A web ontologies framework for digital rights management

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Abstract. In order to improve the management of copyright in the Internet, known as Digital Rights Management, there is the need for a shared language for copyright representation. Current approaches are based on purely syntactic solutions, i.e. a grammar that defines a rights expression language. These languages are difficult to put into practise due to the lack of explicit semantics that facilitate its implementation. Moreover, they are simple from the legal point of view because they are intended just to model the usage licenses granted by content providers to end-users. Thus, they ignore the copyright framework that lies behind and the whole value chain from creators to end-users.

Our proposal is to use a semantic approach based on semantic web ontologies. We detail the development of a copyright ontology in order to put this approach into practice. It models the copyright core concepts for creation, rights and the basic kinds of actions that operate on content. Altogether, it allows building a copyright framework for the complete value chain. The set of actions operating on content are our smaller building blocks in order to cope with the complexity of copyright value chains and statements and, at the same time, guarantee a high level of interoperability and evolvability.

The resulting copyright modelling framework is flexible and complete enough to model many copyright scenarios, not just those related to the economic exploitation of content. The ontology also includes moral rights, so it is possible to model this kind of situations as it is shown in the included example model for a withdrawal scenario.

Finally, the ontology design and the selection of tools result in a straightforward implementation. Description Logic reasoners are used for license checking and retrieval. Rights are modelled as classes of actions, action patterns are modelled also as classes and the same is done for concrete actions. Then, to check if some right or license grants an action is reduced to check for class subsumption, which is a direct functionality of these reasoners.

Keywords. Digital Rights Management; Copyright; Ontology; Semantic Web.

1. Introduction

Our objective is to make a new contribution to the Digital Rights Management (DRM) research field. There are different initiatives trying to solve the problem of interoperability between DRM Systems (DRMS), which have started from isolated and proprietary initiatives. However, they are lately clearly moving to a web-broad application domain.

One of the main initiatives is MPEG-21 (Walle 2005), an ISO/IEC standardisation framework for digital content management. MPEG's DRM modelling is divided into the Rights Expression Language (REL) and the Rights Data Dictionary (RDD) (Wang 2005). Another initiative is ODRL (Open Digital Rights

Language), available also as W3C note (Iannella 2002), that has been adopted by the Open Mobile Alliance [1] as a standard for the mobile communications field.
There are many other initiatives but, basically, all of them have one thing in common, they work at the syntactic level. Their approach is to define some XML Schemas that specify the grammar of rights expression languages. In some cases, the semantics of these languages, i.e. the meaning of the expressions, are also provided but formalised separately as rights data dictionaries. Rights dictionaries list terms definitions in natural language, solely for human consumption and not easily automatable.
However, the syntactic approach does not scale well in really wide and open domains like the Internet. Automatic processing of huge amounts of metadata coming from many different sources requires machine understandable semantics. The syntax is not enough when unforeseen expressions are met. Here is where semantics come to help their interpretation to achieve interoperation.
Other initiatives have also chosen a semantic approach for DRM. The Harmony project (Hunter 2003) integrates copyright concepts from the MPEG-21 RDD into a generic ontological framework and OREL (Qu 2004) is a formal ontology version of MPEG-21 RDD. However, these initiatives do not take into account the copyright legal framework, as the DRM initiatives they are based on neither consider this aspect. On the other hand, there is the Creative Commons initiative (Lessig 2003), which is also based on semantic metadata but it does consider the legal framework. In this case, the inconvenient is that it just provides a very simple formalisation intended for open release environments, e.g. open source software.
Our idea is to facilitate the automation and interoperability of DRMS integrating both parts, the REL and the RDD. This objective can be accomplished using ontologies, which provide the required definitions of the rights expression language terms in a machine-readable form. Thus, from the automatic processing point of view, a more complete vision of the application domain is available and more sophisticated processing can be carried out.
We have taken the Semantic Web approach (Berners-Lee 2001) because it is naturally prepared for the Internet domain and thus we use web ontologies (Hendler 2001). The modularity of web ontologies, constituted by concept and relation definitions openly referenceable as URIs, allows their easy extension and adaptation to meet evolvability and interoperability.
Moreover, in order to formalise copyright law aspects, we have used the World Intellectual Property Organisation[2] recommendations, which try to define a common worldwide legal framework. Using a so general framework helps building a general copyright ontology, which can be then specified for particular law systems. In any case, the current trend is to adapt local copyright systems to this international framework in order to facilitate the multiple interrelations they are being forced to by copyright globalisation.
On the other hand, we have tried to by agnostic in relation to more general concepts. Therefore, we have not bounded the copyright ontology to any upper level ontology during the development process. Our intention has been to keep in mind some top ontologies in order to make our model, after its completion, easy to align with as many upper ontologies as possible. Section 2 describes a more detailed explanation of the ontology development.

