painting, along with Pallas and the Centaur, was in the room next to the bedroom of Lorenzo di Pierfrancesco de' Medici, cousin to Lorenzo the Magnificent, in the palazzo on Via Larga. According to the most widespread interpretation, the protagonist of the scene is Venus. The focus of the entire composition, the goddess stands in the middle of her garden that is filled with countless species of plants and herbs, and which mythology had placed on the island of Cyprus. She is surrounded by the divinities of her entourage: the blindfolded Cupid, the Three Graces dancing in a circle and Mercury. On the opposite side of this huge painting, Zephyr the gentle wind that blows in springtime grasps the nymph Chloris who, fleeing in terror. Next to Spring there is Flora, scattering rosebuds. The entire composition, in all its details is dedicated to exalting spring, the season in which Nature expresses the utmost of her powers of fertility as celebrated by Ovid, Horace and Lucretius. When transferred to the level of Neoplatonic philosophy, the allegory could be interpreted in yet another key: Venus-Humanitas, the blend of

The Allegory of Spring
1482 circa (Botticelli)
tempera on wood; 203 x 314
Firenze, Galleria degli Uffizi

Pills of...
Botticelli

Adoration of the Magi (1476-7) was painted on commission for the chapel of Guasparre Lami (agent of the Bankers Guild whose members included the Medici) in the church of Santa Maria Novella. He painted portraits of the family and many religious pictures, including the famous The Adoration of the Magi. The painting contains likenesses of Lorenzo de' Medici (the Magnificent) and his family as well as a likeness of himself (he is standing on the right looking out to the viewer). A passage from the Gospel According to Matthew tells us that wise men came from the east to Bethlehem to worship the newly born king, and that they followed a shooting star. It seems that they were Persian priests who were experts in astrology and hence able to observe heavenly phenomena and foresee their effects on earth. The theme of the Magi, so dear to the Florentine Renaissance, is picked up here by Botticelli who executed that painting for Gaspare di Zanobi del Lamo, a banker with ties to the Medici family. The painting was to be placed in the family chapel that was built in the church of Santa Maria Novella in 1469 (it has since been lost). The



AXMEDIS Player for STB, PVR, Decoders, etc.



AXMEDIS CONTENT BROWSER

SPORT FUNNY VIDEO ALL

VRSteaser4
VRSteaser5

Title: VRS teaser 4
Subject: short clip from theme 4
Description: n/a
Type: Funny video
Identifier: secret camera
Publisher: lithuanian
Creator: n/a
Language: lithuanian
Price: 0 EUR

MPEG-21

State: Paused Position: 00:00:08 Length: 00:00:20

OK Play Hide status PIP Full screen Seek Skip 10s BACK Menu



STB with AXMEDIS tech

Players Coverage

Device for player	Models	CAS	DRM	Accounting, rep.	Player	Down., Stream., PDown.	Automated back office
PC	VOD, PPV, Counting, Periodic, subscription,	--	Yes	Yes	Yes	D,S,PD, P2P	Yes
STB/PVR		Yes	Yes	Yes	AXOM	D,S,PD, P2P	Yes
PDA		--	Yes	Yes	Yes	D, (S)	Yes
Mobile		Yes	Yes	Yes	Yes	D, PD, S	Yes
IPTV/STB		Yes	Yes	Yes	AXOM	Any	Yes
webTV, IP		--	Yes	Yes	Yes	D, PD, P2P	Yes
Social network		--	Yes	Yes	Yes	D, PD, P2P	Yes
UGC		Cas	Yes	Yes	Yes	Any	Yes
P2P		Cas	Yes	Yes	Yes	D, PD	Yes



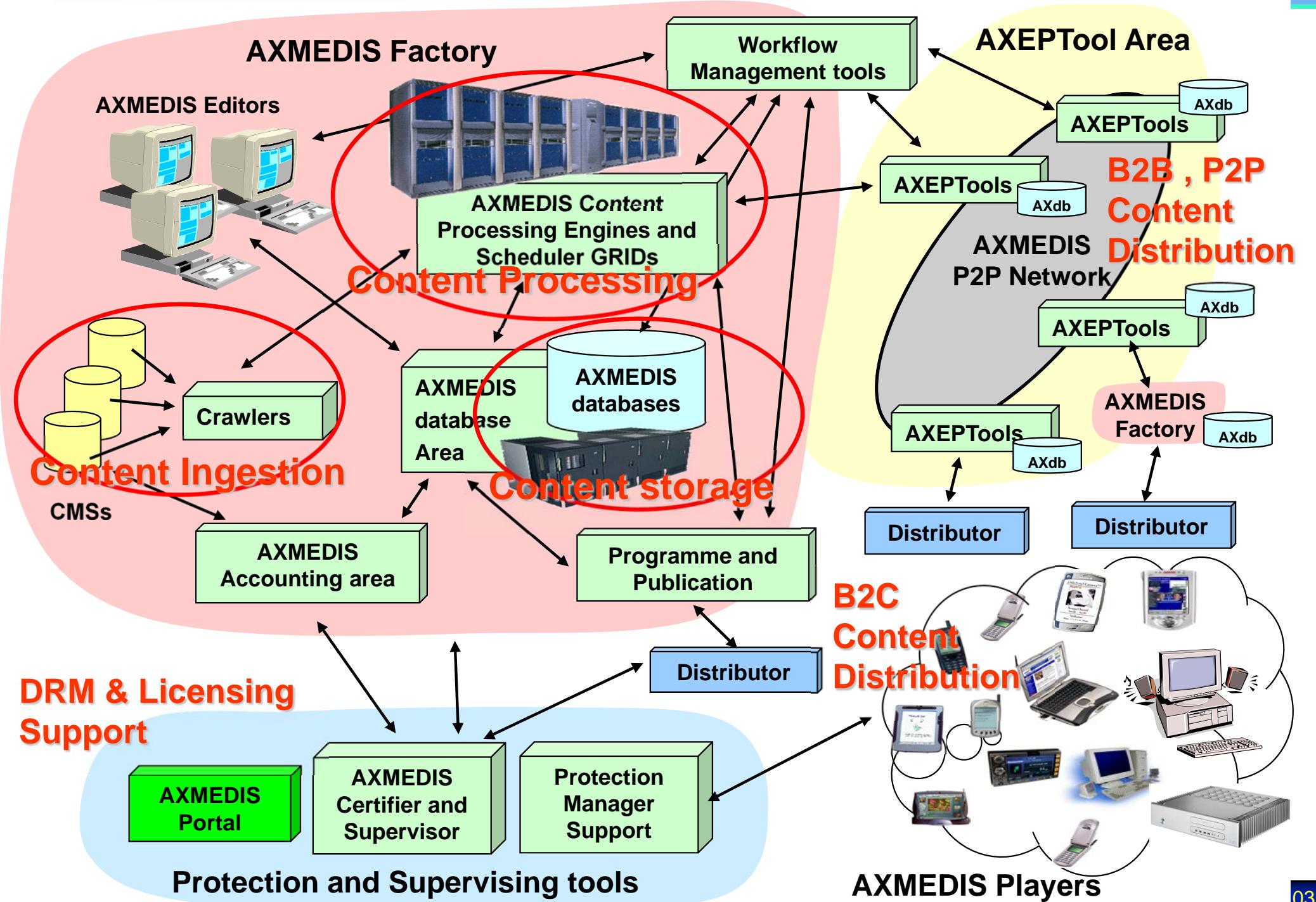
Part 1b: Sistemi di protezione e distribuzione



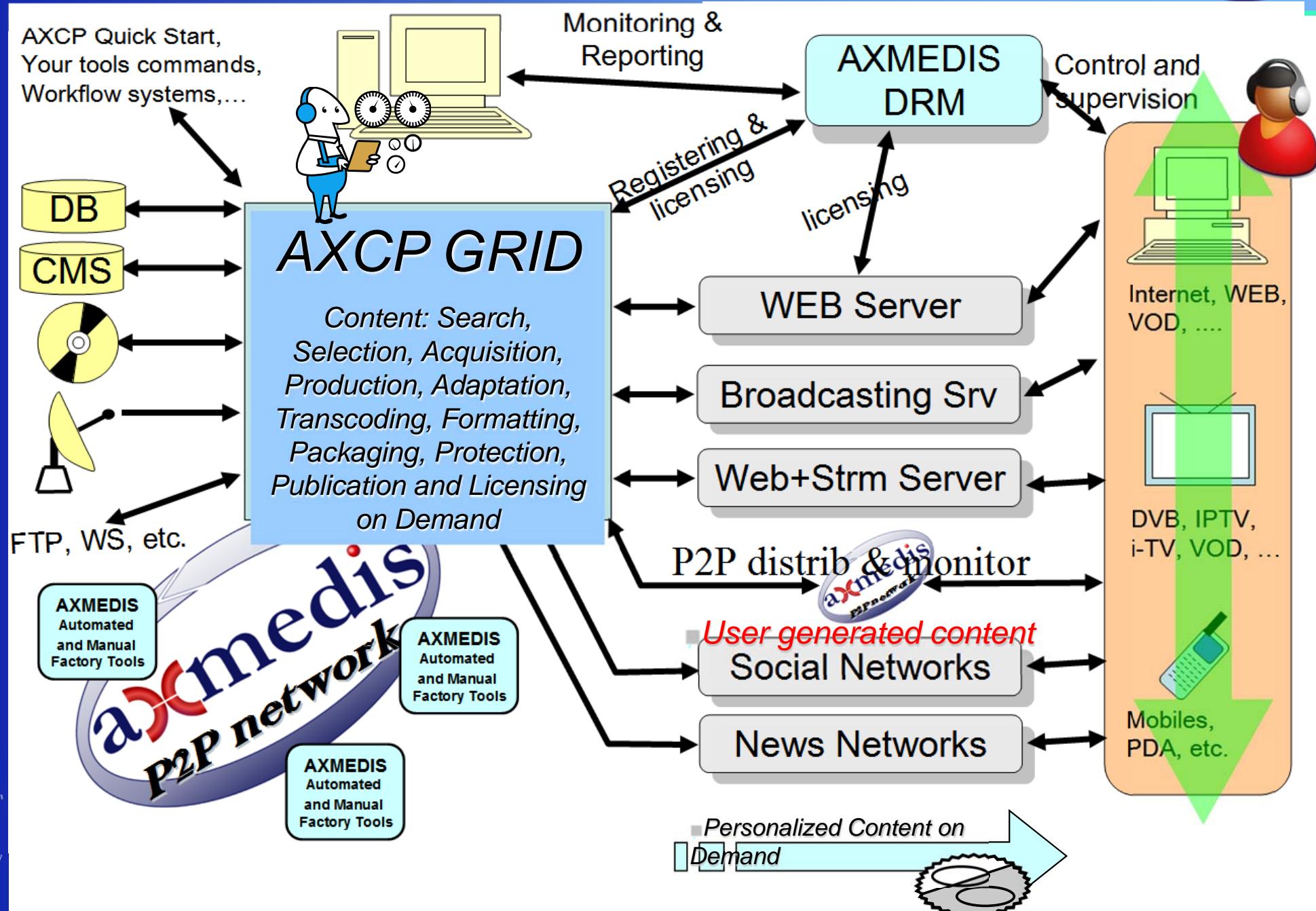
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AXMEDIS Architecture

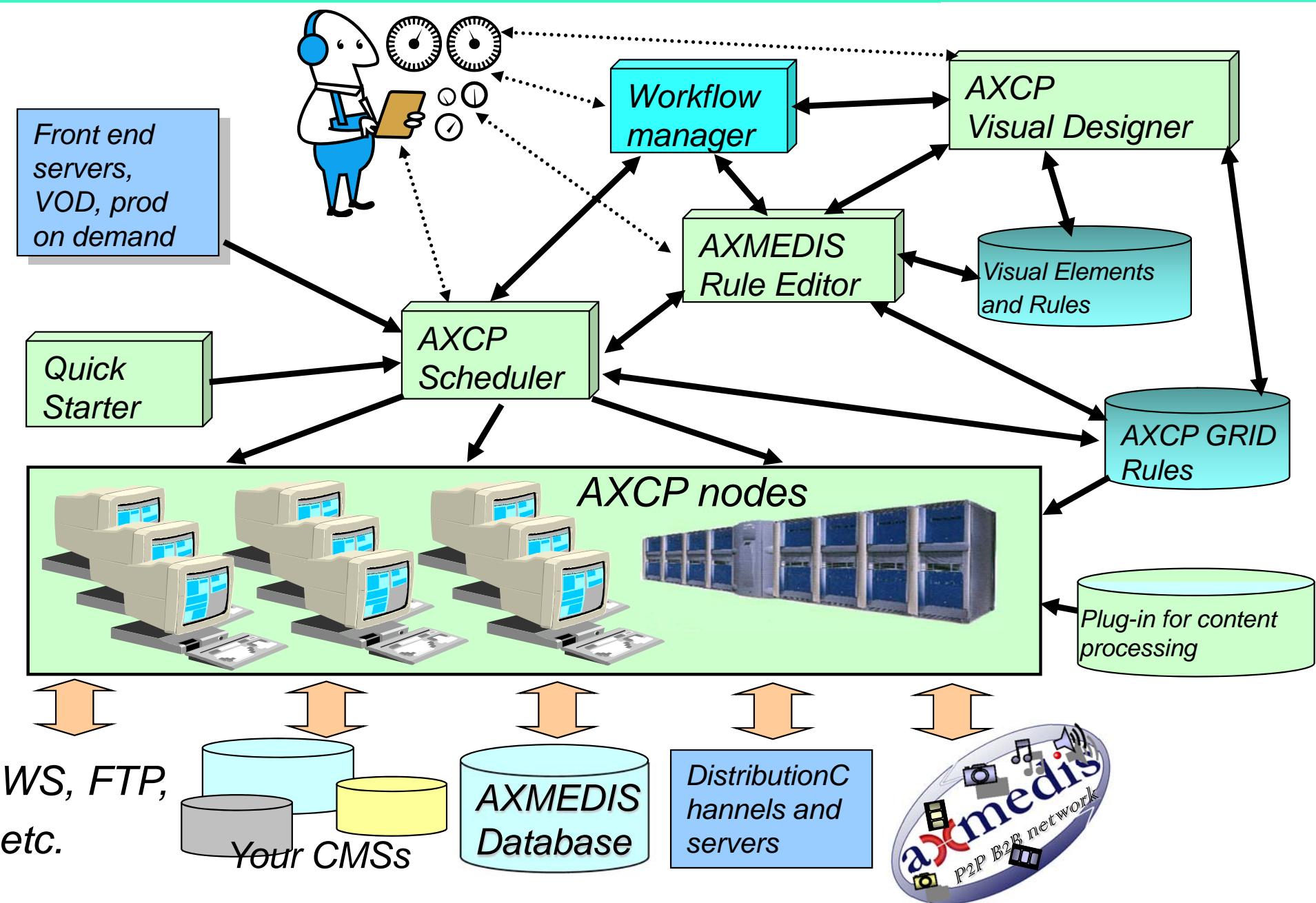


Factory and integration



- ¿ **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 Content Processing GRID





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

The screenshot displays several windows illustrating the AXCP Rule Editor and its components:

- AXCP Rule Editor 1.0 - ANSC_instruments_photogallery_smil-notex-PDA-audio-4.axr - [JS Script Editor - _main]**: Shows the JS Script Editor with the following code snippet:


```

1 // main
2 var tex = false;
3 if (globalPDA) // get the PDA-s
4 {
5   tex = false;
6   commonResourcesFilesDir = co
7 }
8 // see the arguments for the fol
9 instrumentsToProcess = imageFil
10 // this can be deleted in releas
11 smilFileOutputRoot = "c:\\smilPh
12 // create SMIL sources
13 prepareSourceFiles (smilFileOutp
      
```
- AXMEDIS Editor 1**: Shows the AXMEDIS View and MPEG21 View panes. The AXMEDIS View pane lists resources like AXOID, AXMEDIS Info, and Dublin Core. The MPEG21 View pane shows a thumbnail of a wooden object labeled "Claramella".
- Procedure List**: Shows a list of procedures including Java Script, AXCP Rule, and various Create/Remove/Write operations.
- Visual Procedure Editor**: Displays a workflow diagram with nodes like Start, CreateDir, CreateFile, WriteFile, and others connected by arrows.
- AXCP Rule Editor 1.0 - ANSC_instruments_photogallery_smil-notex-PDA-audio-4.axr**: Shows the rule editor interface with a sidebar containing the "ImageProcessing" library, which includes blur, contrast, conversion, despeckle, edge, emboss, enhance, equalize, extractchannel, floodfill, gaussianblur, getinfo, grayscale, import, magnify, median, minify, mirror, modulate, monochrome, negate, noise, and normalize functions.
- AxPDAPlayer**: A player window showing a wooden object labeled "Claramella".
- Help**: A help page titled "Welcome on Axmedis AXCP Rule Editor Help" with a "List of Contents" section and links to the User Manual, Javascript Reference Manual, and E4X Short Guide for Javascript v.1.6.
- Call Stack, Local Variables, Watches, Breakpoints**: Debugging panes at the bottom of the editor.
- Output**: A pane showing log output related to file uploads, such as "Uploading mandoline_napoletano_Porto_PDA.axm" and "Uploading Organetto_balcone_PDA.axm".



Part 1b: Sistemi di protezione e distribuzione



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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](http://XMF.axmedis.org)

• P2P as support for the above channels

- ♣ B2B and/or B2C networks
- ♣ <http://XMF.axmedis.org>



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

tiscali.

- 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



tiscali.

