DMAG
DISTRIBUTED MULTIMEDIA APPLICATIONS GROUP

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Semantic Representation and Enforcement of Electronic Contracts on Audiovisual Content

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- Purpose of the Thesis
- The Media Value Chain Ontology
- Agreements representation
- Implementation results
- Outreach of the Thesis

- Purpose of the Thesis
  - Legal foundation
  - Postulate
  - Objectives
  - Contracts on Audiovisual Content
  - Semantic Representation and Contract Enforcement
  - Digital Rights Management systems
- The Media Value Chain Ontology
- Agreements representation
- Implementation results
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Legal foundation

- **Legal foundation:** There is a universal consensus on intellectual property rights and its limits.
  - International agreements with worldwide application (WIPO Copyright Treaty, WIPO Performance and Phonogram Treaty etc.)
- **Moral foundation:** Human Rights, Art. 27

(1) Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.

(2) Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

The Universal Declaration of Human Rights, text approved in the General Assembly of the United Nations in Paris, December 1948)

Postulate

- **Postulate**: An author is owner of the rights on the created work
- **Types of Intellectual Property (IP) rights**:
  - Moral rights.
  - Exploitation rights. They can be freely traded (→ agreements)

Objectives

- **Challenges**
  - How to express digitally the intellectual property model?
  - How to represent its agreements more precisely?
  - How to govern practical computer applications based on the representation?

- **An answer:**

Semantic Representation and Enforcement of Electronic Contracts on Audiovisual Content

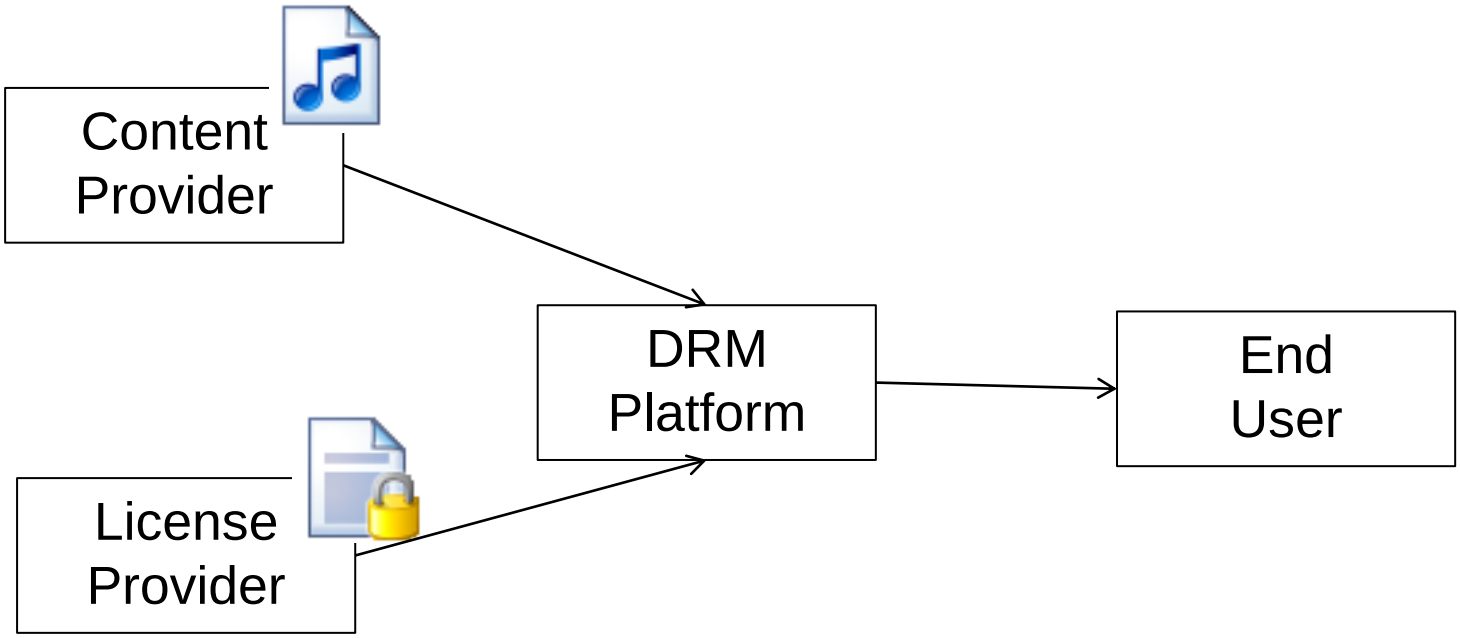
Contracts on audiovisual content

- Agreements where rights on intellectual property are handled, in the context of audiovisual content. Contracts ascertain the transfer of intellectual property rights.

Semantic representation and enforcement

- Semantic representation of electronic contracts
  - *Electronic*: computer-understandable representation of a narrative contract
  - *Semantic*: representation elements do not merely obey a syntax, but they also provide meaningful information
- Enforcement of electronic contracts
  - *Enforcement*: electronic licenses govern the distribution of audiovisual material in content distribution systems and digital rights management systems

Digital Rights Management system



- Purpose of the Thesis
- The Media Value Chain Ontology
  - Ontologies (I, II and III)
  - Purpose of the Ontology
  - Scope: the Media Value Chain elements
  - Scope: Intellectual property entities and actions
  - Scope: User roles on intellectual property
  - Scope: Intellectual property permissions
  - Complete diagram
  - Content assets management with ontology class instances
  - OWL expression (example)
  - Architecture of a generic platform
- Agreements representation
- Implementation results
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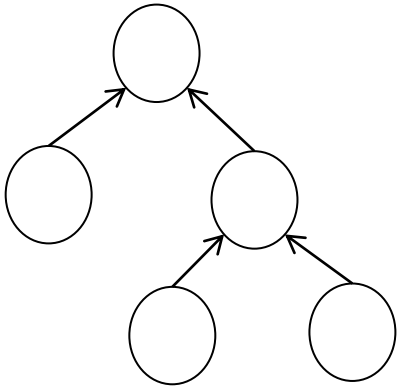
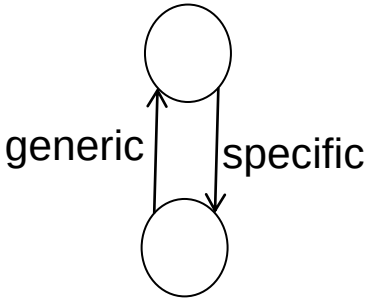
Ontologies (I). The old concept of ontology

- **Ontologies.**
  - An ontology is a system of categories for classifying and talking about the things that are assumed to exist, in a particular domain.

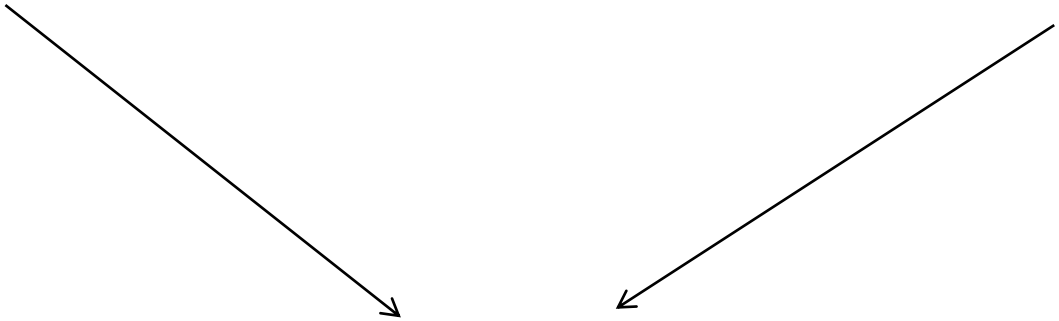




  - Venerable antecedents: Aristotle categories, R. Llull figures, Leibniz, Kant…

Ontologies (II). Modern ontologies

- **Knowledge representation**
  Aimed at representing models
  Archetypical example: UML
- **Formal logic systems.**
  Aimed at performing inference
  Archetypical example: PROLOG



Modern ontologies

Ontologies (III). OWL – Web Ontology Language

Chosen at its OWL-DL level (a computable Description Logic)

- **Expressivity**. Not only it can express generic/specific, but also attributes (height), general relationships (bigger than, or any other concievable), their nature (one to one, many to many, reciprocal, limitations in its scope, etc.)

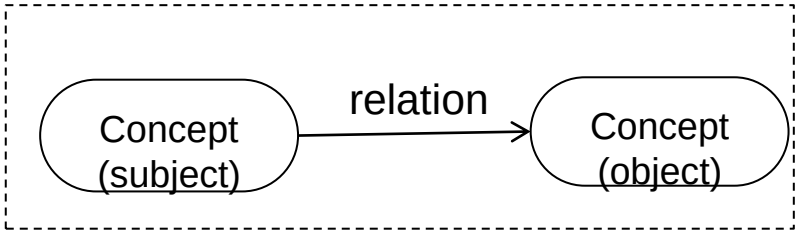
- **Reasoning power**. The subsumption problem, i.e. to determine the category of a given being.