[1] OMA – http://www.openmobilealliance.org
[2] WIPO - http://www.wipo.org

A preliminary version of this ontology, called IPROnto[3], was contributed (Delgado 2001) to MPEG-21 REL-RDD call for proposals[4]. As it has been explained before, MPEG-21 selected a syntax-oriented approach with separated REL and RDD.
The development of the current version of our ontology is detailed in section 2. In order to show the capabilities of the copyright ontology, section 3 poses a quite uncommon scenario about the author's moral right to withdraw its work and shows how this scenario is modelled. Finally, section 4 details how the ontology has been implemented using Semantic Web technologies producing the OWL Copyright Ontology[5]. It also highlights how Description Logic reasoners are used to check actions validity against rights and licenses.

2. Development

Although there is not an established ontology development methodology (Fernández-López 1999), we have decided to adopt one of the existing ones, Methontology (Fernández-López 1997). The evolving prototypes ontology life cycle that Methontology describes has driven our copyright ontology development.
For the development process, we followed the basic steps: conceptualisation, formalisation and implementation. The requirements have been depicted in the introduction and this first step served to detect the candidate knowledge sources. During formalisation, the knowledge sources have been studied and the corresponding models have been built. The more important ones are shown in the next subsections.
Finally, formalisation and implementation have been automatised using ontology development tools. The objective has been to produce computable models based on Semantic Web languages. OWL is used for ontology and SWRL (Horrocks 2004) for rules. More details about the implementation are given in section 4.

2.1 Creation Model

The core concepts of the ontology are those that formalise the notion of creation. Creation can be viewed from three points of view, which constitute the main points of view in almost any ontological approach:

- *Abstract*: it is something that cannot exist at a particular place and time without some physical encoding or embodiment, a mental concept.
- *Object*: it corresponds roughly to the class of ordinary objects. Object is related to the continuant or endurant concepts in some ontologies. It also includes digital objects.
- *Process*: it is something that happens and has temporal parts or stages. It is related to the occurrent or perdurant concepts in some ontologies.

As we can see in Figure 1, these three points of view on creation can be then detailed into the different forms a creation can take. These copyright specific concepts are related through the different actions that can be performed on creations. We will detail them when building the action model.

[3] Intellectual Property Rights ONTOlogy - http://dmag.upf.edu/ontologies/ipronto
[4] MPEG-21 Rights Data Dictionary and Rights Expression Language call for proposals, http://www.chiariglione.org/mpeg/working_documents/mpeg-21/requirements
[5] Copyright Ontology, http://rhizomik.net/ontologies/copyrightonto

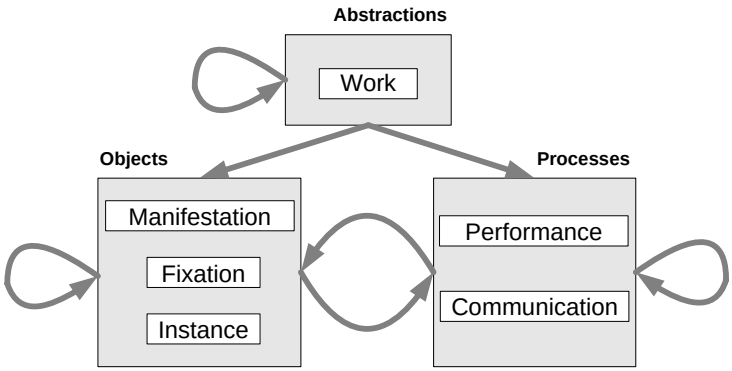

Figure 1. Creation model showing different views on creation

The concrete concepts in the creation model are:

- *Work*: a distinct (original) intellectual or artistic creation, a concept.
- *Manifestation*: the materialisation of a work in a concrete medium, a tangible or digital object.
- *Performance*: the expression in time of a work. Performers or technical methods might be involved in the process. In some cases, there might not be any previous manifestation of the work (an improvisation).
- *Fixation*: the materialisation of a performance in a concrete medium, a tangible or digital object.
- *Instance*: a reproduction (copy) of a manifestation, a fixation or another instance, an object.
- *Communication*: the transmission of a work among places at a given time, a process.