- 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



tiscali.



- PCs via Internet+P2P, AXMEDIS P2P and PC player:

- ◆ free air DVB-T + home domains/media center
 - ◆ BBC, SDAE, ETRI, UPC

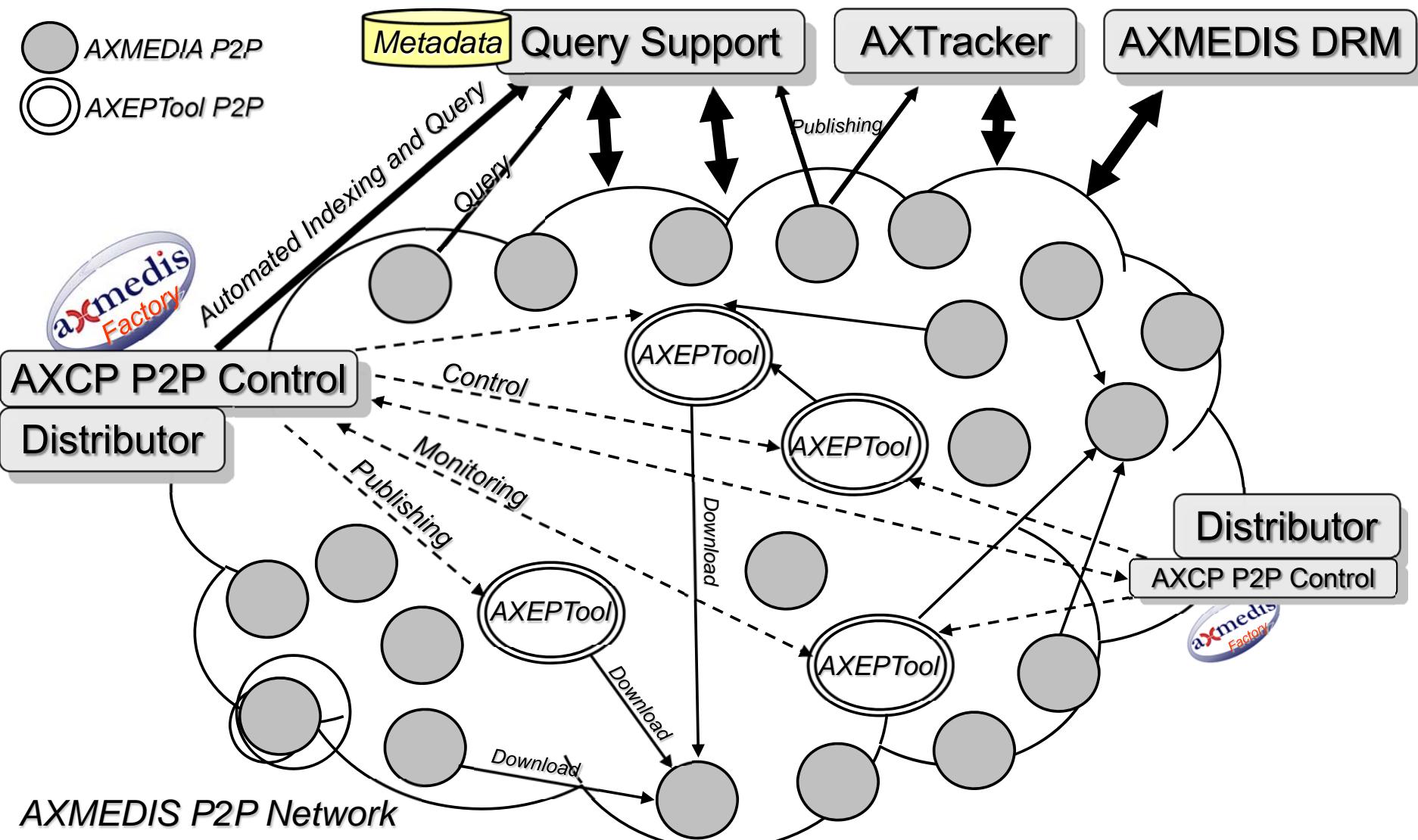
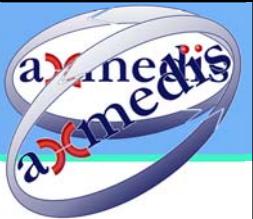


Enabling secure/legal P2P

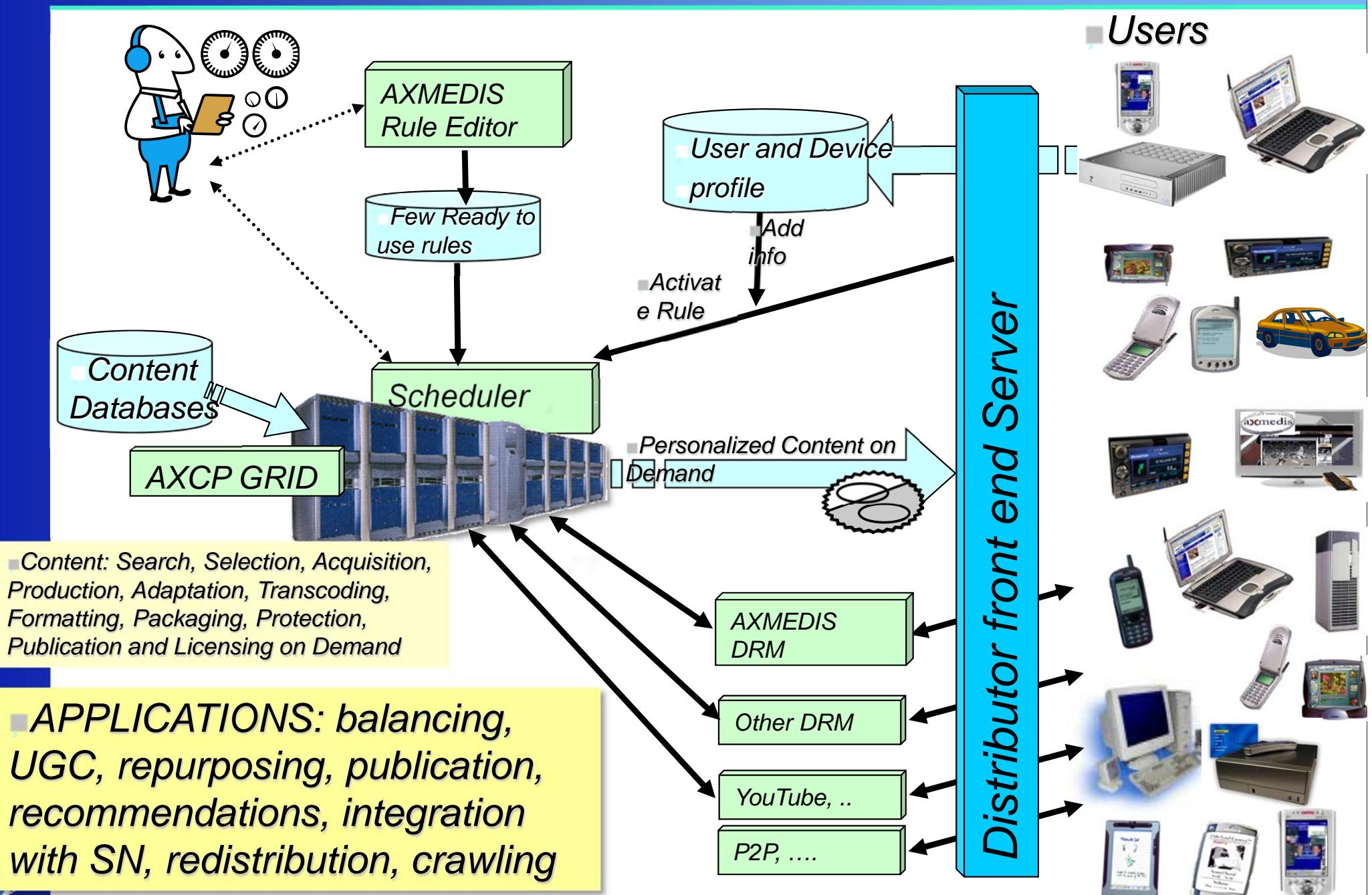
- **P2P network set up for content distribution**
 - ◆ BitTorrent Technology with Query and Catalogue
 - ◆ Protected content, legal P2P set up
 - ◆ P2P Client Tools
 - ◆ Automated B2B content distribution/publication via P2P, fast seeding,
 - ◆ Automated and efficient control of P2P networks
 - ◆ CONSUMER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

- **Content Sharing among, producers, integrators, archives and libraries, etc.**

AXMEDIS P2P network architecture

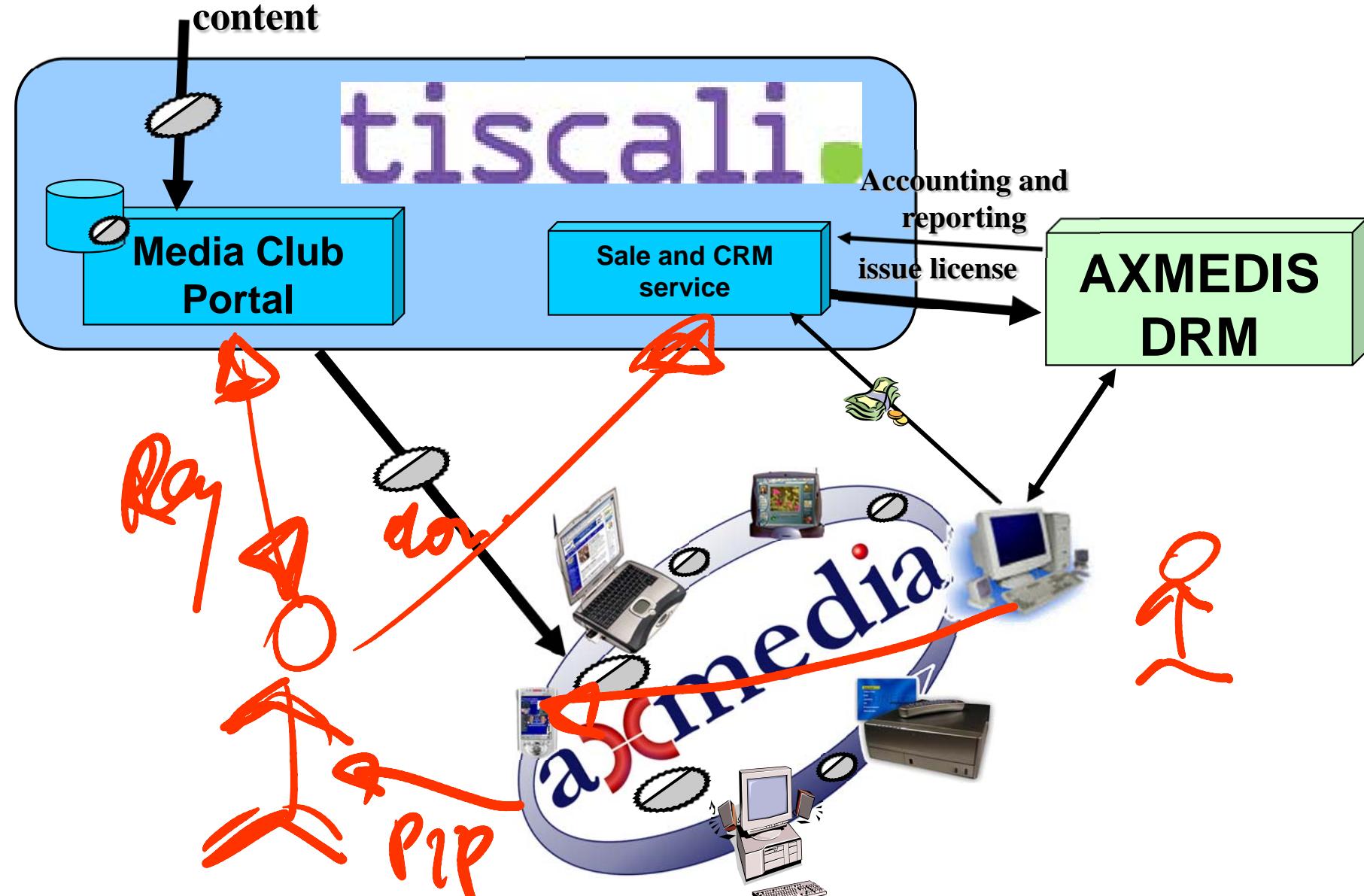


AXCP for empowering WEB portals



Cross media Content, from
video, audio to complex

VOD



TISCALI Media Club, Distribution Portal

Media Club - Windows Internet Explorer

http://medioclub.tiscalilab.com/license.jsp?SHOPTRANSACTION_ID=115ae3ce904&user=gnateri%40tiscali.it&device=medioclub&shop=Test_IT&transaction=115ae3ce904&axc

File Modifica Visualizza Preferiti Strumenti ?

Media Club

medioclub

gnateri@tiscali.it
portfolio logout
help

MENU
home
new entries

CATEGORIES
action
adventure
comedy
drama
cartoon
romance
musical
mystery
thriller
western

LICENSE

Audition

Acquired Licence
License Id: LID2107

download film p2p download

The screenshot shows a Windows Internet Explorer window displaying the TISCALI Media Club distribution portal. The main header is 'medioclub'. On the right, there's a user session area with an email link 'gnateri@tiscali.it', 'portfolio', 'logout', and 'help'. Below that is a large blue button labeled 'Acquired Licence' and 'License Id: LID2107'. At the bottom of the page are two orange buttons: 'download film' and 'p2p download'. To the left of the main content, there's a sidebar with 'MENU' and 'CATEGORIES' sections. The 'CATEGORIES' section lists various movie genres: action, adventure, comedy, drama, cartoon, romance, musical, mystery, thriller, and western. The background of the portal features a blue circular graphic with white highlights.

- ¿ **B2C distribution**
- ¿ **AXMEDIS objects with**
 - ◆ Video and Audio Files, with MD, images and also MPEG-4
- ¿ **The AXMEDIS Objects may be**
 - ◆ Downloaded from the TISCALI media club or P2P AXMEDIA
 - ◆ shared among consumers with AXMEDIA Tool a P2P tool
 - ◆ Visualized and played on AXMEDIS players free accessible
- ¿ **The users**
 - ◆ have to perform the registration on TISCALI
 - ◆ by a license to use the content
 - ◆ may use any AXMEDIS player
 - ◆ Mainly on PCs and Media Centers. PVRs
- ¿ **License allows**
 - ◆ Content sharing on AXMEDIA
 - ◆ Content play
 - ◆ Content Adaptation...
 - ◆ Content Migration on other P2P channels...
 - ◆ Content Migration on any other AXMEDIS terminal

tiscali.



medioclubmanager

- Search Axmedis media
- Media catalog
- Statistics

tiscali.

Search Axmedis media

Search for: title CONTAINS ariel

right EQUAL play

territory EQUAL

exercise limit EQUAL

validity interval LESS EQUAL

Search

2 records found [<< Prev](#) [Page 1](#) [Next >>](#)

	title	type	creator	date	import status
	Arielle	NULL	NULL	12/09/2007	

Statistics

Search: from: 2007-06-16 media id:

creator: domain: work identification:

1844 records found [<< Prev](#) [Page 1](#) [Next >>](#) **Search**

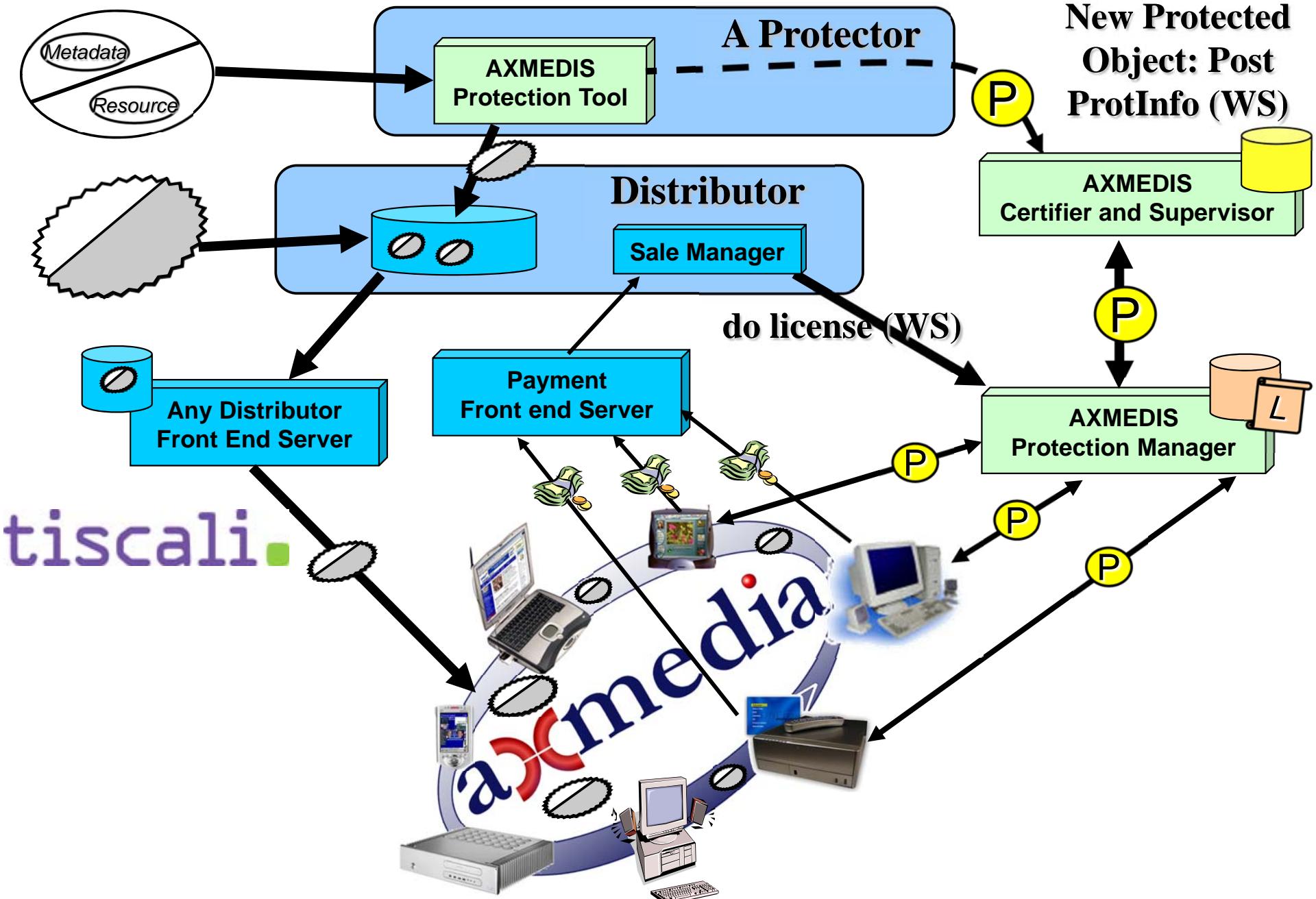
media id	creator	operation	execution	regi
URN:AXMEDIS:00002:OBJ:0B909E67-1D09-3708-8467-11518307131B	URN:AXMEDIS:00002:BUS:DD998008-6E83-3EC0-ABC4-882122A0654C	mx:play	2007-10-16 10:50:02	2007-10:49
URN:AXMEDIS:00002:OBJ:7362A059-8A61-31A1-8B51-DBD73ED1E3F3	URN:AXMEDIS:00002:USR:7C98E82E-60A0-3EB9-8476-9C200BDEE43D	mx:play	2007-10-16 09:34:19	2007-09:34
URN:AXMEDIS:00002:OBJ:9A295BCC-34DB-3B29-B26A-44EF6CFD9B51	URN:AXMEDIS:00002:BUS:DD998008-6E83-3EC0-ABC4-882122A0654C	mx:play	2007-10-16 08:43:19	2007-08:43
URN:AXMEDIS:00002:OBJ:8905BACD-8687-375D-BC58-628F152AAF67	URN:AXMEDIS:00002:BUS:D6D45C52-602E-3AC2-995E-EF9097C784A4	mx:play	2007-10-15 17:36:14	2007-17:37

Information Society

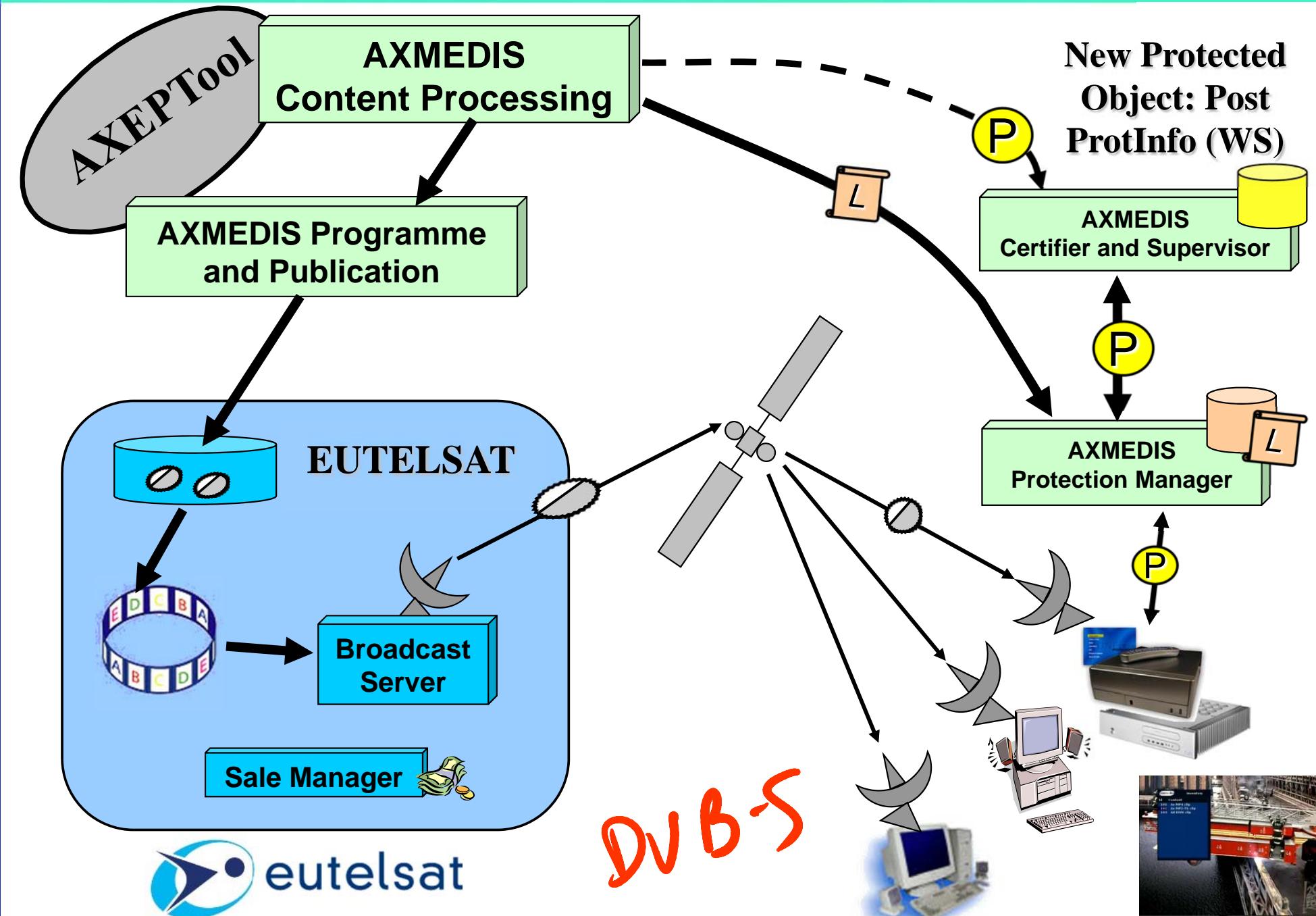
Sistemi Collaborativi e di Protezione, Univ. Firenze, Paolo Nesi 2012-2013

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TISCALI Distribution with AXMEDIS Technology

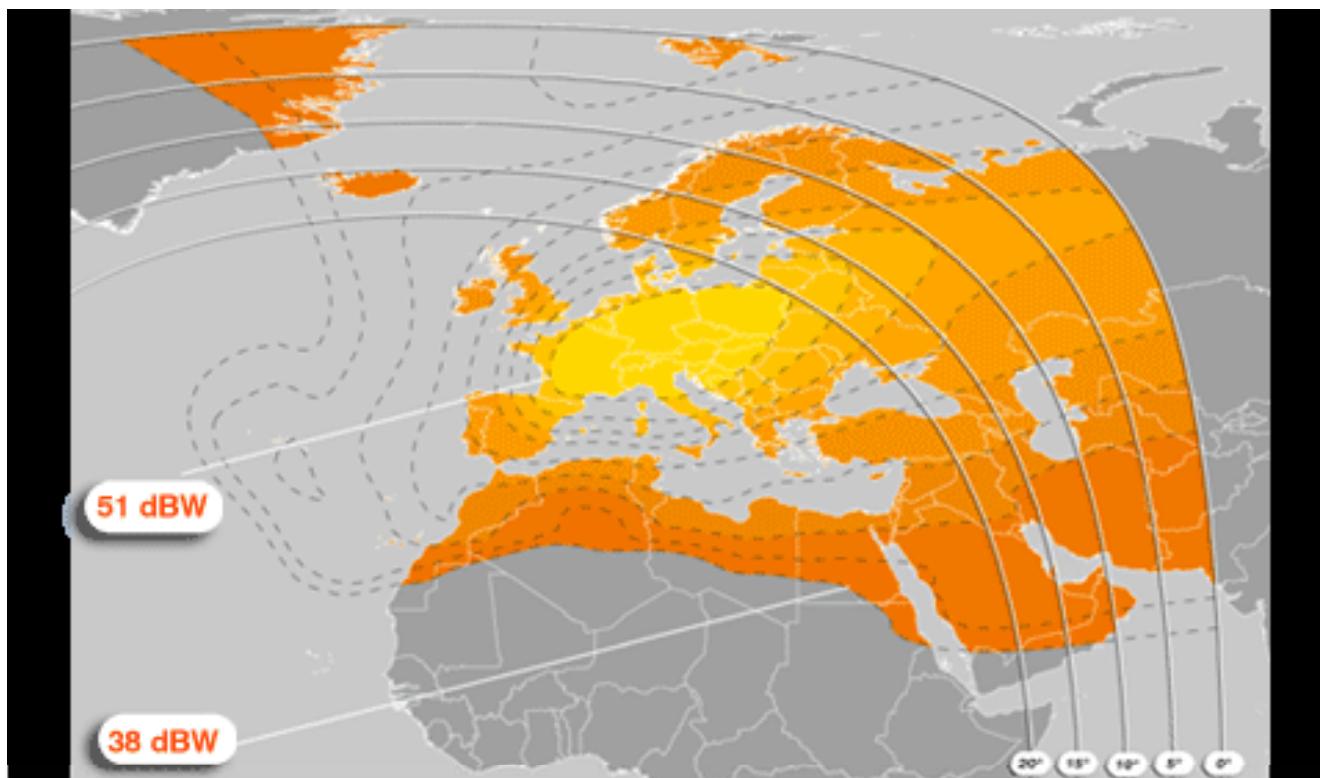


EUTELSAT Distribution with AXMEDIS Technology



AXMEDIS Service on ATLANTIC BIRD™ 1:

- 12.5° West, covering Europe and Americas
- Frequency: 11.428GHz
- Symbol rate: 30000KSym/s
- Polarization: Horizontal



<http://www.eutelsat.com/satellites/125e.html>

• **B2B and B2C distribution**

- ◆ Non completed content is completed via DSL or Dial UP communication



PUSH

• **AXMEDIS objects with**

- ◆ Any kind of content,...
- ◆ Video, images, document, audio, animations, etc.

• **The AXMEDIS Objects may be**

- ◆ Visualized and played on AXMEDIS players free downloaded
- ◆ Received on Kiosks
- ◆ Received and player on STB of MBI

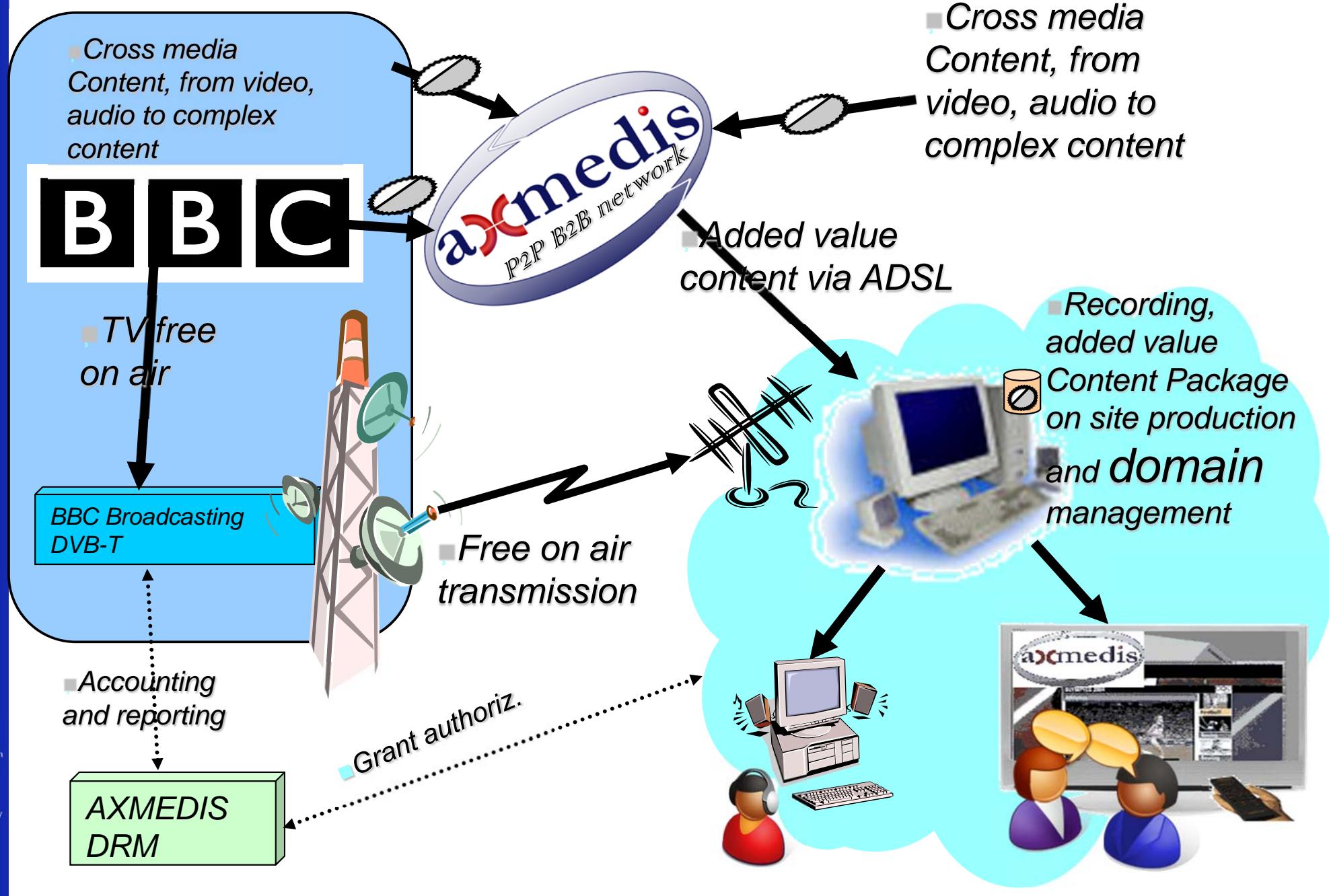
• **The users have to perform the registration of**

- ◆ themselves on an AXMEDIS portal or via the STB ID/PIN
- ◆ any AXMEDIS player tool they would use
- ◆ Mainly on PC for TV and/or STB and/or Kiosks

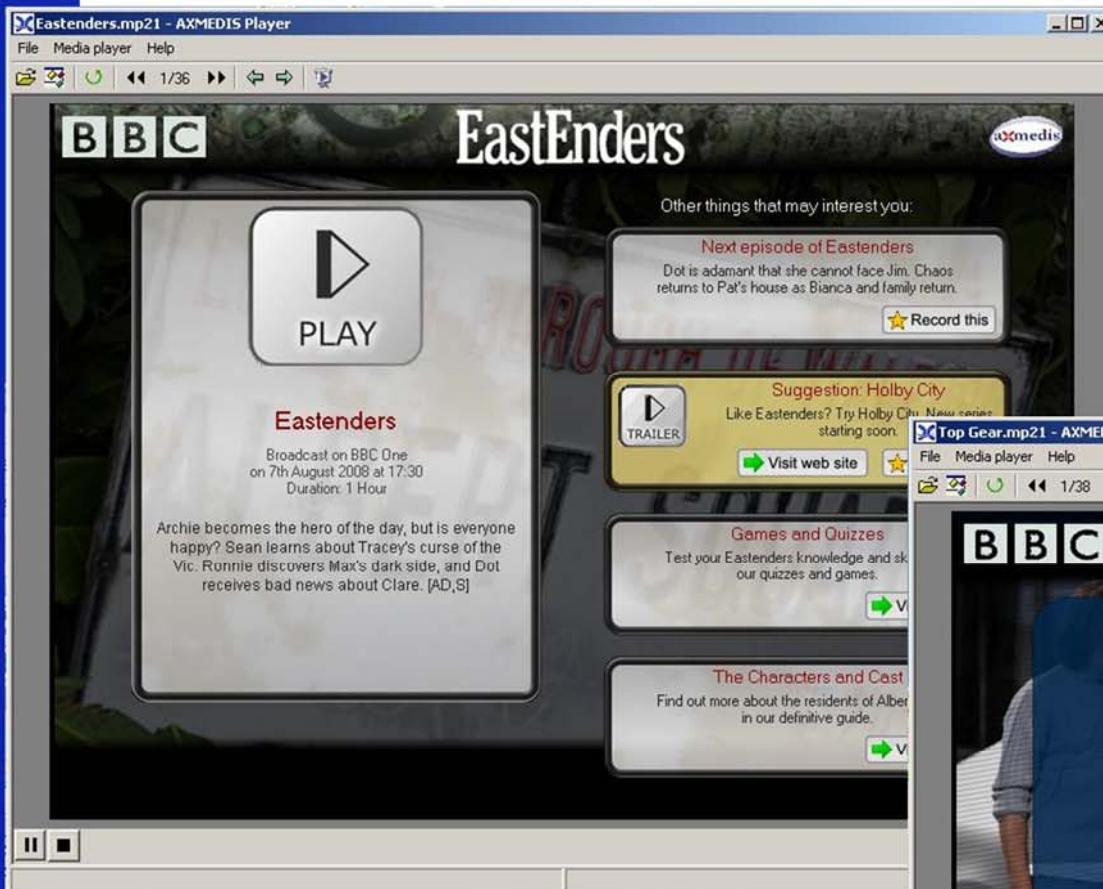
• **License allows**

- ◆ Content play
- ◆ Content Adaptation...
- ◆ Content Migration on any other AXMEDIS terminal, in some cases