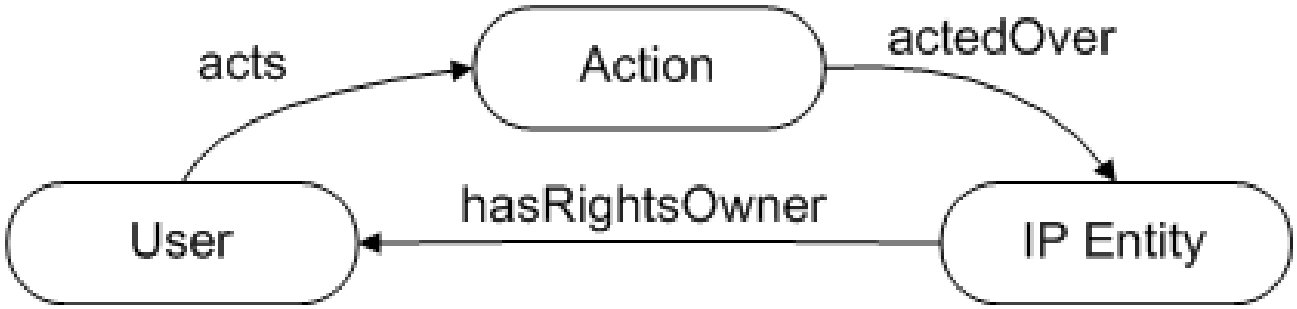
Ontology purpose

- **To explicitly represent a model**
  - Important in a conflictive field
  - To be taken by different parties unambiguously
- **To manage actual systems**
  - Content distribution systems can be ontology-based
  - An ontology reasoner can authorise Intellectual Property relevant actions

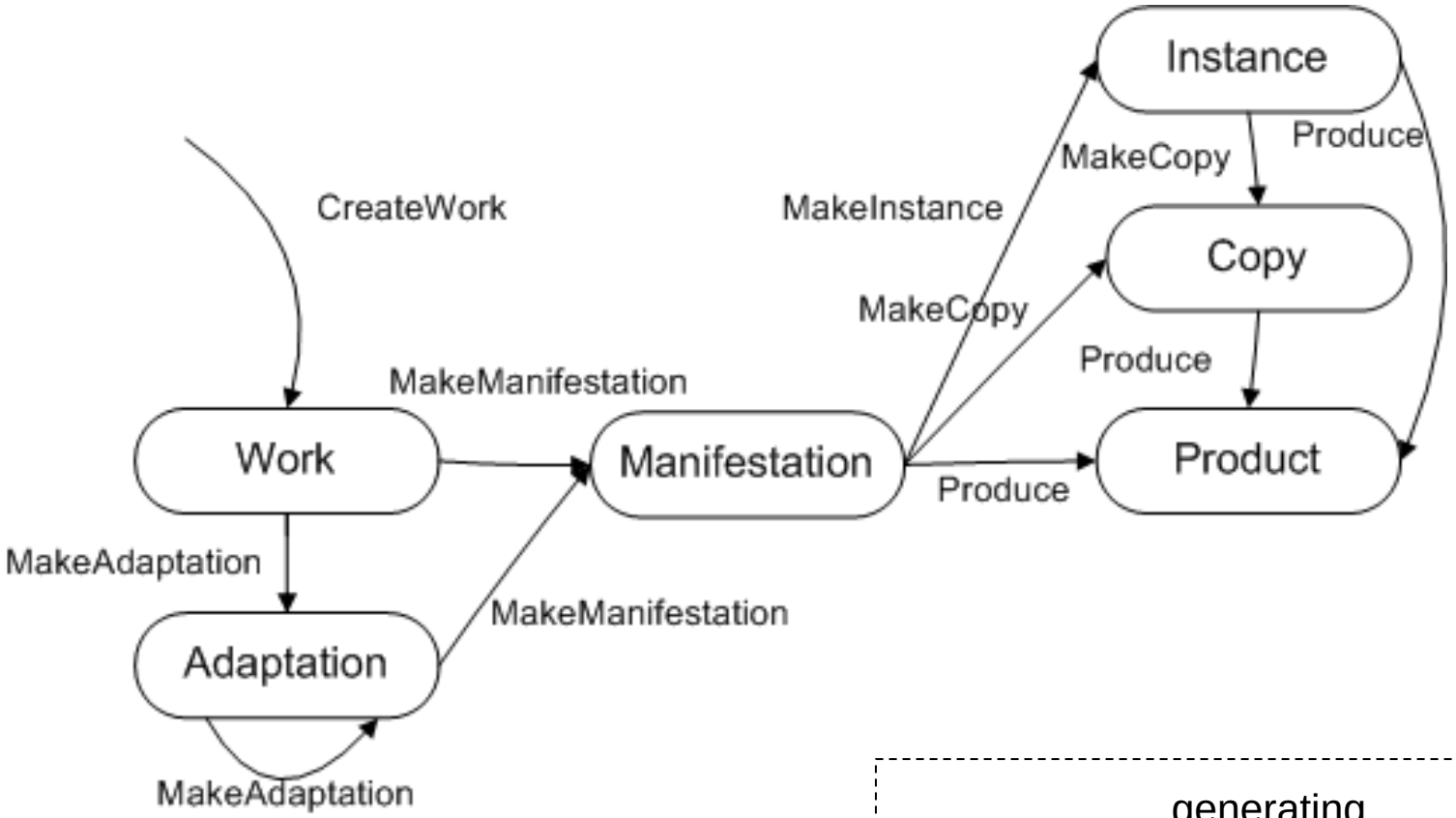
- **Helping to answer the challenges…**
  - How to express digitally the intellectual property model?
  - How to represent its agreements more precisely? How to govern practical computer applications based on the representation?