For instance, if we consider the creation “Les Misérables”, we can observe it from these three perspectives taking different forms. From the *Object* view, we can see the original manuscript by Victor Hugo as a *Manifestation*; there are other manifestations of posterior adaptations, like a script for a film or theatre representation. Then, there is the *Fixation* of the film and *Instances* like a DVD copy of the film fixation or a book reproducing a manifestation. From the *Process* perspective, the theatre representation and the film projection in a cinema are *Performances*. Its broadcasting is a *Communication*. All the previous concepts have in common what is socially identified as the Victor Hugo’s *Work*. This is from the abstract perspective and it represents what we grasp as common in the different manifestations, performances, fixations and instances, i.e. what allows us saying that they are from the same *Work*.

2.2 Rights Model

From the legal point of view, the WIPO recommendations have been followed and the copyright notions it defines at the international level have been incorporated into our ontological framework. Table 1 shows the included rights hierarchy starting from Copyright. There are the economic rights plus the moral rights, as promoted by the WIPO, and the copyright related rights.

The more important rights in the DRM context are the economic rights as they are related to productive and commercial aspects of copyright. Each of these rights regulates an abstract set of actions:

- *Reproduction Right*: regulates actions that produce replicas of a given object, i.e. *Instances*. Examples of reproduction are the mass production of CD copies from an audio recording master, to scan a book in order to

produce a digitalisation of it or to download a digital file into the local hard disk.

- *Distribution Right*: regulates actions geared to distribute previously made copies incorporated in tangible articles. The ownership of the corresponding physical support can be transferred permanently, i.e. the distribute act is a sale, or just temporally, i.e. a rent if there is a significant economic compensation or a loan if not.
- *Public Performance Right*: regulates *Performances* of works when they are made in public, i.e. before an audience.
- *Fixation Right*: regulates the materialisation of a *Performance* into an object that constitutes a *Fixation*. Common fixations are motion pictures and sound recordings.
- *Communication Right*: regulates the realisation of C*ommunications* of works, including wire or wireless means and those realised from a place and at a time individually selected. This right is concretised into *Broadcasting Right*, when the communication is massive, and *Make Available Right*, when the communication is individually chosen.
- *Transformation Right*: regulates actions that generate new works from previously existing ones. The results of this kind of actions are considered new works, and not mere reproductions, because they contribute something new. This right is concretised into the *Adaptation Right* and the *Translation Right*. The former creates a new work of a different type than the original one, e.g. a film from a novel. The latter generates a work of the same type but in a different language.

Table 1. Copyright hierarchy

Copyright	
Economic Rights	**Moral Rights**
Reproduction Right	Attribution Right
Distribution Right	Integrity Right
Rental Right	Disclosure Right
Importation Right	Withdrawal Right
Public Performance Right	
Fixation Rights	**Related Rights**
Sound Record Right	Performers Rights
Motion Picture Right	Phonograms Producers Rights
Communication Rights	Broadcasters Rights
Broadcasting Right	
Making Available Right	
Transformation Rights	
Adaptation Right	
Translation Right	

These rights are conceded to the author or promoter of the creation by the mere action of bringing the work into existence. From this initial situation, it is possible to transfer, or at least license, the economic rights to third parties. This fact, together with end-users consumption, motivates value chains to arise.

On the other hand, moral rights are always held by the creator and cannot be commercially exploited. They are not present in all legal systems. However, WIPO treaties are promoting some of them in order to improve worldwide copyright law harmonisation:

- *Attribution Right*: the right to claim authorship of the work.

- *Integrity Right*: the right to object to any distortion, mutilation or other modification of, or other derogatory action in relation to, the work which would be prejudicial to the author's honour or reputation.
- *Disclosure Right*: exclusive right to disclose the work.
- *Withdrawal Right*: exclusive right to withdraw the work. In order to show the capabilities of the ontological framework, a complete withdrawal scenario is modelled in section 3.

Finally, there are the rights of other persons also involved in the exploitation of works. Performers, producers and broadcasters make a significant contribution in order to make works reach end-users. Their contribution is also protected by some rights related to copyright, the *Related Rights* or *Neighbouring Rights*.

End-users do not hold any right. They just consume creations, i.e. they use them, and uses are not covered by copyright. However, this does not mean that end users can do whatever they want, they should not realise actions that require copyright. Moreover, they might be subject to special conditions under which they have acquired the permission to use a creation, e.g. a film that can only be viewed a fixed number of times and thus is cheaper than a DVD reproduction. This kind of conditions is not regulated by copyright; it is established by the usage agreements among end-users and content providers.