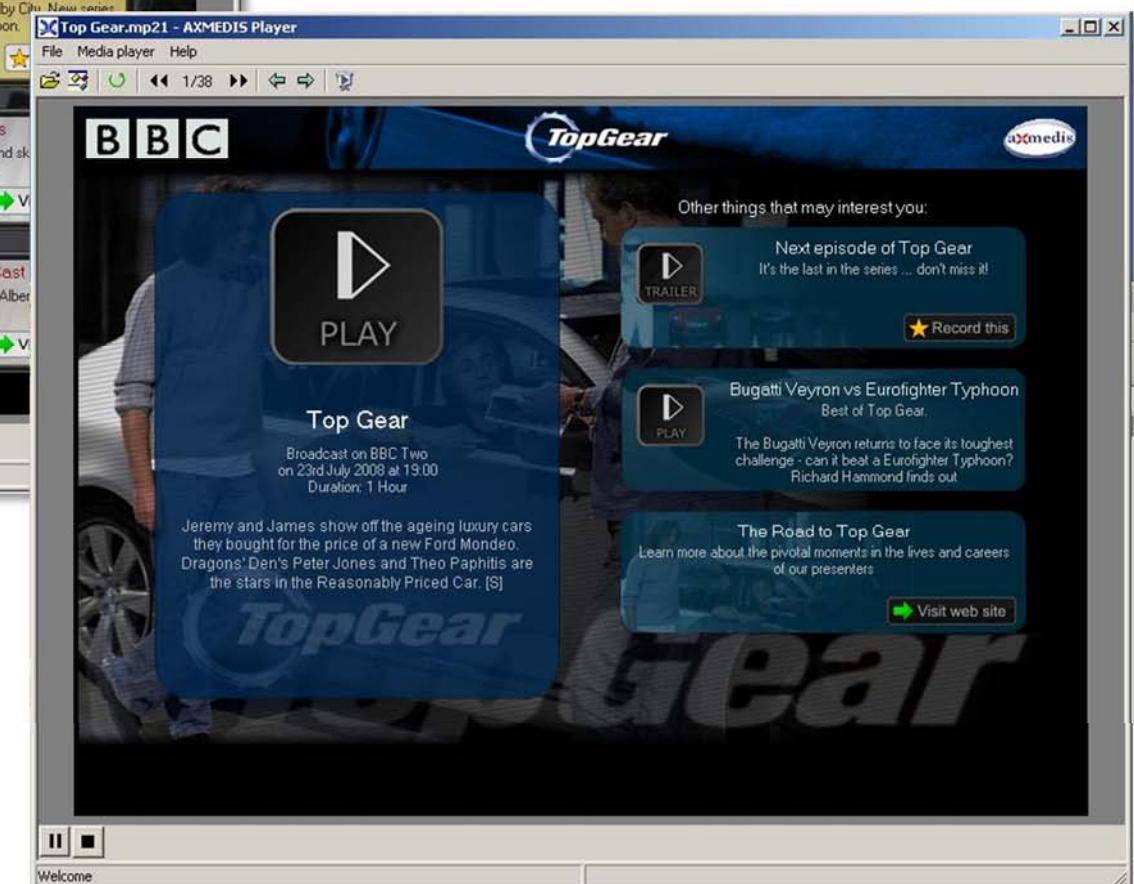
Content Production on the Consumer Side

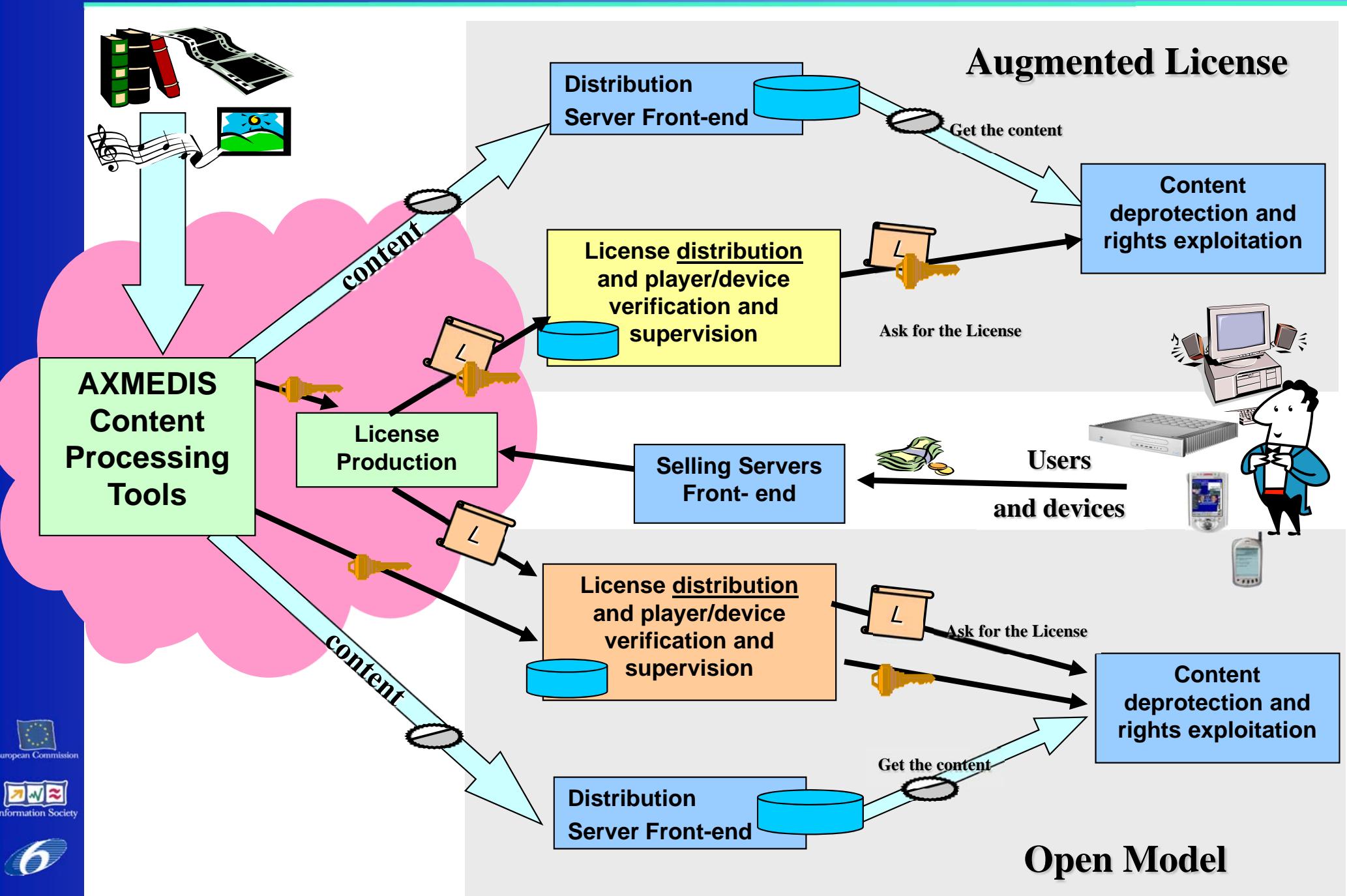


■ Examples Content from AX4HOME

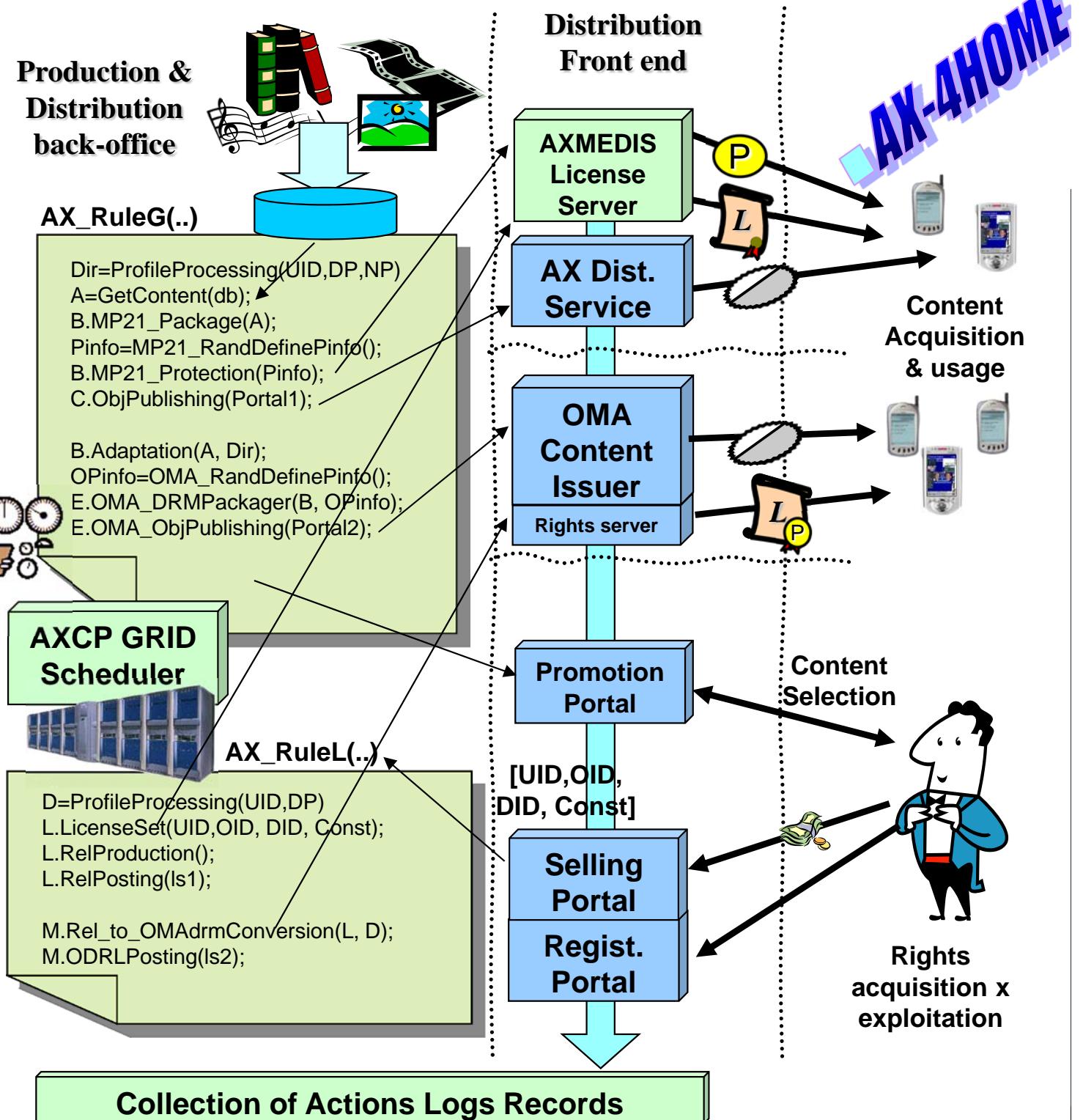


The Axmedis content can be intelligent to be proactive with the users and bring it suggestions and stimulus

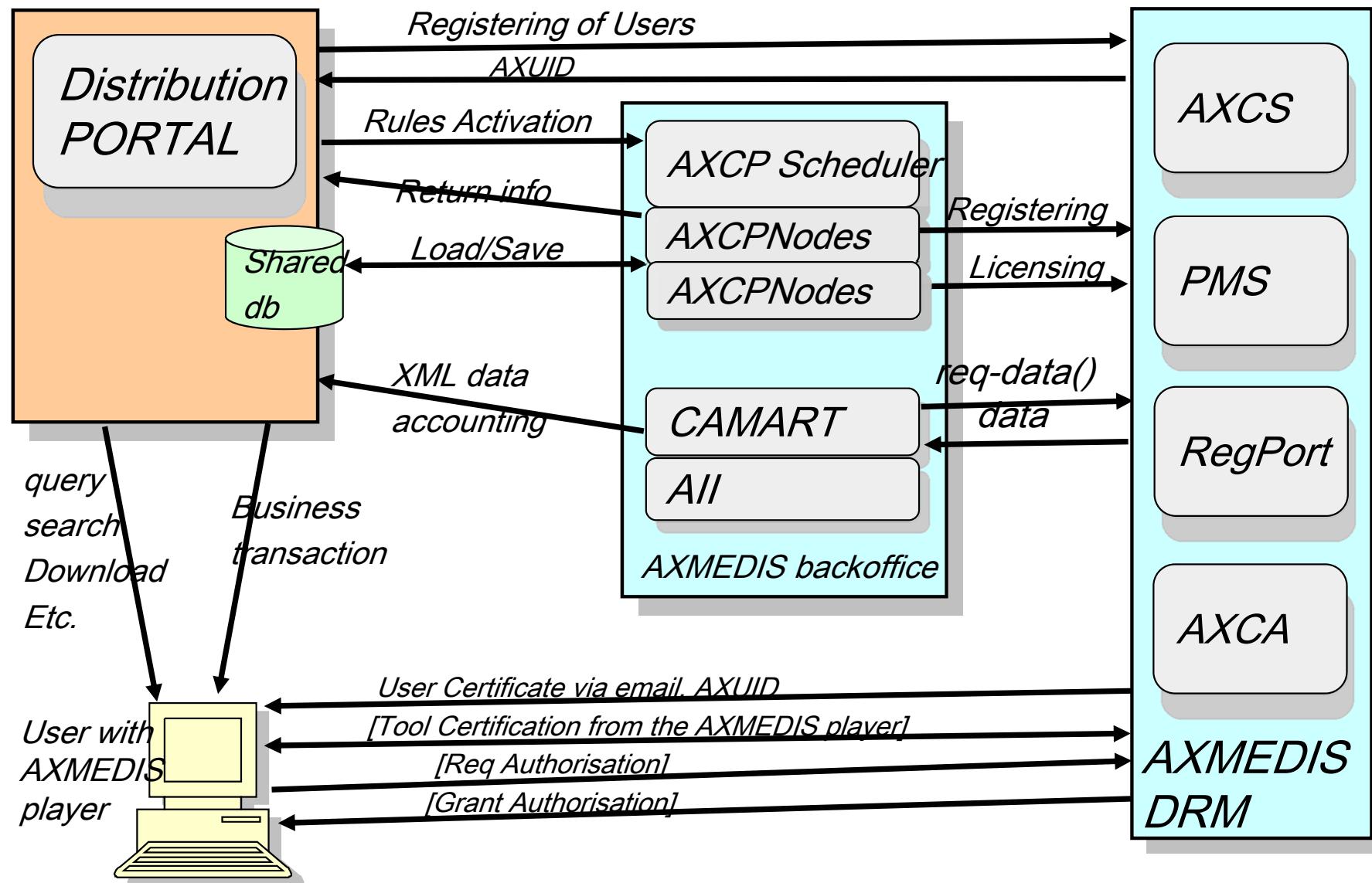




Mobile distribution, OMA and **MPEG-21**



AXMEDIS DRM Single channel integration



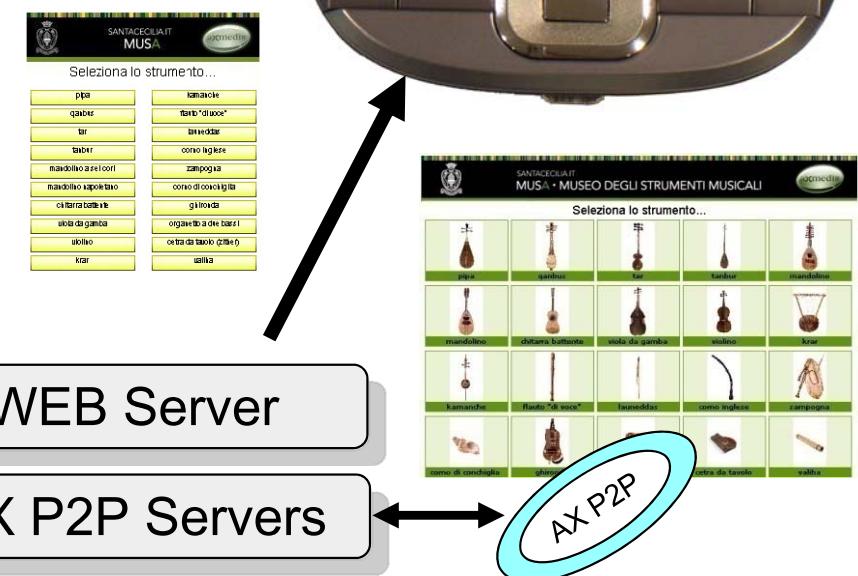
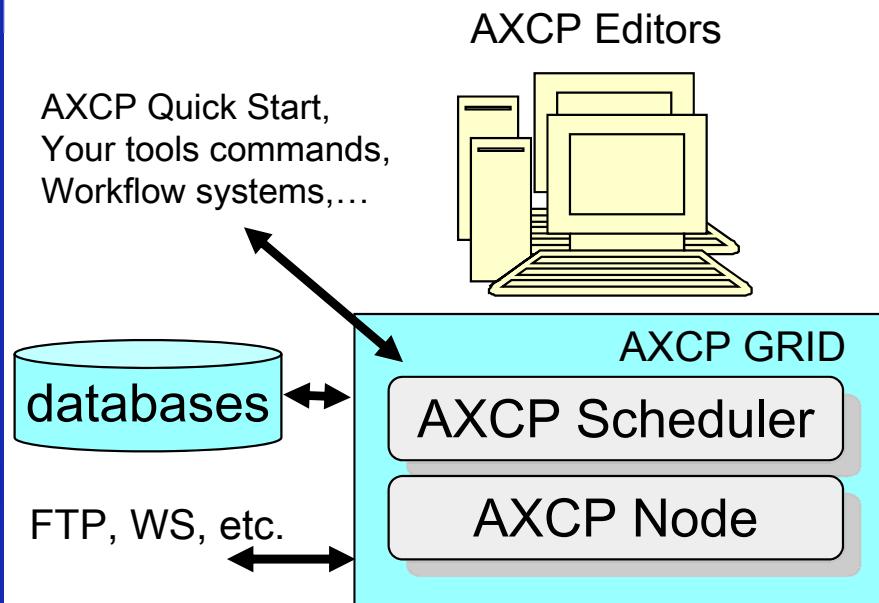
Distribution of cultural content, AV guides