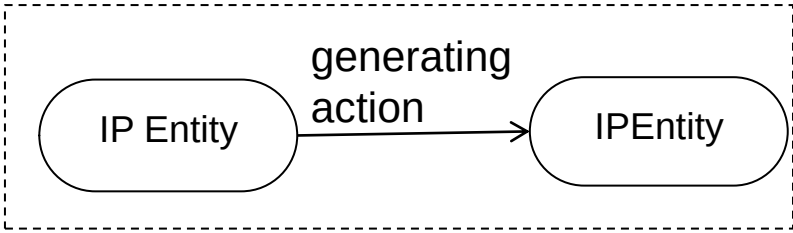
Scope: the media value chain users



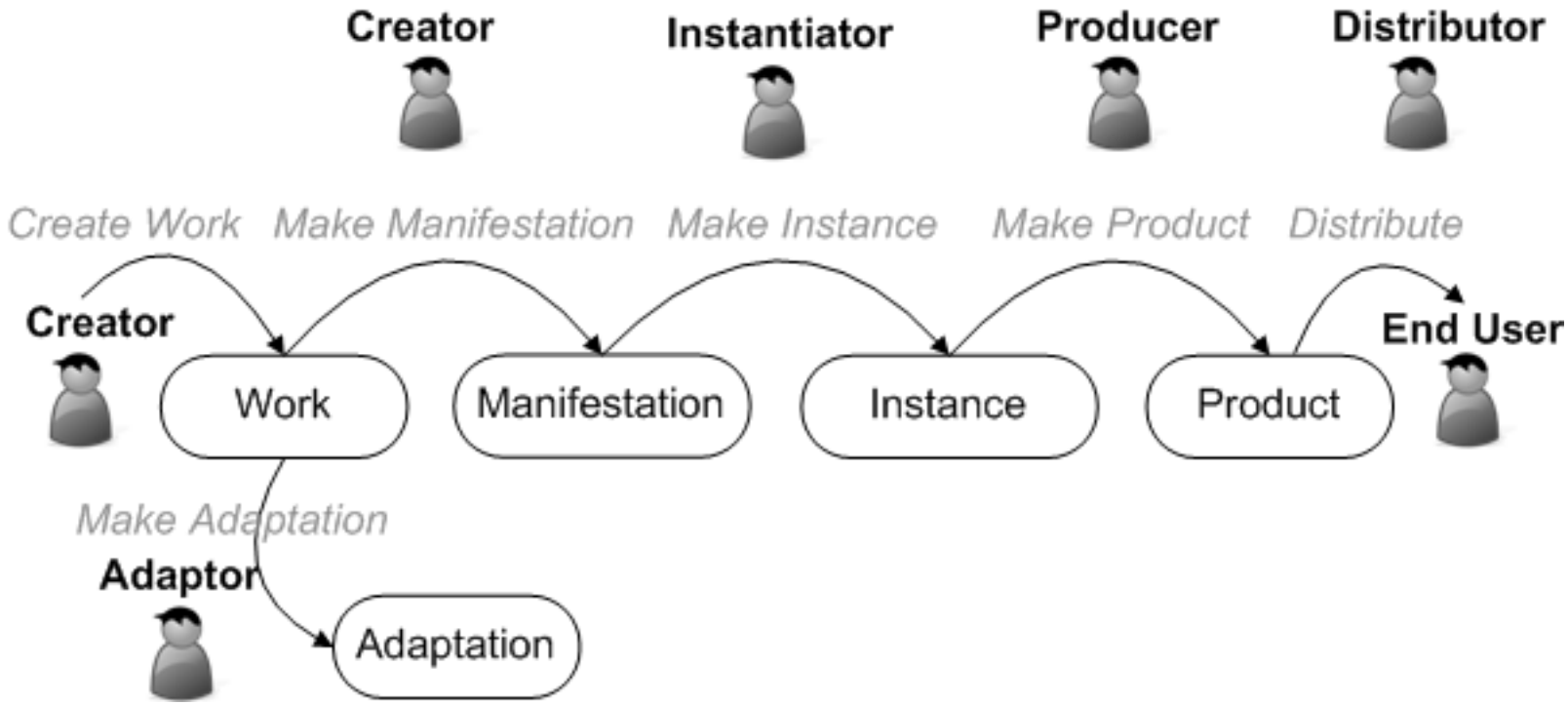


Scope: IP entities and actions

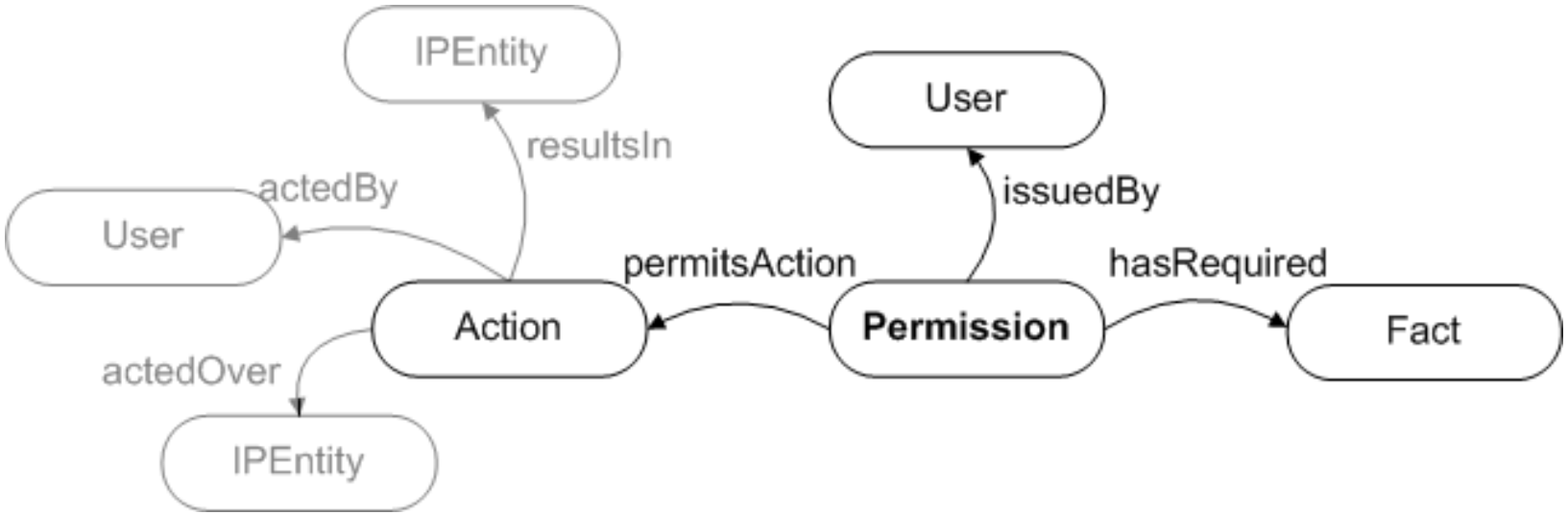


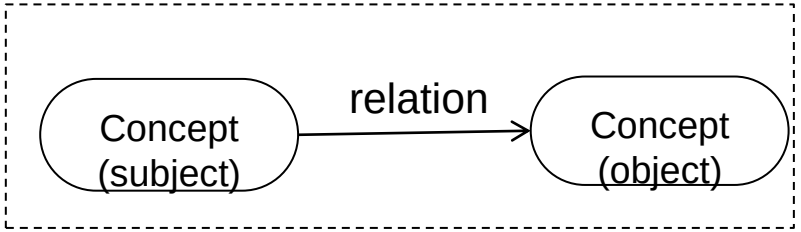


Scope: IP user roles

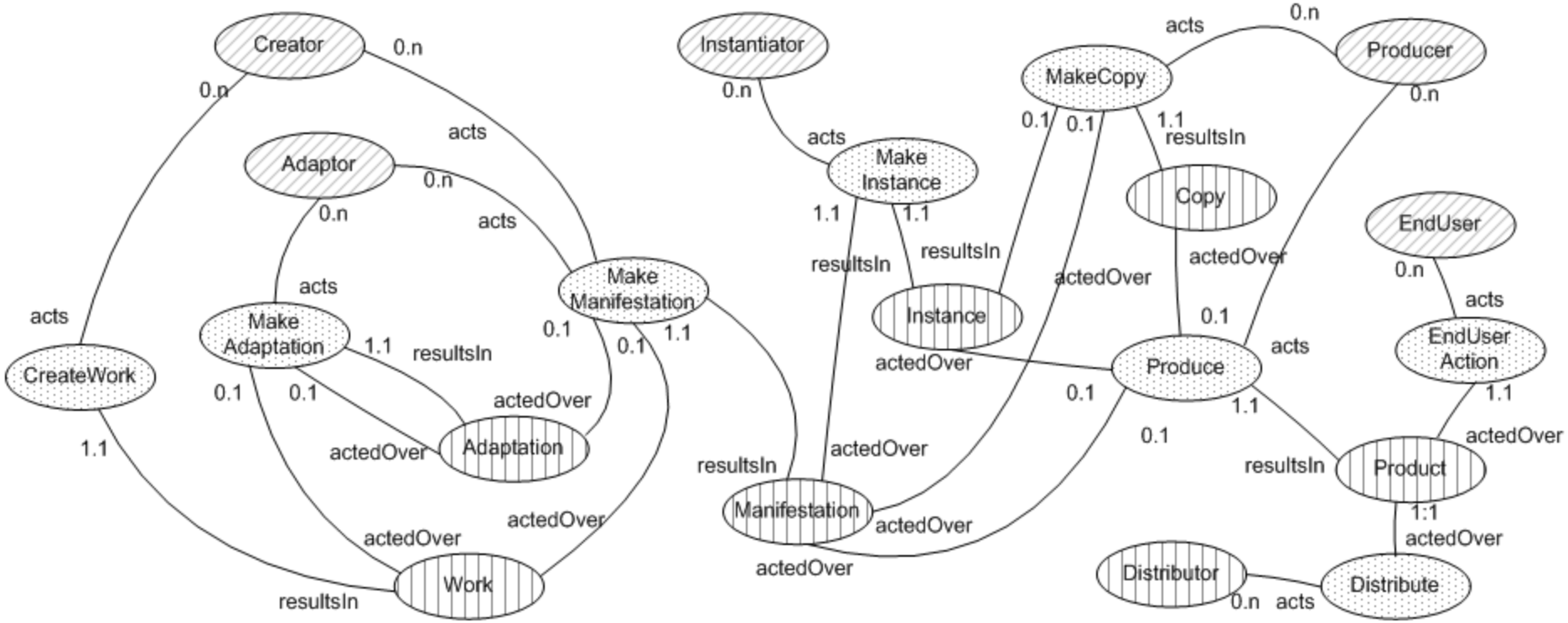


Scope: Intellectual property permissions

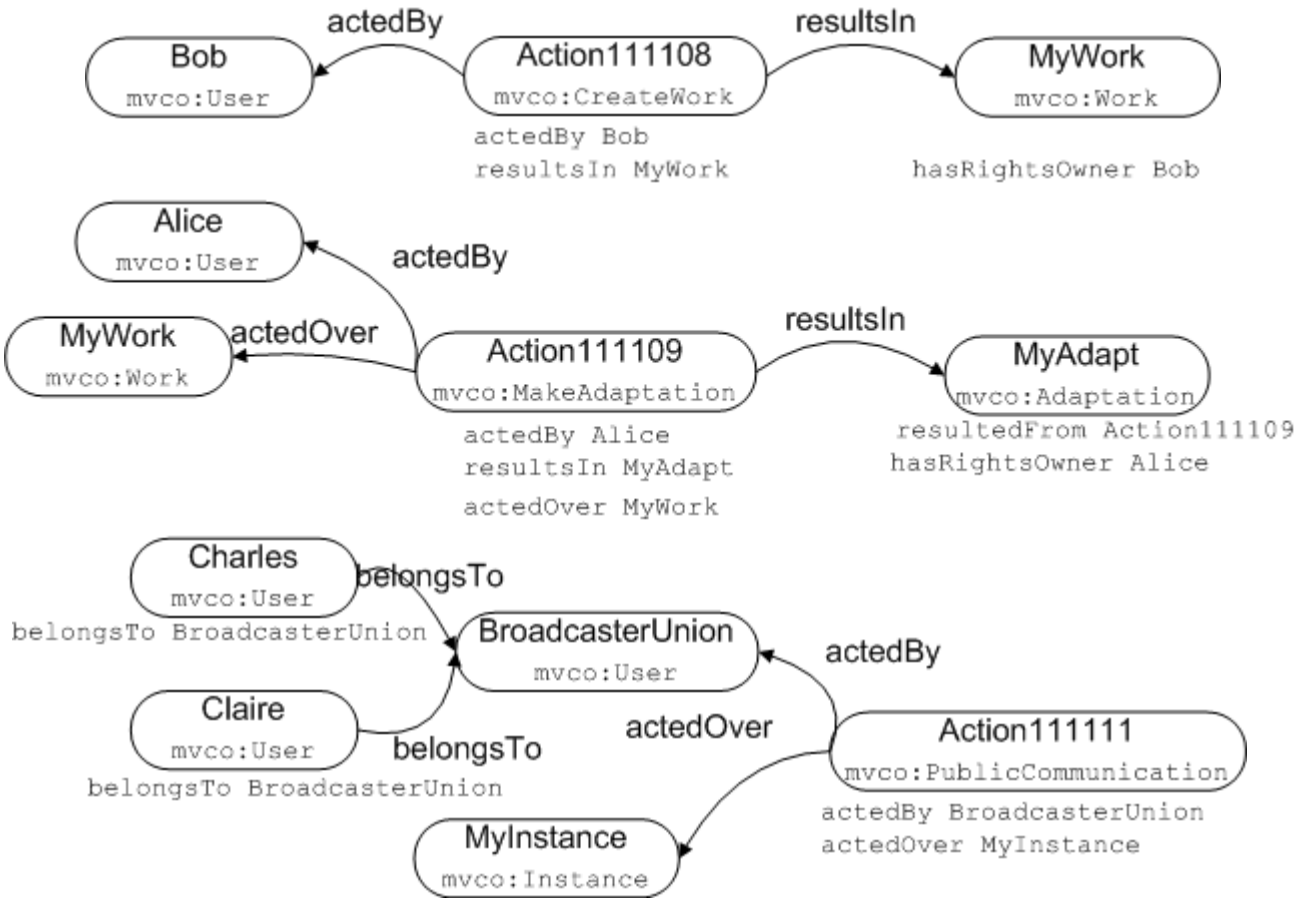


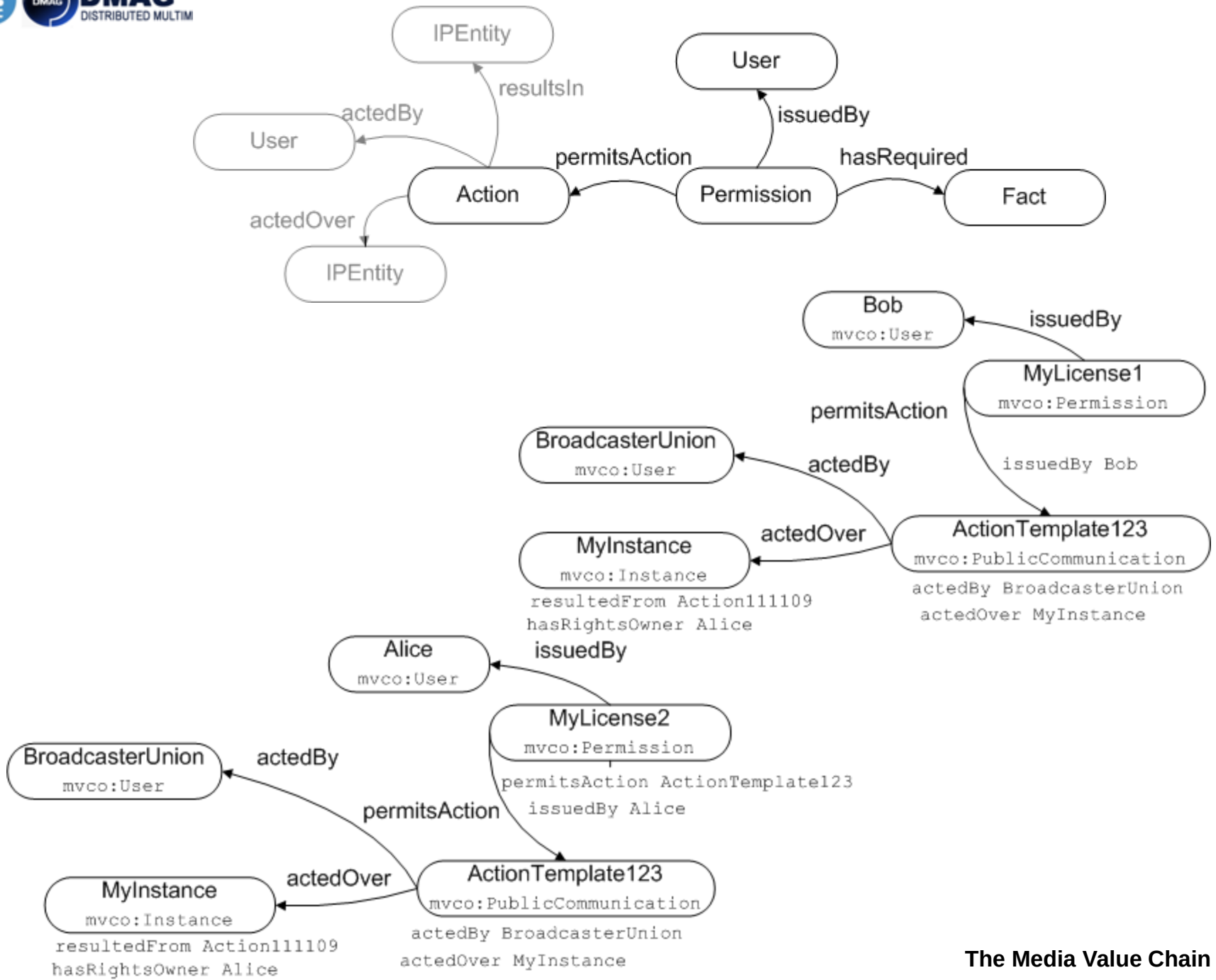


Complete diagram



Class instances example




IPEntity
resultsIn
User
actedBy
User
issuedBy
permitsAction
hasRequired
Action
Permission
Fact
actedOver
IPEntity
Bob
mvco:User
issuedBy
MyLicense1
mvco:Permission
permitsAction
BroadcasterUnion
mvco:User
actedBy
issuedBy Bob
actedOver
ActionTemplate123
mvco:PublicCommunication
MyInstance
mvco:Instance
resultedFrom Action111109
hasRightsOwner Alice
actedBy BroadcasterUnion
actedOver MyInstance
Alice
mvco:User
issuedBy
MyLicense2
mvco:Permission
BroadcasterUnion
mvco:User
actedBy
permitsAction ActionTemplate123
issuedBy Alice
permitsAction
actedOver
MyInstance
mvco:Instance
ActionTemplate123
mvco:PublicCommunication
resultedFrom Action111109
hasRightsOwner Alice
actedBy BroadcasterUnion
actedOver MyInstance

OWL expression of the model (example)

In OWL/XML:

```
:PublicCommunication rdf:type owl:Class ;
   rdfs:subClassOf :Action ,
         [
         rdf:type owl:Restriction ;
                  owl:onProperty :actedOver ;
                  owl:allValuesFrom
                  [
                           rdf:type owl:Class ;
                           owl:unionOf ( :Copy :Instance :Product)
                  ]
         ] ;
   owl:disjointWith :Synchronise ;
   owl:versionInfo "1.0"^^xsd:string ;
   :rightGivenBy "http://purl.oclc.org/NET/mvco.owl#Creator"^^xsd:anyURI ,
   "http://purl.oclc.org/NET/mvco.owl#Producer"^^xsd:anyURI ;
   :impliesAlso "http://purl.oclc.org/NET/mvco.owl#Render"^^xsd:anyURI ;
   rdfs:comment "The Function of publicly displaying/performing, e.g. live
   performance, radio, television, internet streaming, multicast of
   Instances and Manifestations, and download"@en .
```

OWL expression of class instances (ex.)

In OWL/XML:

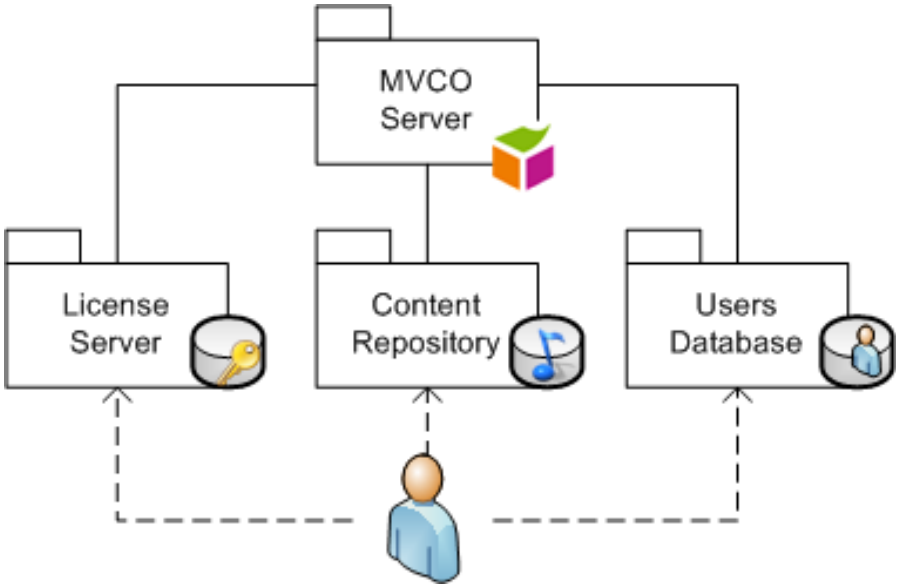
```
<User rdf:about="#Bob"/>
<Work rdf:about="#MyWork"/>
<CreateWork rdf:about="#Action111108">
    <actedBy rdf:resource="#Bob"/>
    <resultsIn rdf:resource="#MyWork"/>
</CreateWork>
```

In TURTLE/N3 Syntax:

```
:Bob rdf:type :User .
:MyWork rdf:type :Work .
:Action111108 rdf:type :CreateWork ;
    :actedBy :Bob ;
    :resultsIn :MyWork .
```

Architecture of a generic platform

- The MVCO acting as a triple store and authorisation resolver, in contact with the other elements in a typical DRM platform.