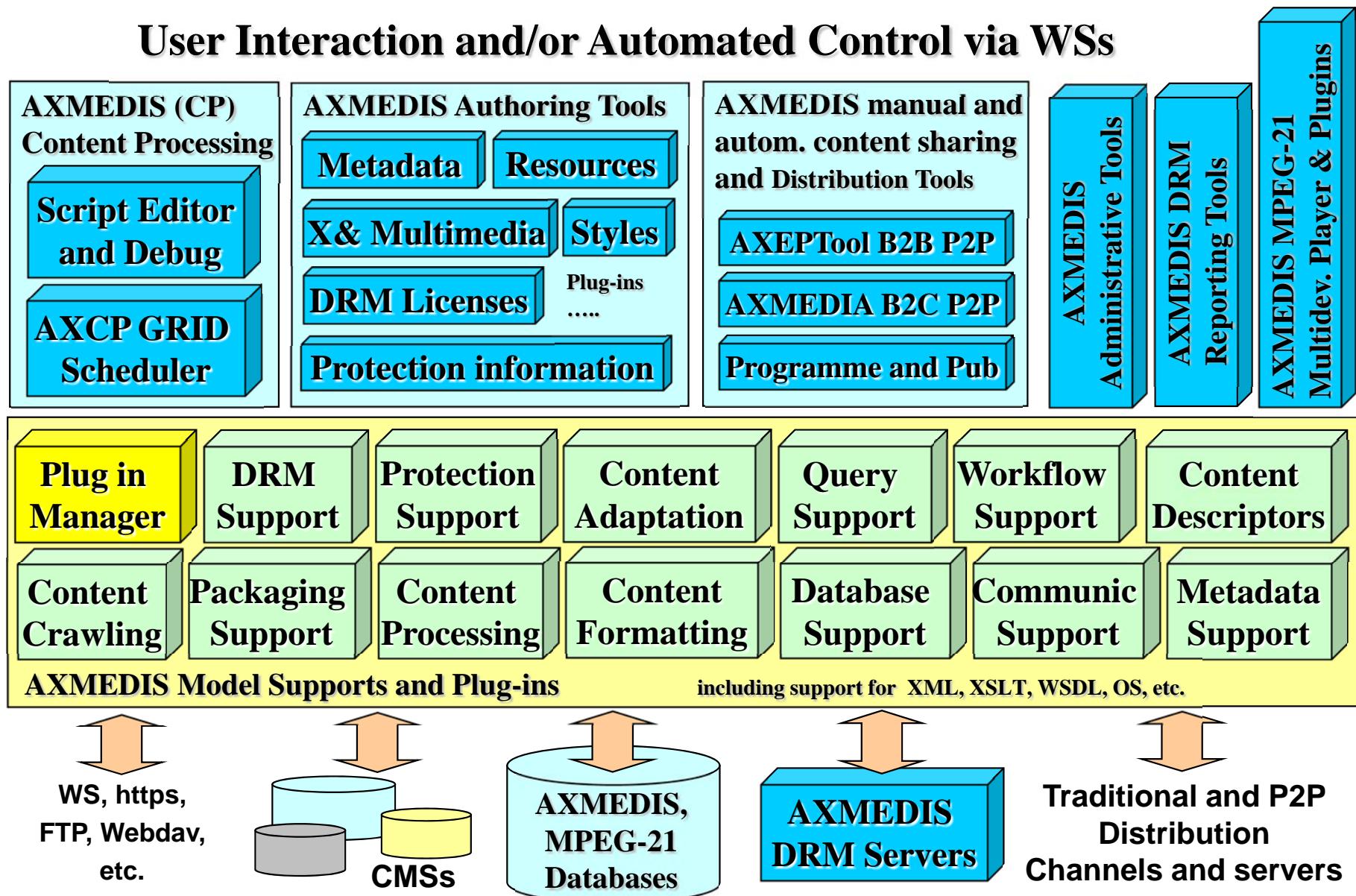
- At MUSA: instrument museum at Accademia Nazionale di Santa Cecilia, Roma
- Usable for AV guides, even with RFID
- Production of content for continuous formation, in medical area or for other interactive guides
- Monitoring of the user activities



ACCADEMIA NAZIONALE
DI SANTA CECILIA
Fondazione



User Interaction and/or Automated Control via WSS



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.asp>

Click on these links to download the videos



- **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-anse-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

Please download AXMEDIS Tools



- **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 AXEPTTool:**
 - ◆ http://www.axmedis.org/documenti/view_documenti.php?doc_id=3840





Part 1b: Sistemi di protezione e distribuzione



- Apple I-Tune DRM
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 - ♣ AnalogHole, Triple Play, Quadruple play, Super-distribution
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 - ♣ Integrazione con Portale di distribuzione
- DRM Reciprocal Trust via P2P



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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



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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



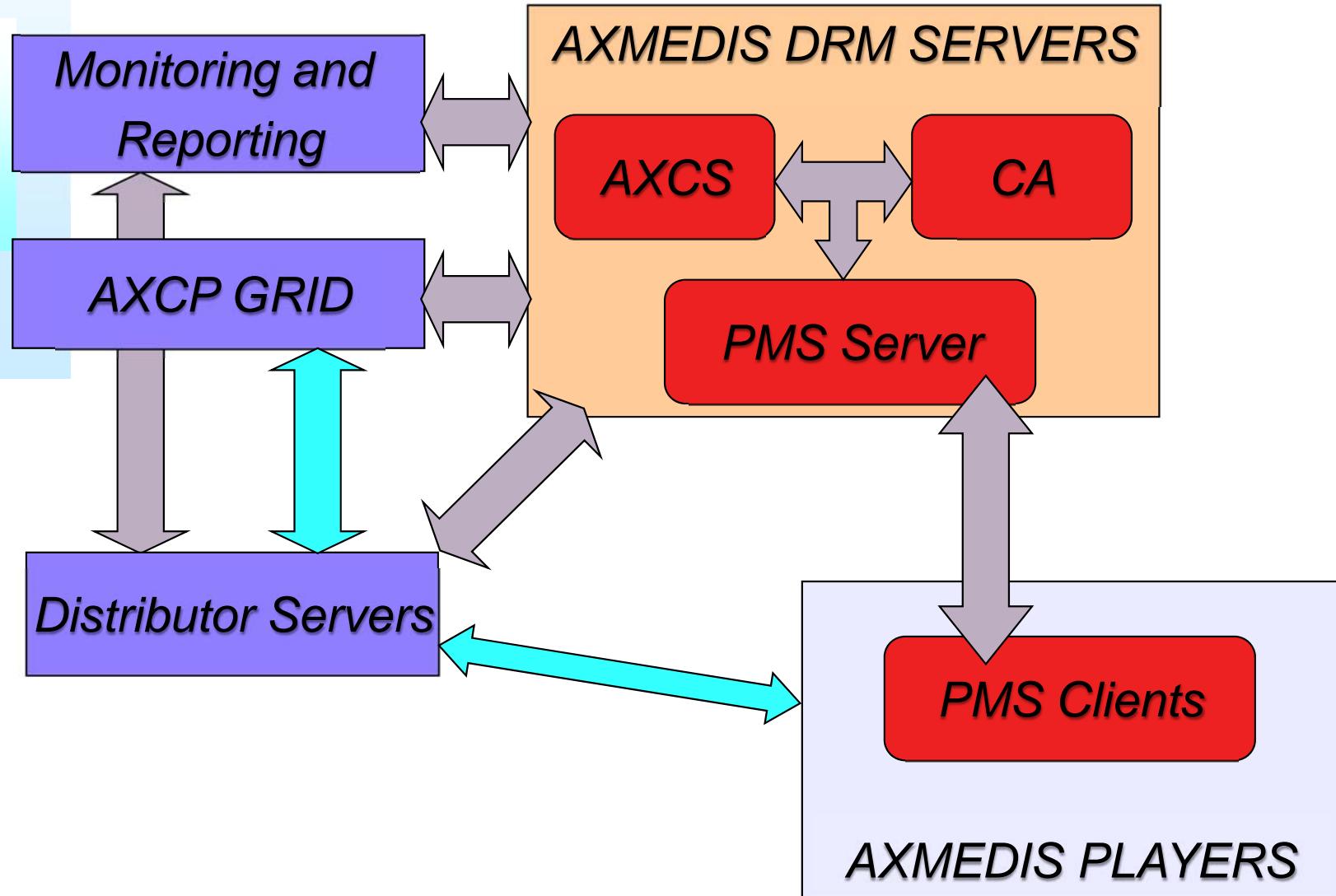
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Architettura DRM AXMEDIS





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**

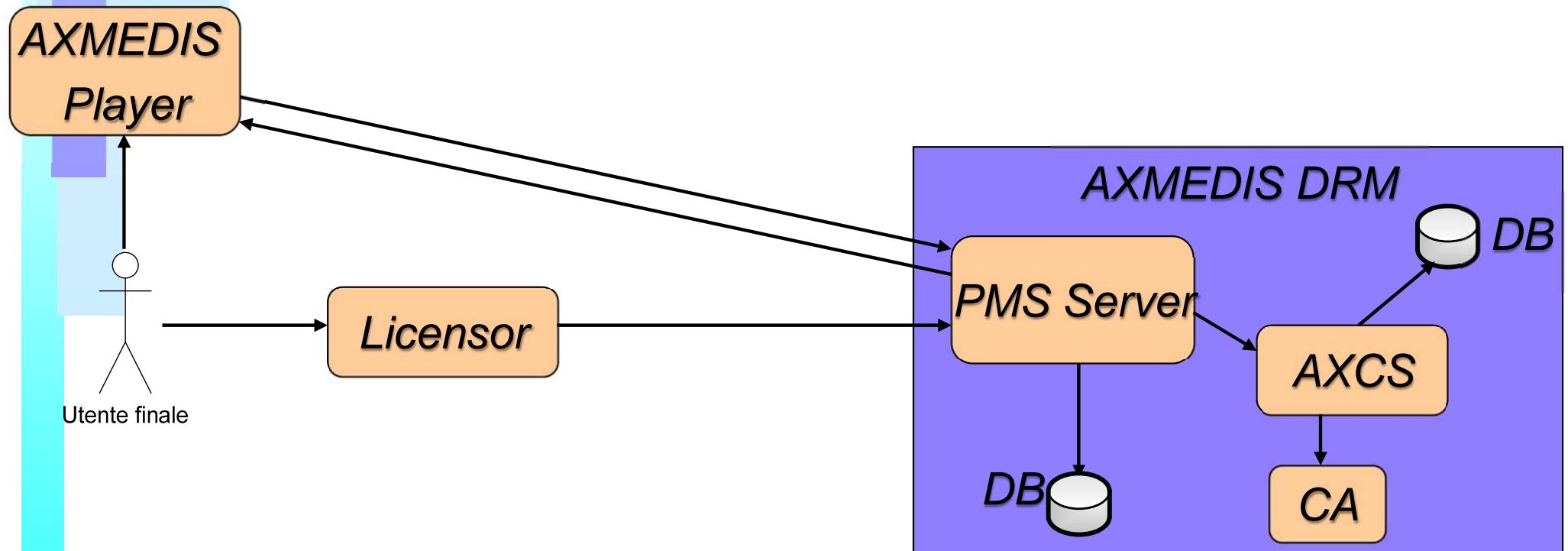
- *certificazione del tool: salvataggio dei dati relativi al tool utilizzato*
- *verifica del tool: controllo sull'integrità*
- *autorizzazione: concessione del grant all'utente finale*





DRM AXMEDIS Esempio

*Autorizzazione
Verifica del tool
Registrazione della licenza
Certificazione del tool*





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

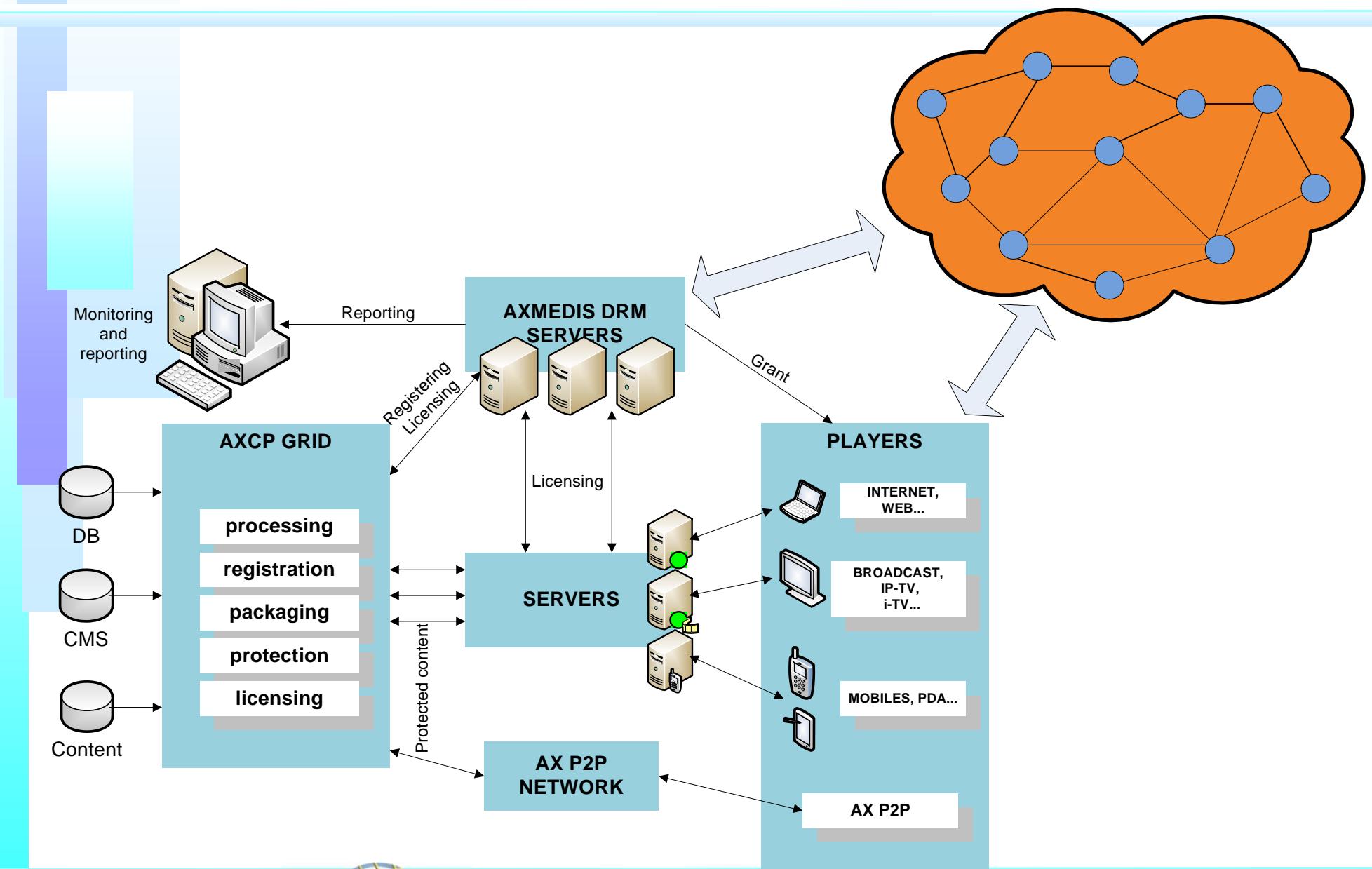
Perché Bamboo DHT:

- *due insiemi di vicini: leaf set e routing table*
- *interfacce put/get predefinite: XML-RPC*
- *gestione del churn*
- *open source*