Note that this schema (without the MVCO) is the essential one of the so called *Digital Rights Management* system. Note, too, that licenses are usually written in the so called *Rights Exprsesion Language*

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- Agreements representation
  - Kinds of contracts
  - Contract clauses
  - The Media Value Chain Ontology in a broader context
  - Components of the contract representation
  - An example
  - Vocabulary comparison
  - Extension of MPEG-21 for contracts
  - Enforceable clauses representation
  - Deontic logic and example of prohibition
  - Contract clause with an MVCO extension
- Implementation results
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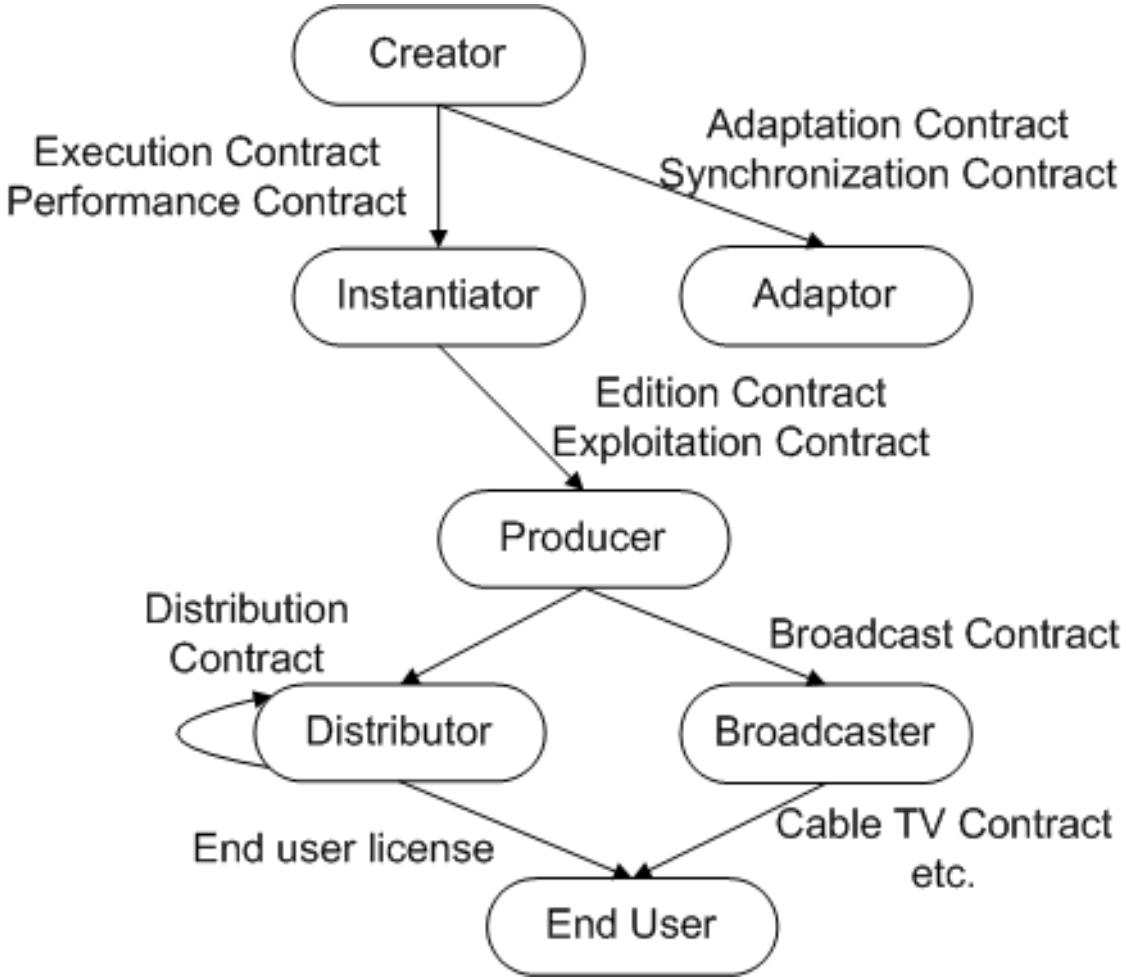
Kinds of contracts

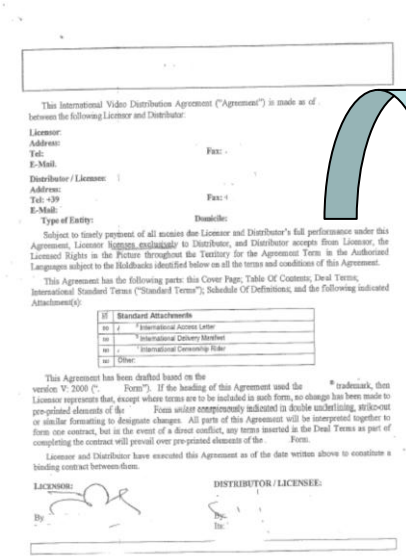


Contract clauses

- Typical contract clauses

•*Rights transferred (object of the contract)*.
•*Resource*..
•*Report and Auditing*.
•*Fee*.
•*Territory*.
•*Term*.
•*Confidentiality*.

•*Disclaimer*.
•*Jurisdiction*..
•*Breach and termination*.



This International Video Distribution Agreement ("Agreement") is made as of
between the following Licensor and Distributor:

Licensor:
Address:
Tel: Fax:
E-Mail.

Distributor / Licensee:
Address:
Tel: +39 Fax:
E-Mail:
Type of Entity: Domicile:

Subject to timely payment of all monies due Licensor and Distributor's full performance under this Agreement, Licensor licenses exclusively to Distributor, and Distributor accepts from Licensor, the Licensed Rights in the Picture throughout the Territory for the Agreement Term in the Authorized Languages subject to the Holdbacks identified below on all the terms and conditions of this Agreement.

This Agreement has the following parts: this Cover Page; Table Of Contents; Deal Terms; International Standard Terms ("Standard Terms"); Schedule Of Definitions; and the following indicated Attachment(s):

If	Standard Attachments
no	International Access Letter
no	International Delivery Manifest
no	International Censorship Rider
no	Other:

This Agreement has been drafted based on the * trademark, then version V: 2000 (". Form"). If the heading of this Agreement used the Licensor represents that, except where terms are to be included in such form, no change has been made to pre-printed elements of the Form unless conspicuously indicated in double underlining, strikeout or similar formatting to designate changes. All parts of this Agreement will be interpreted together to form one contract, but in the event of a direct conflict, any terms inserted in the Deal Terms as part of completing the contract will prevail over pre-printed elements of the Form.

Licensor and Distributor have executed this Agreement as of the date written above to constitute a binding contract between them.

LICENSOR: DISTRIBUTOR / LICENSEE:
By: By:
Its:

```
ml version="1.0" encoding="UTF-8" standalone="yes"?>
license xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
ns:xsi="http://www.w3.org/2001/XMLSchema-instance"
schemaLocation="urn:mpeg:mpeg21:2003:01-REL-R-NS
emas/rel-r.xsd  urn:mpeg:mpeg21:2003:01-REL-SX-NS
as/rel-sx.xsd urn:mpeg:mpeg21:2003:01-REL-MX-NS
es/rel-mx.xsd">
  <r:grantGroup>
    <r:grant>
      <r:keyHolder>
        <r:info>
          <dsig:KeyName
ns:dsig="http://www.w3.org/2000/09/xmldsig#">DemoEndUser</dsig:
/Name>
        </r:info>
      </r:keyHolder>
      <mx:play xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"/>
      <r:digitalResource>
        <r:nonSecureIndirect
:="urnaxmedis00000obj36ed2d7040504fcca05112a74322ee14"/>
      </r:digitalResource>
      <r:allConditions>
        <sx:territory xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-SX-
">
          <sx:location>
            <sx:country xmlns:iso="urn:mpeg:mpeg21:2003:01-REL-
-NS:country">iso:CN</sx:country>
          </sx:location>
        </sx:territory>
      </r:allConditions>
    </r:grant>
  </r:grantGroup>
  <r:issuer>
    <r:keyHolder>
      <r:info>
        <dsig:KeyName
ns:dsig="http://www.w3.org/2000/09/xmldsig#">DemoDistributor</d
:KeyName>
```