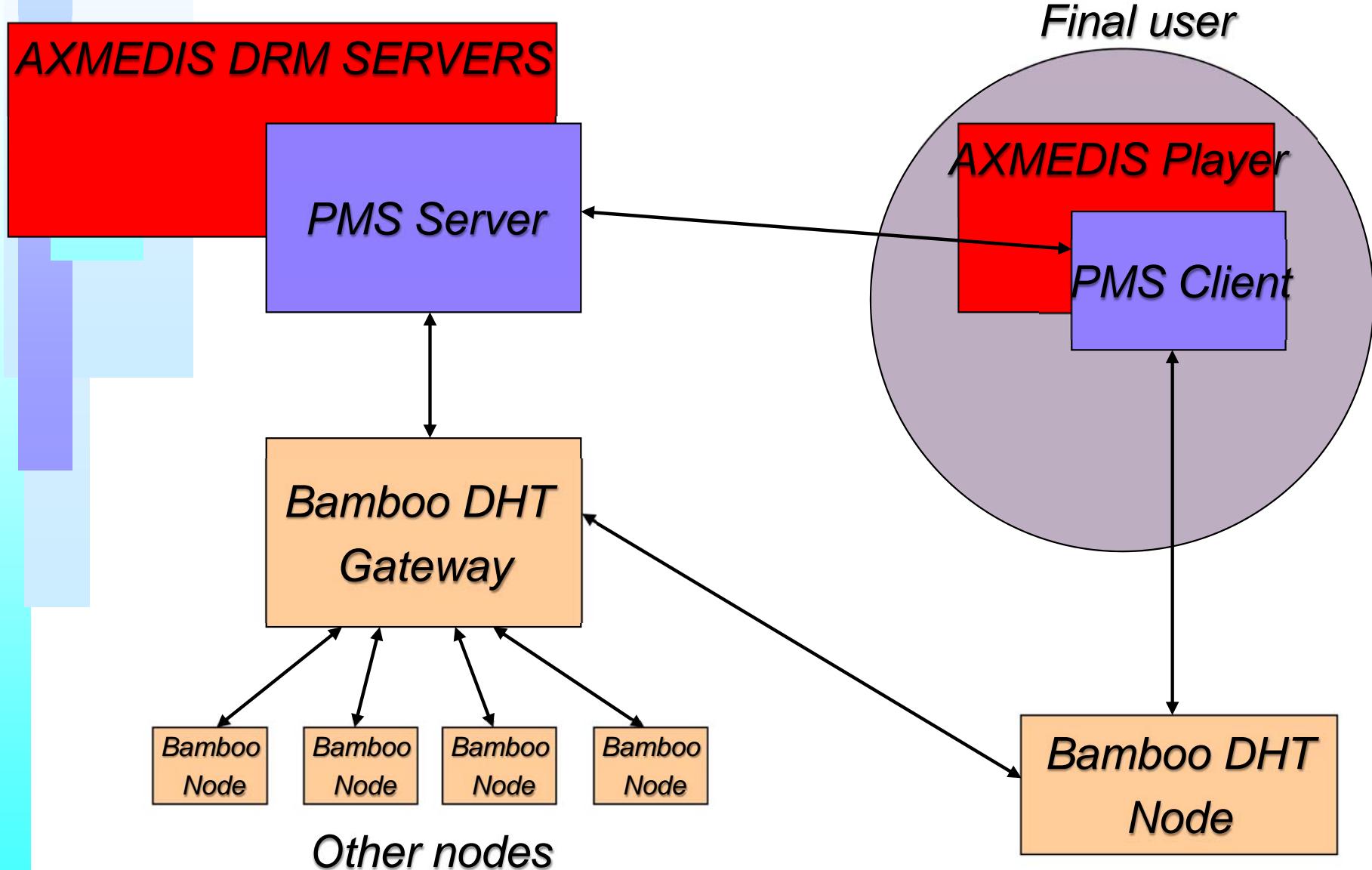


RETE P2P



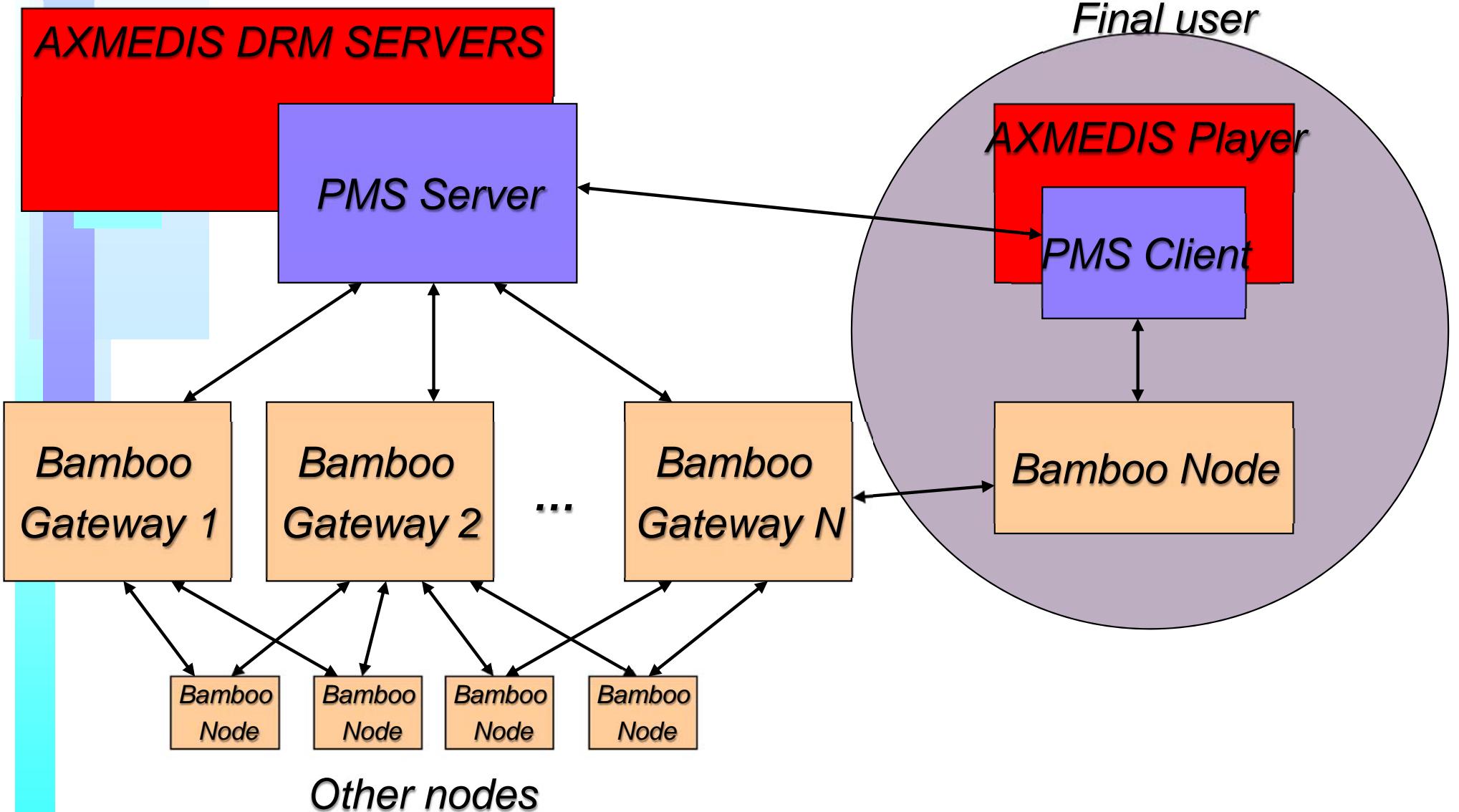


Interazioni tra nodi e DRM





Esempio di deployment ‘ottimo’





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.





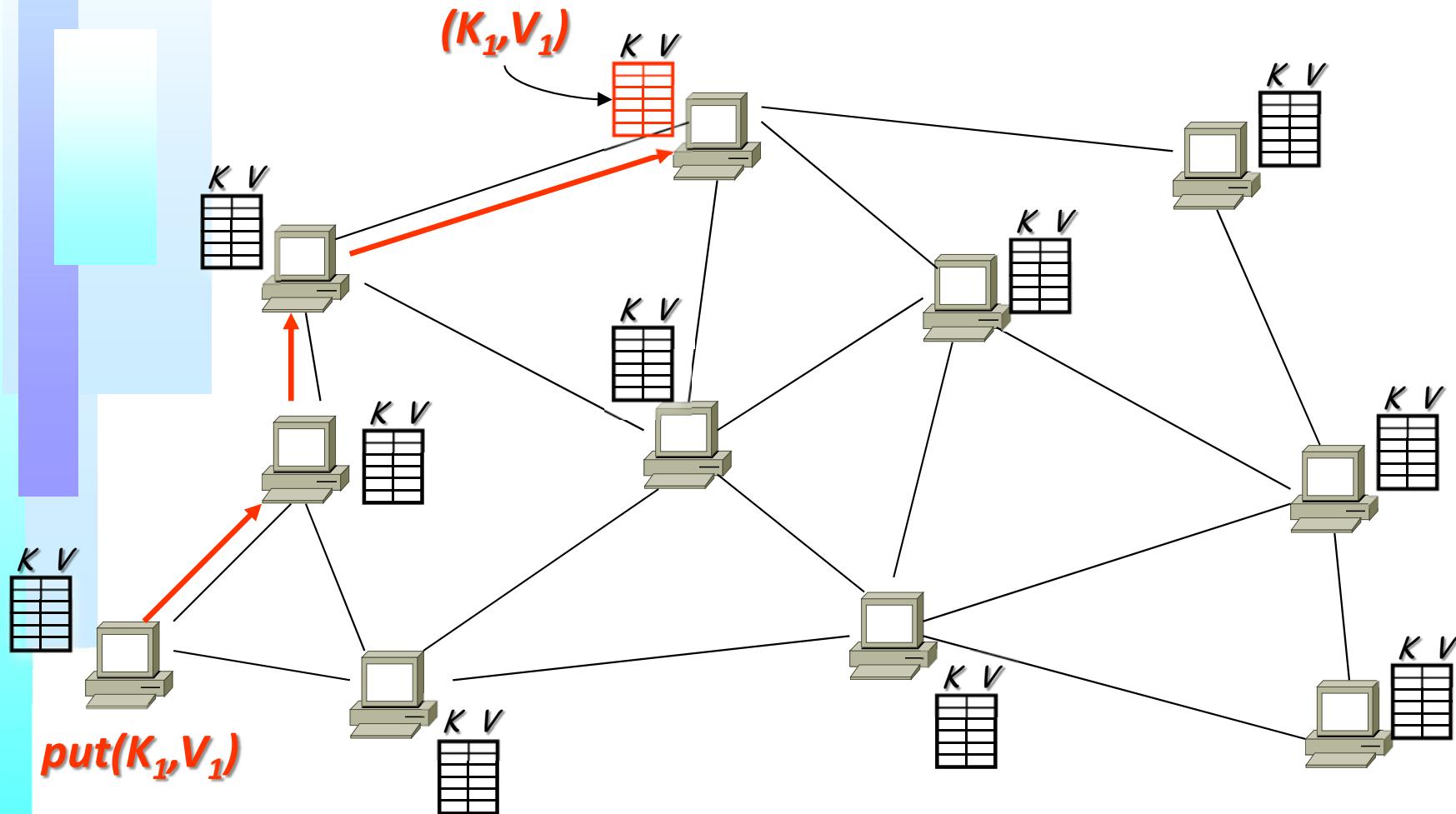
Recupero dati dalla DHT

- 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



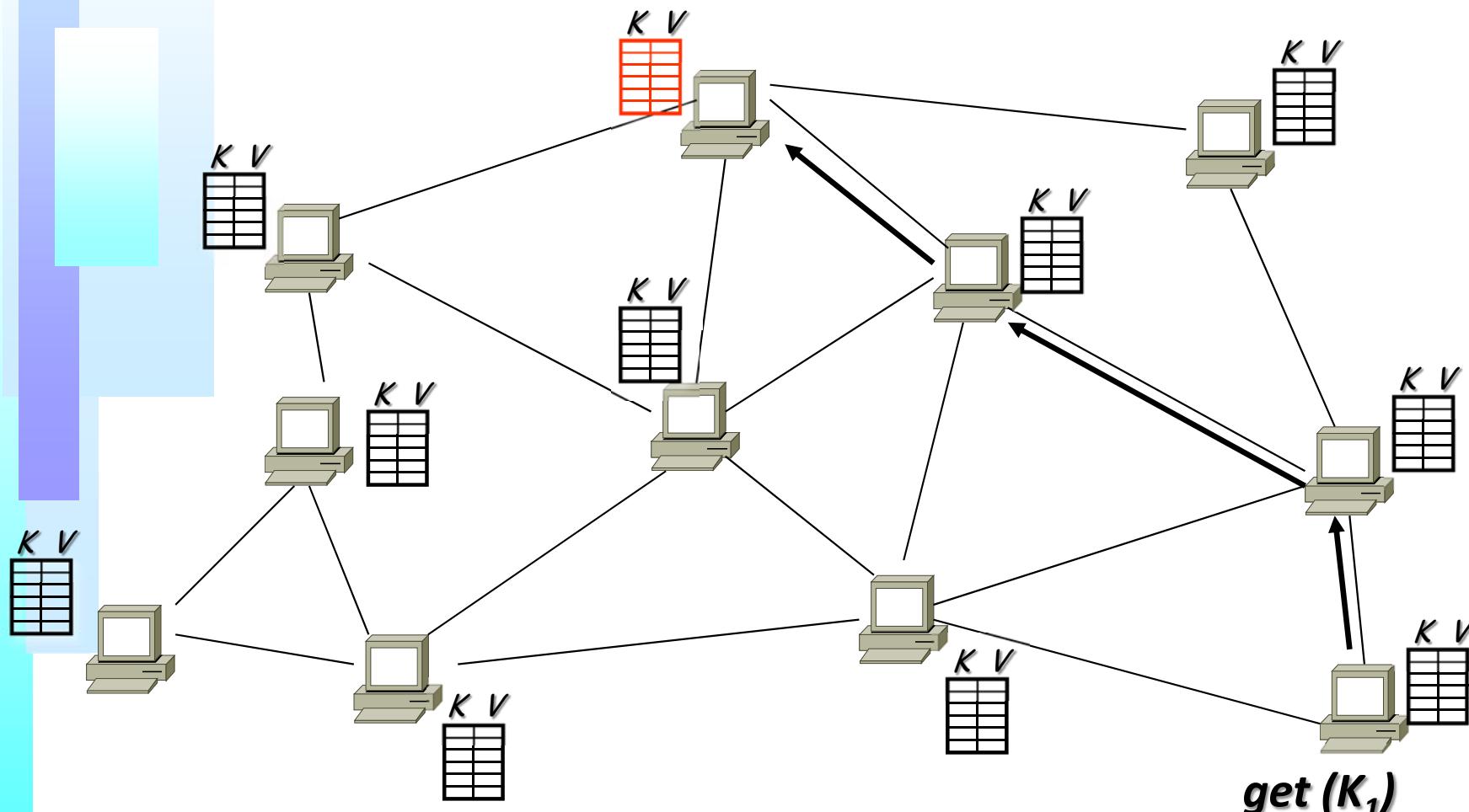
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DHT in action: get()



Operation: take key as input; route msgs to node holding key





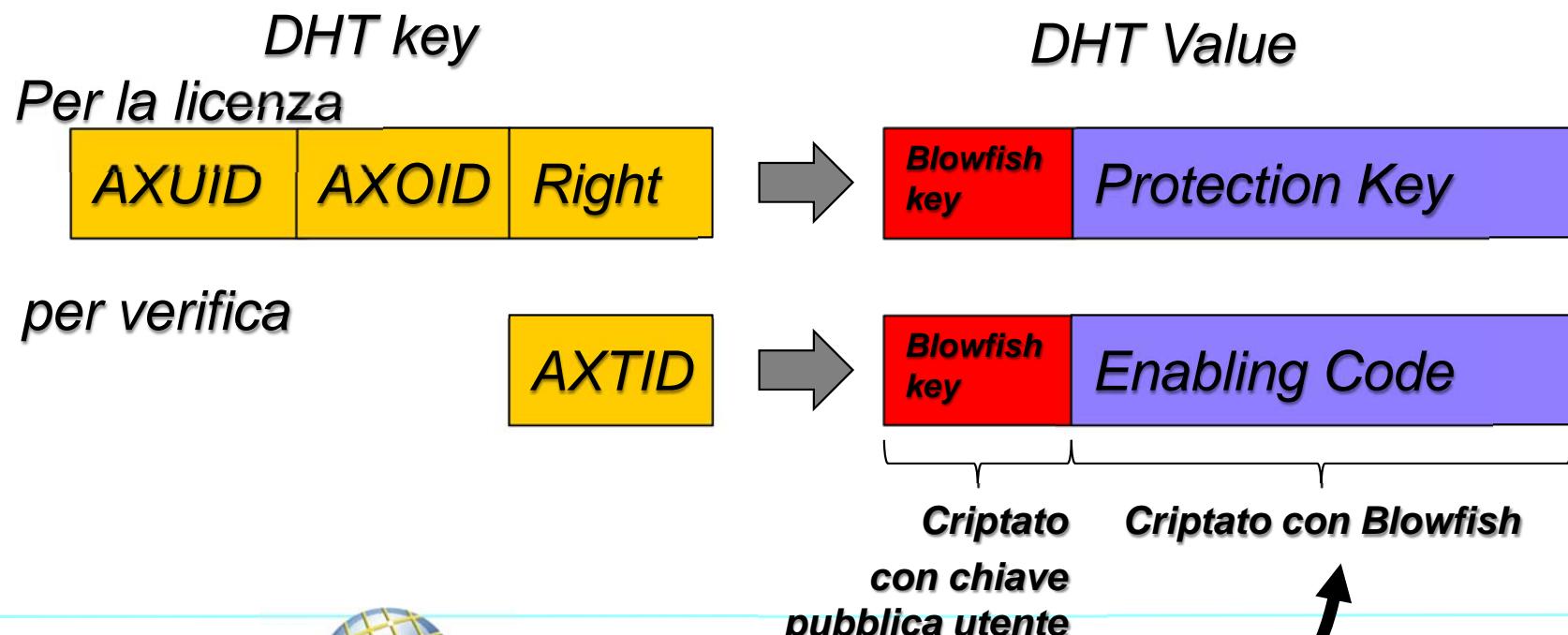
- In keyspace composto da stringhe di 160 bit
 - ♣ Al massimo di hanno un numero di hop pari al Log in base due di 160
 - ♣ Costo della ricerca: $O(\log N)$
- Se si vuole immettere nella DHT un contenuto caratterizzato dai parametri *filename* e *data*, viene inizialmente calcolato l'hash del filename, 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.