Agreement representation

The MVCO in a broader context

- **Problems** of using existing Rights Expression Languages
  - Limited vocabulary not focused for the complete value chain
  - Rights Expression Languages are XML-expressive
  - Permission model is unidirectional in existing RELs
  - Non-enforceable classes should not be dropped

- **Solution**: insert Media Value Chain Ontology expressions into a OASIS eContract document (XML)

Components of the contract representation

- Non enforceable clauses remain with narrative content, but well structured
- Enforceable clauses are made of:
  - Permission model of the Media Value Chain Ontology
  - Elements specific of audiovisual contracts missing in MPEG-21 REL

An example

```
00 <ec:body>
01  <ec:item>
02   <aec:enforceable>
03    <mvco:permission rdf:about="#Permission000">
04     <mvco:permitsAction rdf:resource="#Action000"/>
05     <mvco:issuedBy rdf:resource="#Alice"/>
06     <mvco:hasRequired rdf:resource="#Germany"/>
07    </mvco:permission>
08    <aec:assertion>
09     <mvco:MakeAdaptation rdf:about="#Action000">
10      <mvco:actedBy rdf:resource="#Bob"/>
11      <mvco:actedOver rdf:resource="#mywork1"/>
12     </mvco:MakeAdaptation>
13     <aec:Territory rdf:about="#Germany">
14      <aec:hasCountry>ISO:DE</mvco:hasCountry>
15     </aec:Territory>
16     <mvco:Work rdf:about="#mywork1">
17      <mvco:hasRightsOwner rdf:resource="#Alice"/>
18     </mvco:Work>
19    </aec:assertion>
20   </aec:enforceable>
21  </ec:item>
22 </ec:body>
```

Vocabulary comparison

Vocabulary of MPEG-21 REL does not suffice but it can be extended.

MPEG-21 REL rights			ODRL permissions			
			Usage	Reuse	Asset Management	Transfer
End user	End user	Distributor	End-user			Distributor
Enlarge	Play	Issue	Display	Modify	Move	Sell
Reduce	Print	Revoke	Print	Excerpt	Duplicate	Lend
Move	execute	Obtain	Play	Annotate	Delete	Give
Adapt	Install	modify	Execute	Aggregate	Verify	Lease
Extract	Uninstall				Backup/Restore	
Embed	delete				Install/Uninstall	

Most common rights appeared in contracts				
Reproduce	Broadcast	Adapt	Lease	Advertise
Download	Copy	Convert	License	Dub
Upload	Print	Transcode	Promote	Transmit
MakeAvailable	Record	Remix	Stream	Exhibit
PubliclyPerform	Modify	Distribute	Translate	Sell

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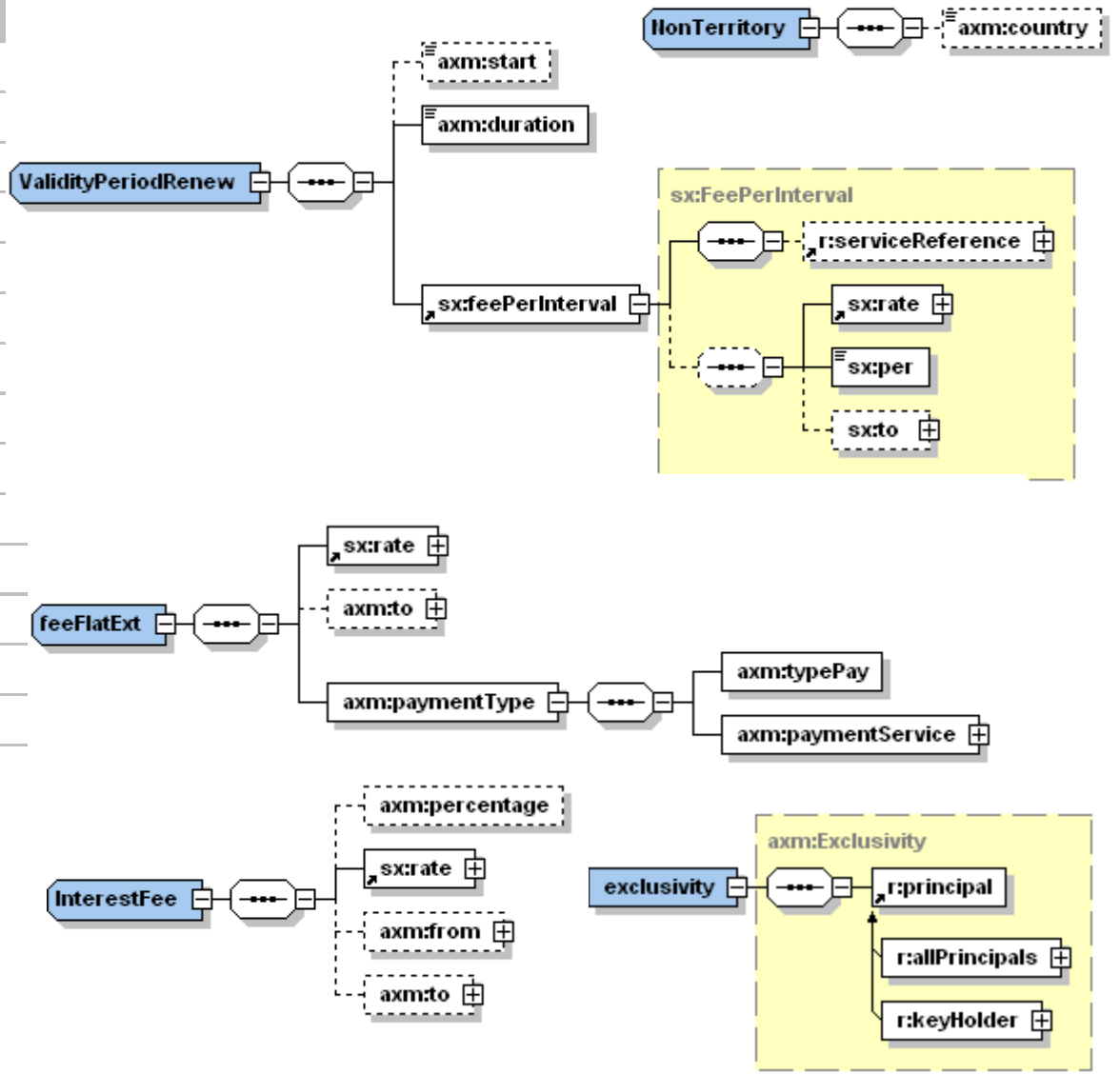
Extension of REL for contracts

	comment	=== Rights ===
	comment	
	complexType	**Reproduce**
	complexType	**Perform**
	complexType	**Transmit**
	complexType	**Broadcast**
	complexType	**Publish**
	complexType	**Record**
	complexType	**Translate**
	complexType	**Dub**
	complexType	**Remix**
	complexType	**Publicize**
	complexType	**Promote**
	complexType	**Synchronize**
	complexType	**Digitalize**



Agreement represenation

Enforceable clauses representation

- Enforceable clauses are classified according to the meaning they convey.
  - Permission. What can be done (e.g. licensee rights)
  - Prohibition. What cannot be done (e.g. confidentiality, exclusivity)
  - Obligation. What must be done (e.g. fee, territory, term)
  - Assertion. What it is. (e.g. parties)
- Permissions, obligations, prohibitions are expressions of the **deontic logic**

Deontic logic

- Traditional logic systems: Propositional logic, predicate logic, modal logics
  - Deontic logic is a branch of modal logic
- Deontic logic introduces two new operators
  - *it is necessary that* (□)
    - Obligation: □P
    - Prohibition: ~□P
  - *it is possible that* (◊)
    - Permission ◊P (or ¬□¬P)

Is it possible deontic logic in OWL??

- OWL DL is a Description Logics is fully mappeable to a **First Order Predicate Logic,** OWL DL can be expressed with traditional logic operators

  $\vee\wedge\ \neg\rightarrow$ etc. $\perp \equiv \subseteq$… etc. $\forall\ \exists$

- But FOPL can also be used to express deontic sentences (Kripke work) if two axioms are added…