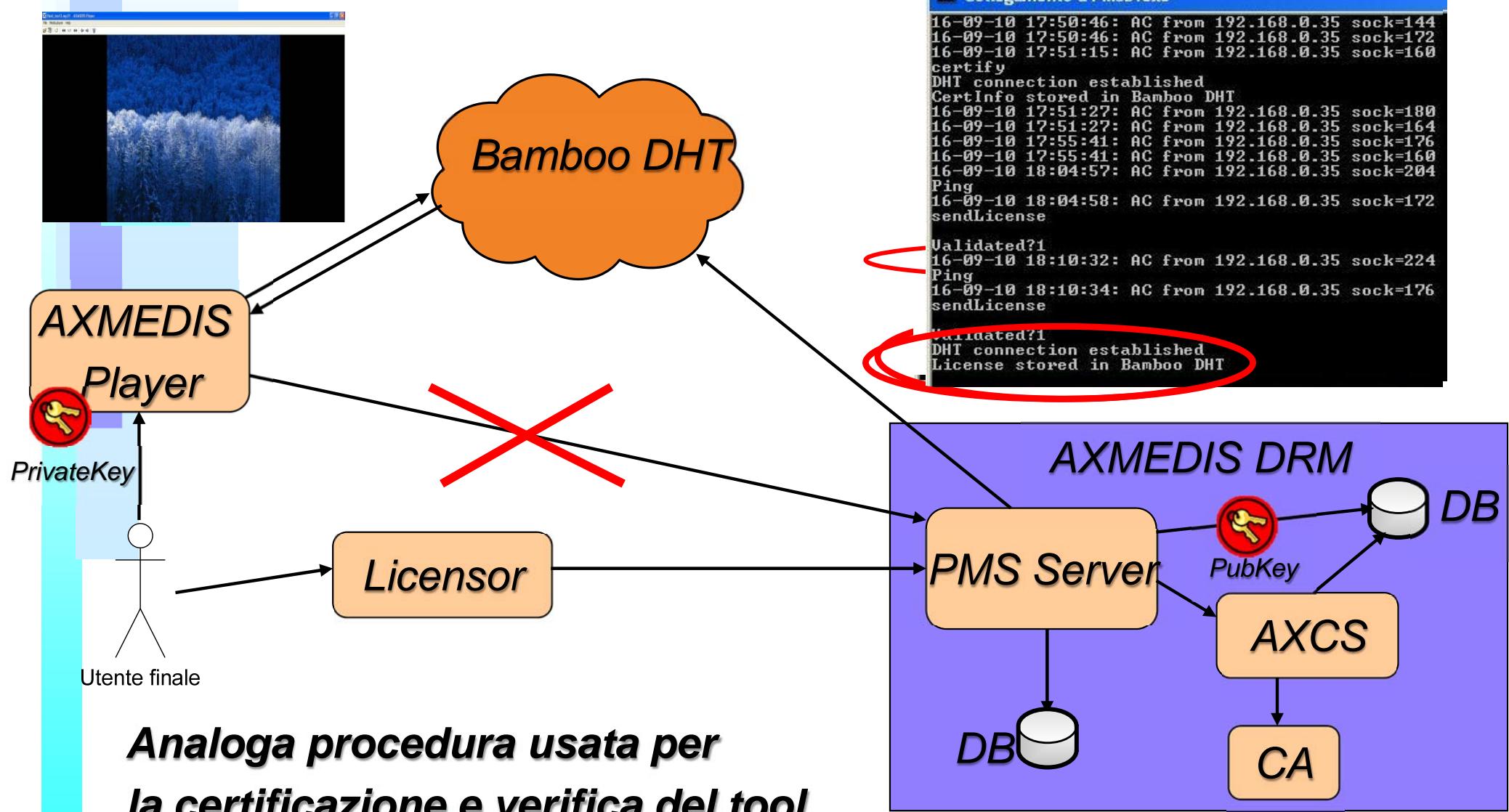
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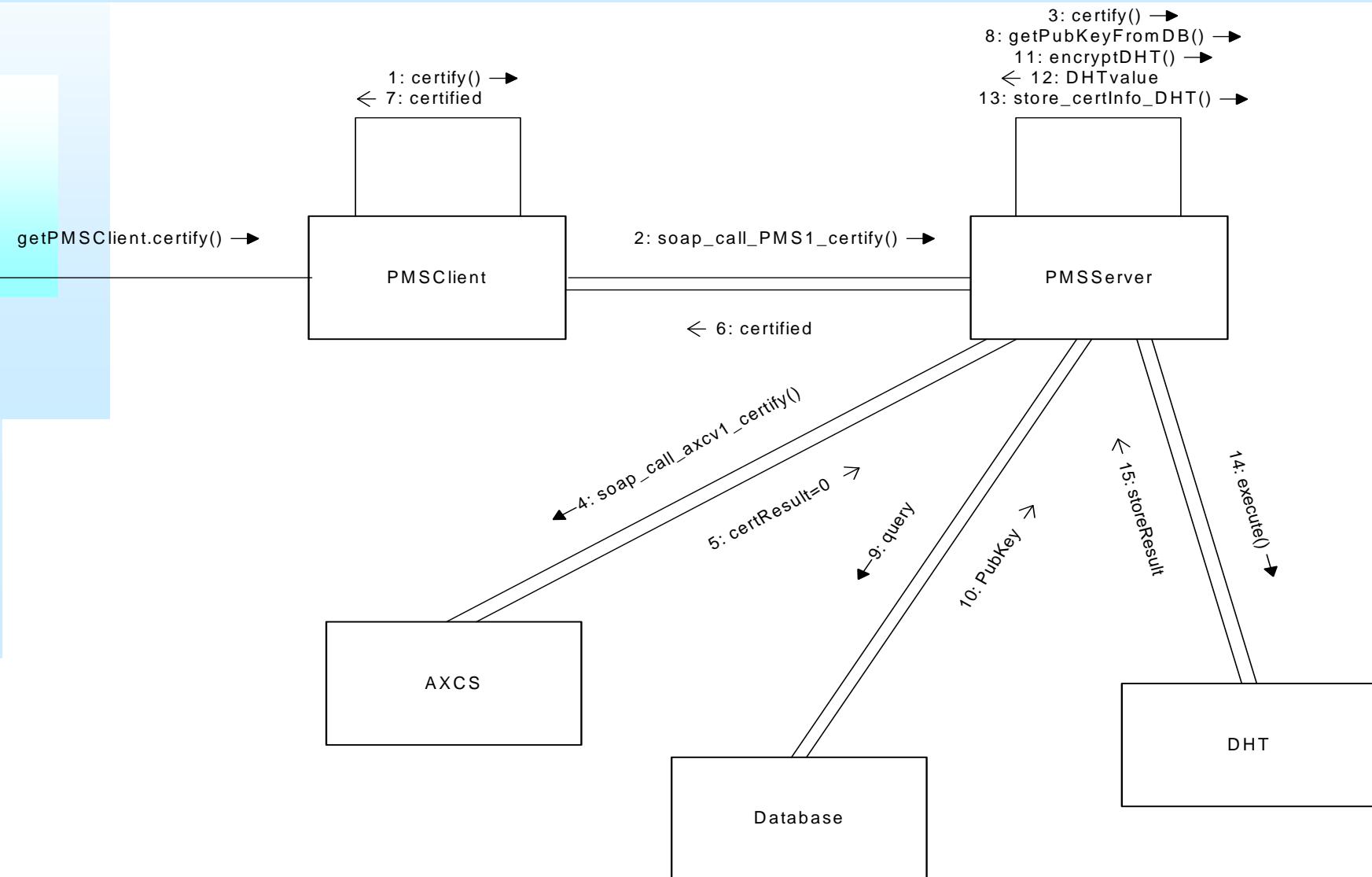
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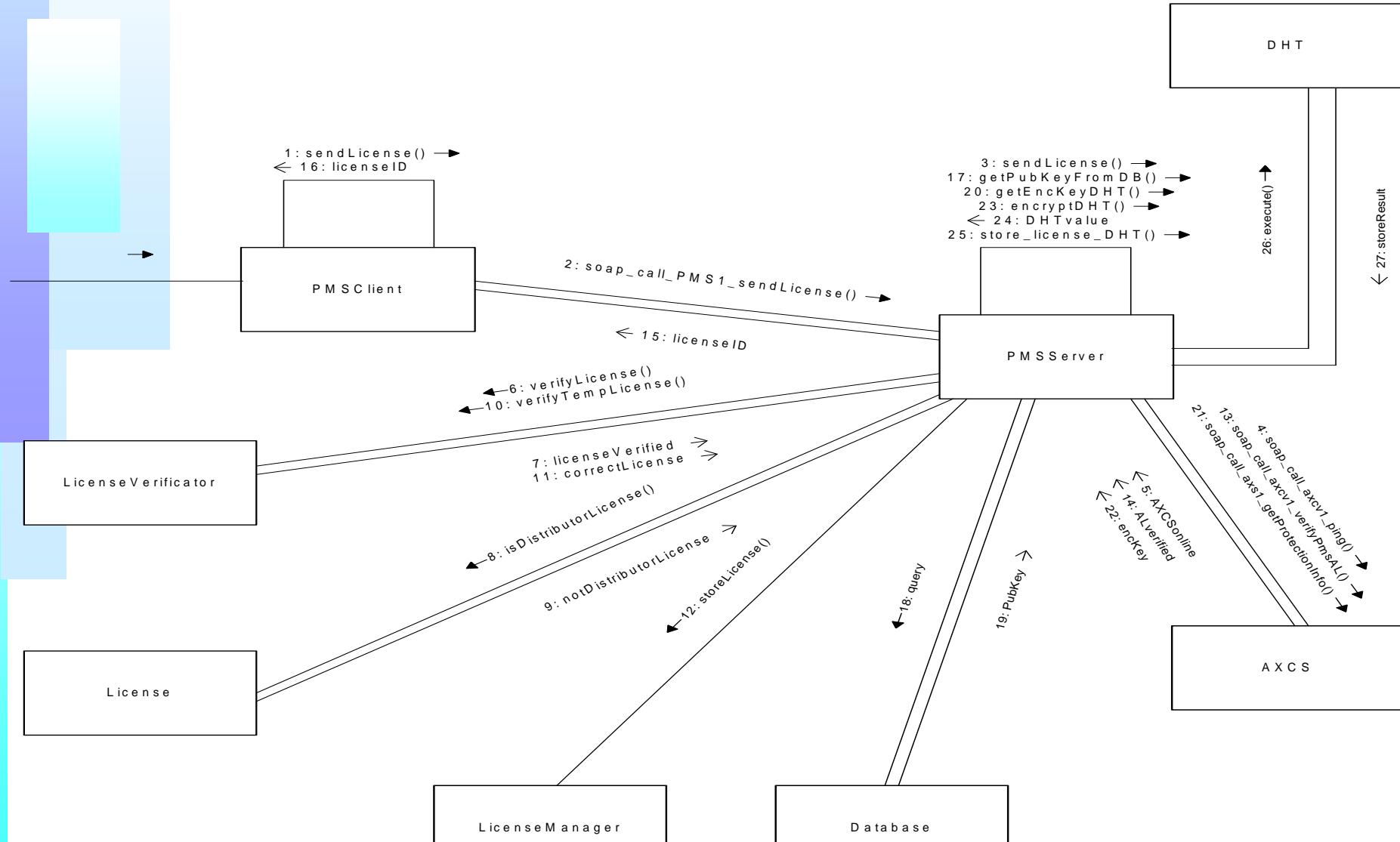


Scenario di test (1)



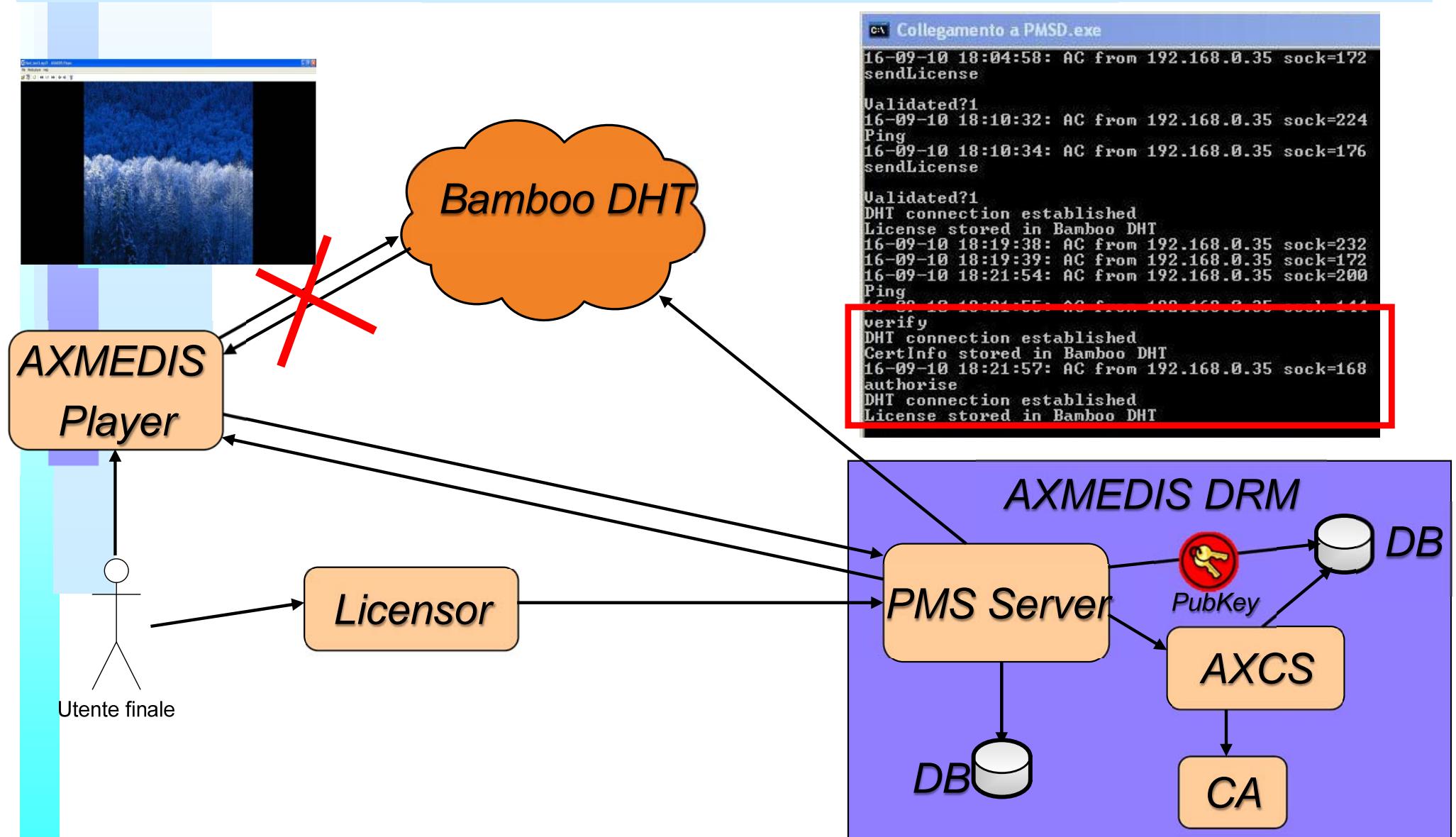


Computing and saving protection information related to a grant authorization formalized in a license, in the case of DRM P2P.