  $\Box(A \rightarrow B) \rightarrow(\Box\ A \rightarrow\ \Box B)$

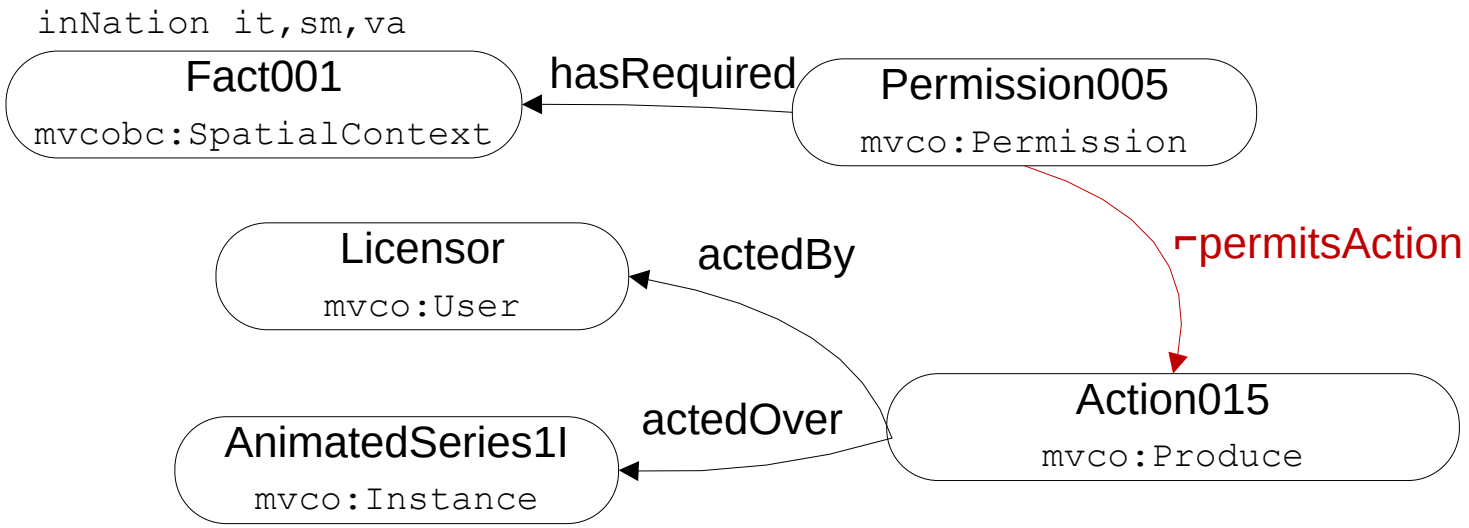
  $\Box A \rightarrow \neg\Box\neg A$

- The obligation operator as an OWL object property
  - But owl:complementOf cannot be used for classes and remain within OWL DL. Therefore we need two object properties (obligatory and not obligatory)
  - Or use OWL 2.0 which provides negative property assertions

Example of prohibition

- Exclussivity as a prohibition.

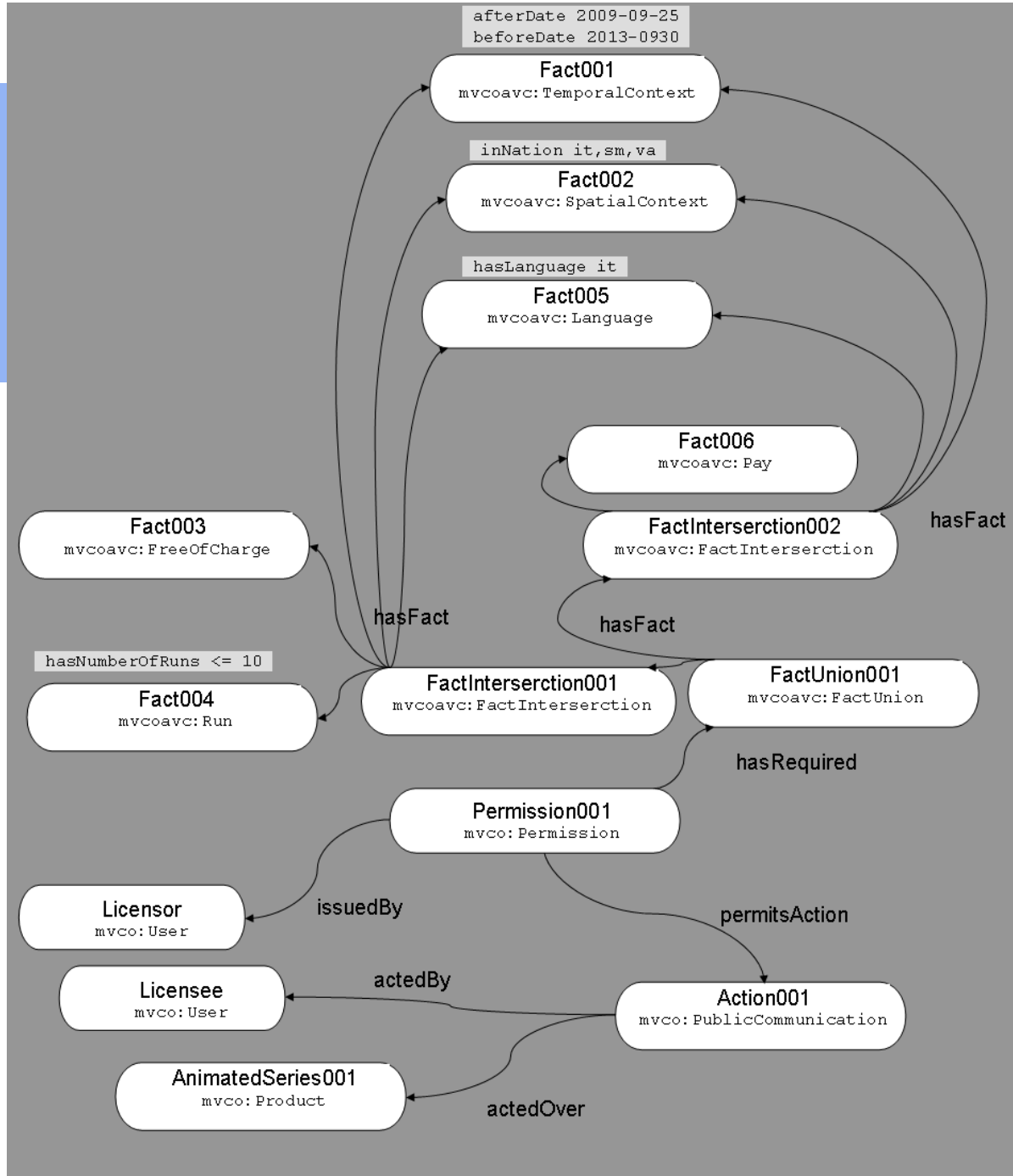
Through the use of: `owl:NegativeObjectPropertyAssertion`



Contract clause with an MVCO extension

Not included in the Thesis:

- This example is NOT my work
- Produced in the last weeks



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  - API functionality
  - Examples of verifications in the MVCO server
  - Towards a semantic authorisation
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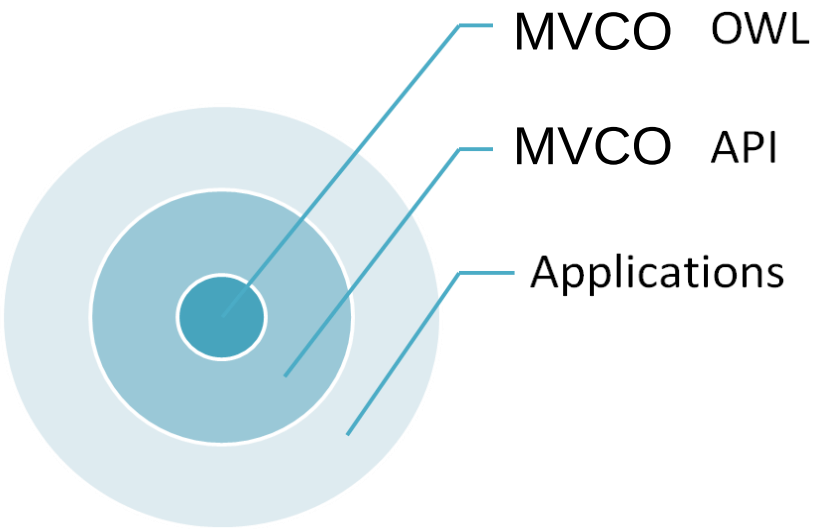
MVCO based application architecture



- Defined a Java API (API automatic vs API ad-hoc)