Scenario di test (2)





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	$O(U^{\text{devices}})$, caso peggiore	$O(1) \rightarrow O(U^D)$ sul server oppure su DHT $O(\log_2 N)$
FAULT TOLERANCE	NO	SI



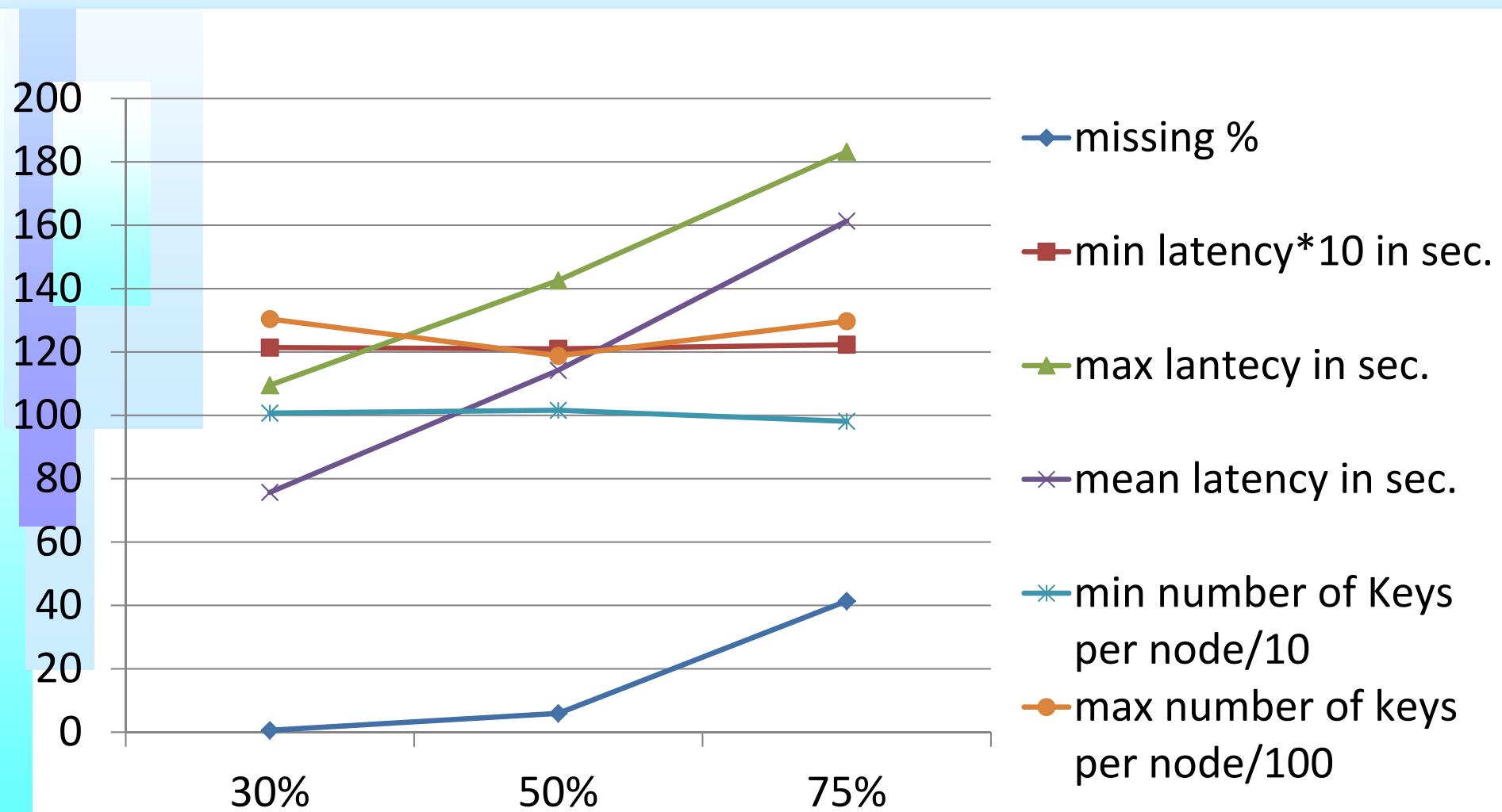


Parameter	Description	Range of values
L	Size of the leaf node list	8-400
Ltime	Time to update the leaf node list	25-250s
K	Number of replicas per node	4-200
N	Number of nodes involved in the network	1000-10000
Delay	Delay of transmission	30-50 ms
Jitter	variability over time of the packet latency across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



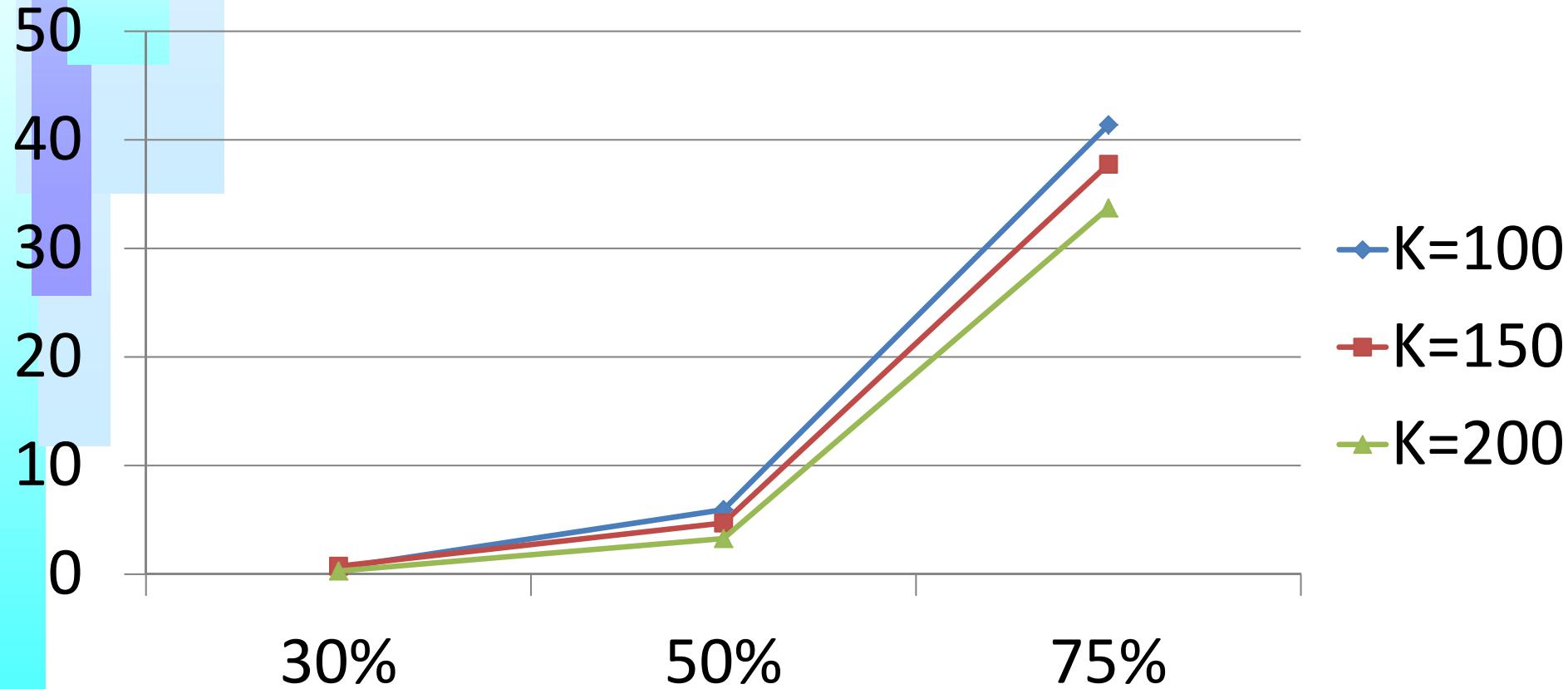


(a) L=200, K=100;



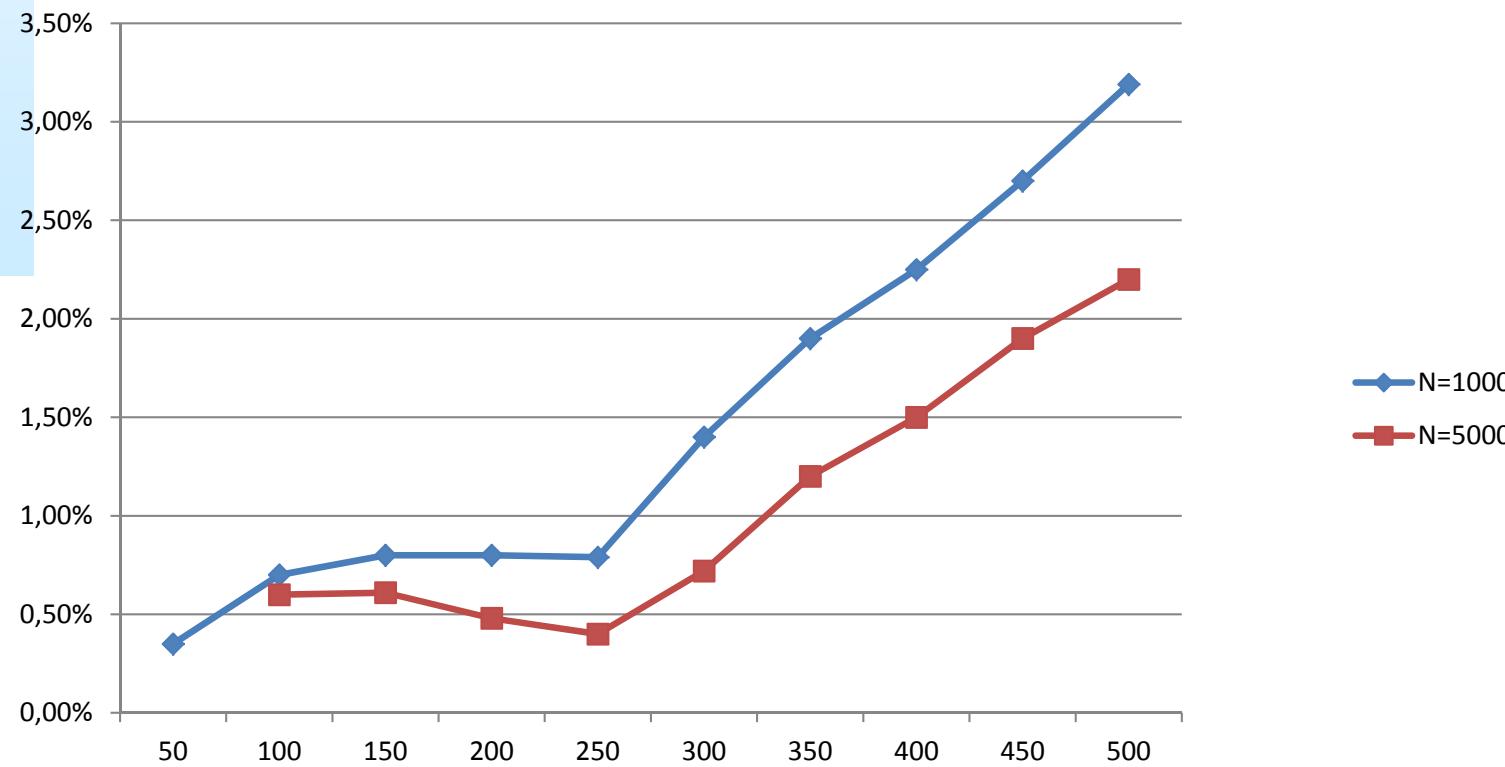


Trend of the percentage of missing estimated on the DHT P2P for the cases of a churn of 30%, 50% and 75%, and K equal to 100, 150, and 200.



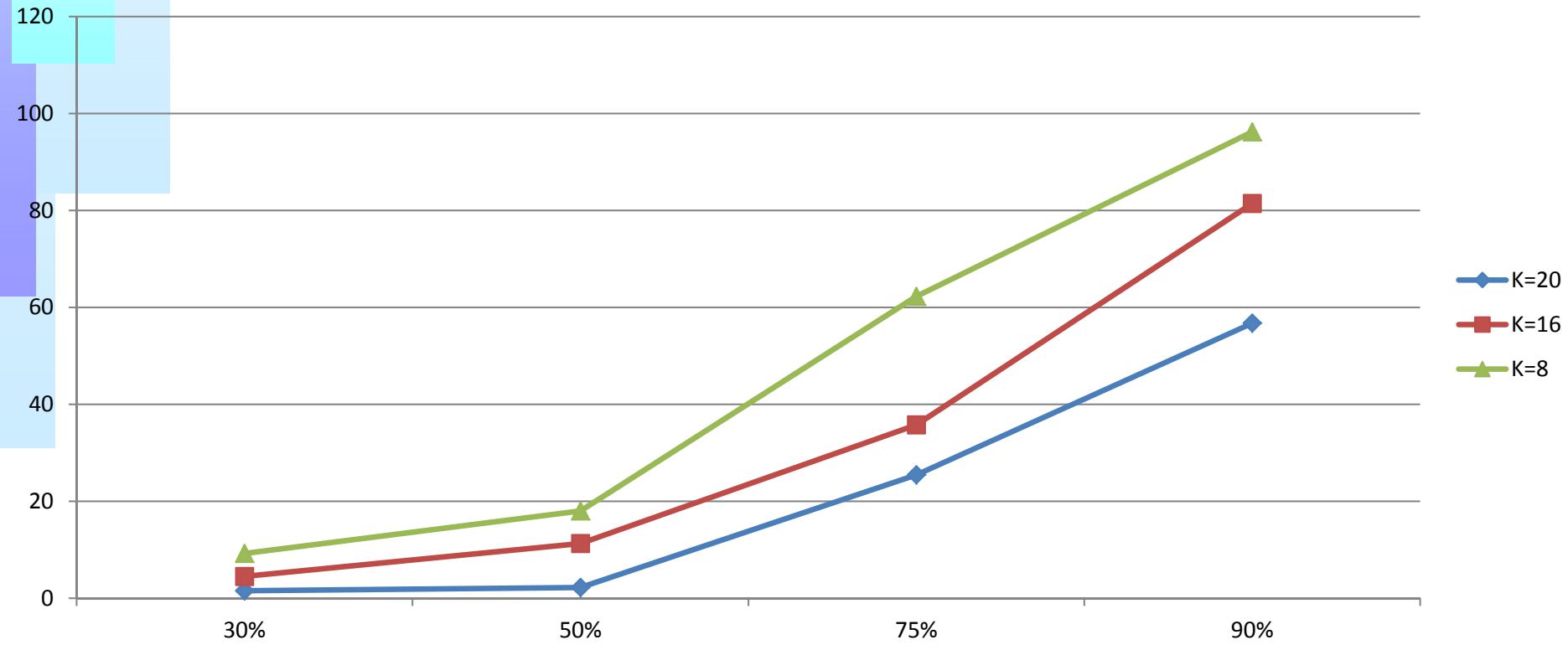


Trend of the percentage of missing estimated on the DHT P2P With respect to the Ltime value for the cases of a churn of 30%, and different values of the number of nodes, N, with the same number of replica

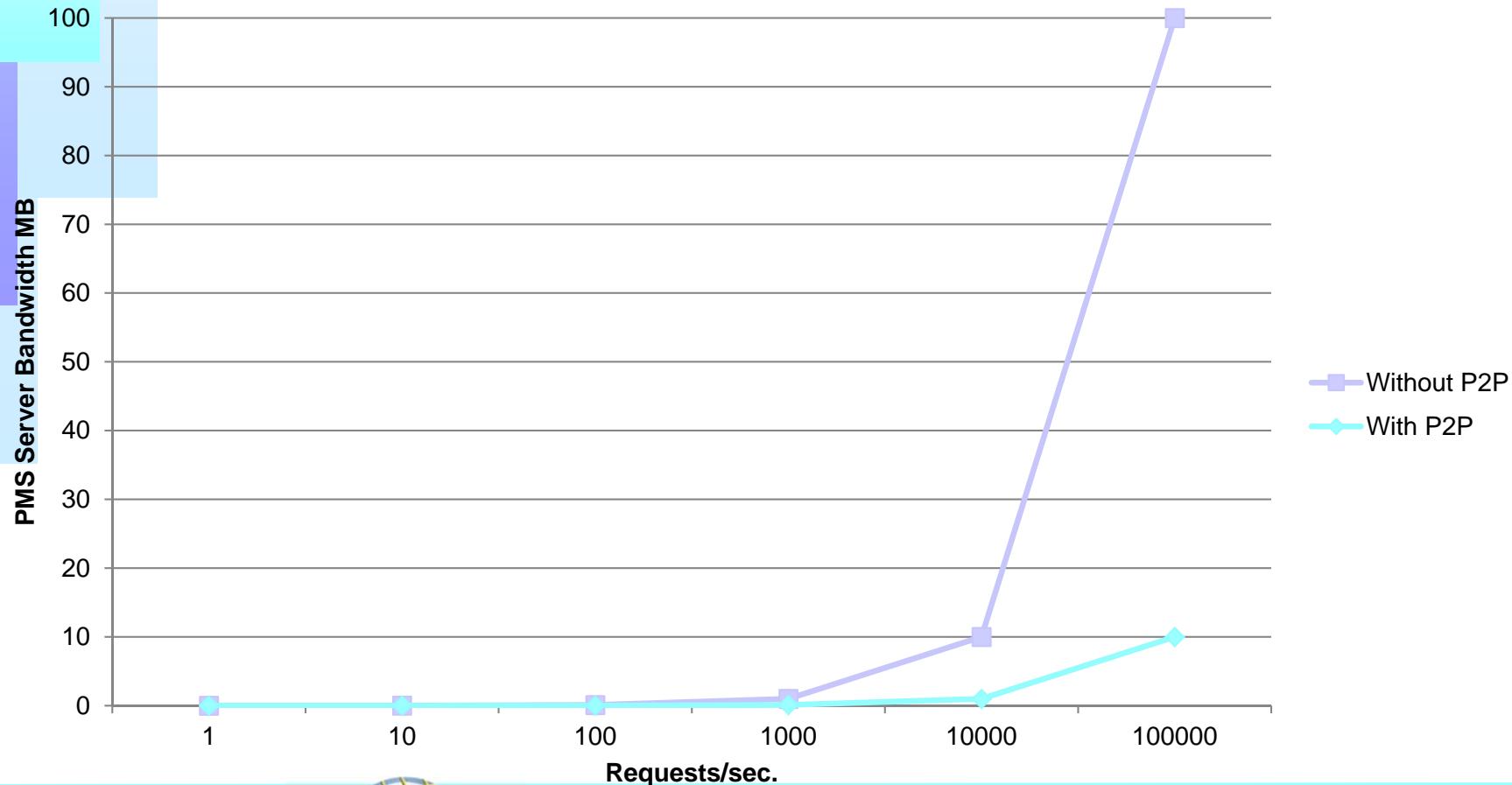




Trend of the percentage of missing estimated on the DHT P2P with respect to different percentage of churn, for K equal to 20, 16 and 8



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.





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