API functionality

Queries on the model

- Get Roles
- Get IP Entities
- Get Actions
- Get Hierarchy

Administration Actions

- Create Users
- Delete Users
- Validate

User Actions

- Execute Action
- Issue Permission

Queries on Individuals

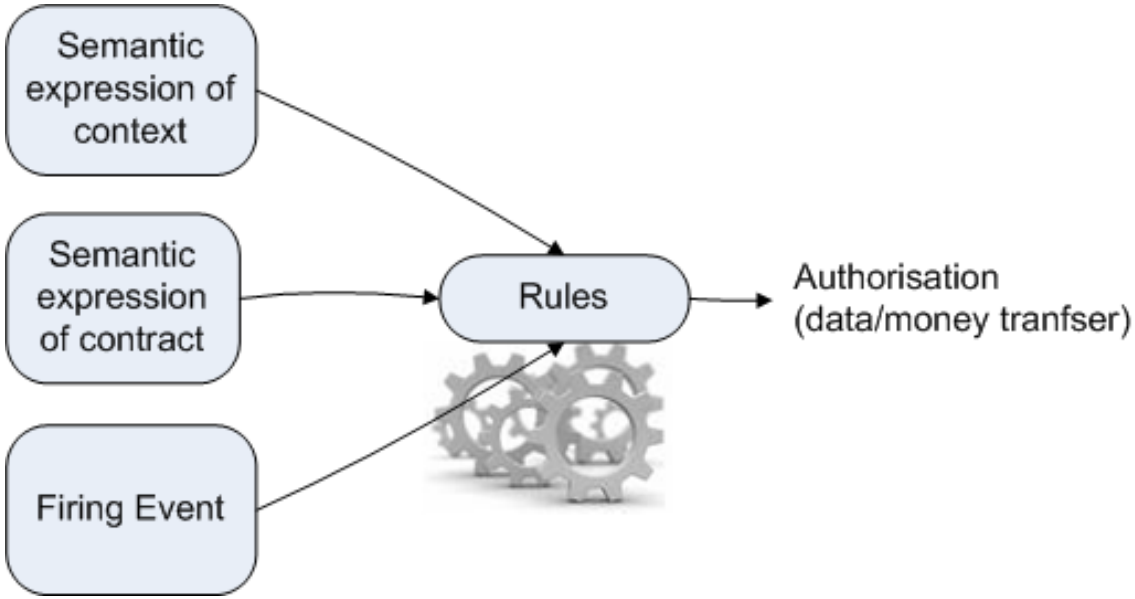
- Query

I/O Actions

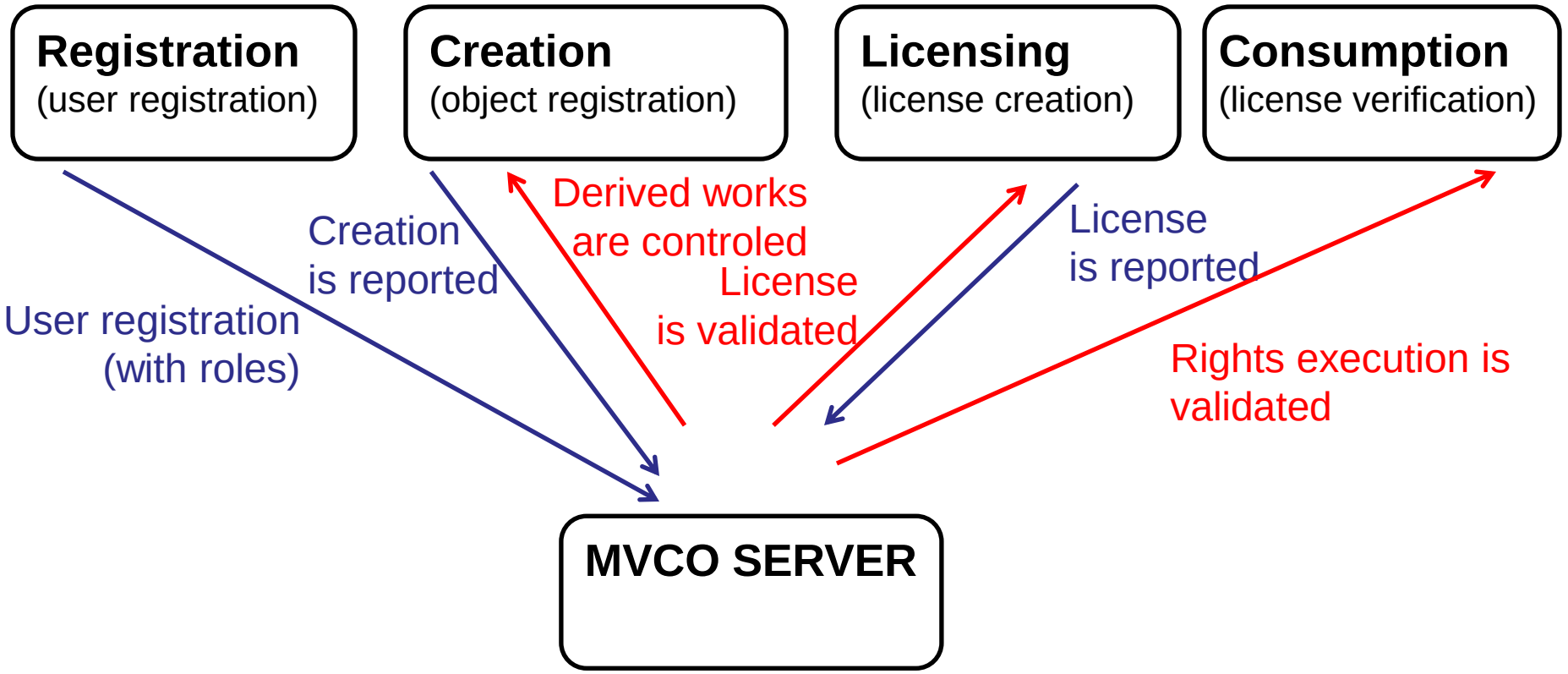
- Unload
- Load
- Store

Towards a semantic authorisation

- Authorisation process.
  - A single SWRL rule determines whether the contract has ben respected or not (the requested operation is authorised or not).
  - Implemented a trivial authoriser, pending to implement a full authoriser.



Example of verifications in the MVCO server



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  - International Standards
  - Refereed publications
  - Derived applications

Outreach

- International standards
  - The main achievement: this Thesis as the basis of an International Standard Part
- Refereed publications
  - Research work for this Thesis has produced two JCR indexed journal papers, one book chapter and seven conference papers
- Derived applications
  - Applications of this work have been included in different projects

Outreach: standard

- As the *Media Value Chain Ontology (MVCO)*, Part 19 of the MPEG-21 standard
  - ISO/IEC JTC 1/SC 29: ISO/IEC FDIS 21000-19:2009, Information technology – Multimedia Framework (MPEG-21) – Part 19: Media Value Chain Ontology

Outreach: standard

- Integration in other parts of the MPEG set of standards
  - **Also coeditor of**: ISO/IEC 23006 FCD Information technology -- MPEG extensible middleware (MXM) – Part 4: MXM architecture and technologies
- **Precedent**: as the *Represent Rights Data* ontology in the *Interoperable DRM Platform* of the Digital Media Project
  - Approved Document No 2 - Technical Reference: Architecture, v. 2.1, Digital Media Project DMP0952/AHG40, July 2007
  - Approved Document No 3 - Technical Specification: Interoperable DRM Platform, ver. 2.1, Digital Media Project 0953/AHG41, March 2007

Outreach: publications

- **Journal papers**
  - Victor Rodriguez-Doncel, Jaime Delgado, "A Media Value Chain Ontology for MPEG-21," IEEE MultiMedia, vol. 16, no. 4, pp. 44-51, Oct.-Dec. 2009
  - Víctor Rodríguez, Jaime Delgado, Filippo Chiariglione, Marius Preda, Christian Timmerer, A Interoperable Digital Rights Management based on the MPEG Extensible Middleware, Multimedia Tools and Applications, April 2010.
- **Conference papers**
  - Víctor Rodríguez, Marc Gauvin and Jaime Delgado, “An Ontology for the Expression of Intellectual Property Entities and Relations”, in Proc. of the 5th International Workshop on Security in Information Systems (WOSIS 2007), Funchal, April 2007
  - Víctor Rodríguez, Jaime Delgado and Eva Rodríguez, From Narrative Contracts to Electronic Licenses: A Guided Translation Process for the Case of Audiovisual Content Management, in Proc. of the 3rd Int. Conference on Automated Production of Cross Media Content for Multi-Channel Distribution (AXMEDIS 2007), Barcelona, November 2007
  - Víctor Rodríguez and Jaime Delgado, Multimedia Content Distribution Governed by Ontology-Represented Contracts, Workshop on Multimedia Ontologies and Artificial Intelligence Techniques in Law, (MOAIL 2007) Leiden, December 2007

Outreach: publications

- **Conference papers (continued)**
  - Victor Rodriguez, Anna Carreras, Vitor Barbosa, Jaime Delgado and Maria Teresa Andrade, A Semantic Model for the Authorisation of Context-Aware Content Adaptation, in Proc. of the 3rd Int. Conference on Semantic and Digital Media Technologies (SAMT 2008), Koblenz, December 2008
  - Eva Rodríguez, Victor Rodríguez, Anna Carreras and Jaime Delgado, A Digital Rights Management approach to privacy in online social networks, Workshop on on Privacy and Protection inWeb-based Social Networks (within ICAIL2009), Barcelona, June 2009
  - Víctor Rodríguez, Anna Carreras, Eva Rodríguez and Jaime Delgado, Applications to Improve Privacy on Online Social Networks, Proc. of the First Workshop on Law and Web 2.0, September 2009
  - Víctor Rodríguez and Jaime Delgado, Semantic Expression and Execution of B2B Contracts on Multimedia Content, in Proc. of the 4th Int. Conference on Semantic and Digital Media Technologies (SAMT2009), Graz, December 2009 (to appear)
- **Book chapters**
  - Christian Timmerer, Filippo Chiariglione, Marius Preda, Victor Rodríguez Doncel, Accelerating Media Business Developmens with the MPEG Extensible Middleware, in Towards the Future of Internet, IOS Press 2010.

Outreach: derived applications

- In European-supported projects
  - A major contribution in **AXMEDIS** (Automating Production of Cross Media Content for Multichannel Distribution), European Integrated Project funded under the European Commission IST FP6 Program
  - A minor contribution in **VISNET-II** (Networked Audiovisual Media Technologies) a Network of Excellence funded under the European Commission IST FP6 Program
- In State-supported projects
  - **E2E-RM** (End To End Rights Management), funded by the Spanish Ministerio de Industria Turismo y Comercio.

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