However, some aspects of end-users activity are regulated by copyright. End-users have some special permissions that grant them the possibility to perform some actions otherwise forbidden by copyright. These are the copyright exceptions:

- *Quotation Right*: the making of quotations from a protected work, provided that the source is mentioned and that the extent of the quotation is compatible with fair practice.
- *Uses for Education*: illustration for teaching and research, uses for reproduction and communication to the public in educational institutions, libraries and archives.
- *Uses for Information Purposes*: news incorporating other news and news incorporating other works.
- *Use for certain proceedings and ceremonies*: administrative, judicial, security, religious, official, etc.
- *Private Copy*: the reproduction of a work exclusively for the personal and private use of the person who makes the reproduction, e.g. a backup.
- *Parody and Caricature*.
- *Temporary Reproduction*: ephemeral reproductions required for facilitating some technological processes geared towards work usage, e.g. internet caches.

2.3 Action Model

As it has been already shown, the ontological framework considers creation in its different forms and copyright rights. Trying to go to the more primitive elements in this framework, we can see that rights define actions packages that are regulated. Moreover, the different forms a creation can take are organised in a creation life cycle that is performed by these same actions, at least in the part that is governed by copyright. Figure 2 situates these actions in the creation life cycle.

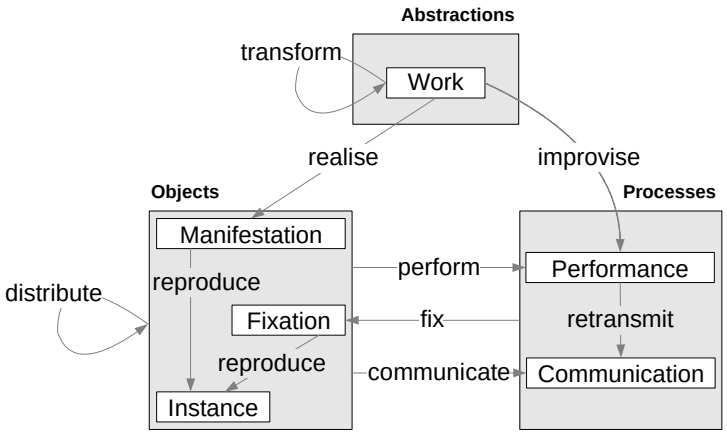

Figure 2. Actions in the creation life cycle

These actions are generalisations of the kinds of actions governed by the different copyright rights:

- Reproduction Right: *reproduce*, or commonly speaking *copy*.
- Distribution Right: *distribute*. More specifically *sell*, *rent* and *lend*.
- Public Performance Right: *perform*; it is regulated by copyright when it is a public performance and not a private one.
- Fixation Right: *fix*, or *record*.
- Communication Right: *communicate* or *retransmit* when communicating a live performance. Specific actions are *broadcast* or *make available*.
- Transformation Right: *transform*. Some concretisations are *adapt* or *translate*.

From this life cycle, many value chains can be built but, in order to do that, we must also consider the *Transfer* and *Use* actions. The former is the basic action to model the flux of rights through the value chain, even if it is a real transfer or a temporary one, i.e. a license. The latter models any kind of consumption of a creation in one of its object or process forms. For instance, to assist to a cinema projection (to use a performance), to buy a book (to use an instance), to tune a broadcast (to use a communication), to access a file (to use something made available), etc. Finally, in order to complete the action model, we have also included negotiation actions: *Offer*, *Agree* and *Counteroffer*.

The previously introduced pool of primitive actions can be combined in order to build different value chains in the copyright domain. Figure 3 shows how we can build a model for the value chain of serials adapted from literary works. The ovals represent the different roles involved, which perform the actions they are linked to.

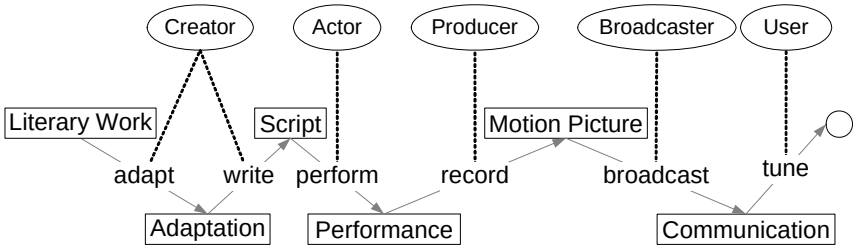

Figure 3. Literary works adapted to serials value chain

First, the creator adapts the original literary work, e.g. Alexandre Dumas' "The Count of Monte Cristo", in order to produce a serial. The resulting adaptation is realised as a script that is performed by some actors, e.g. Gerard Depardieu, and

recorded into a motion picture. This motion picture is finally broadcasted to users who can tune the resulting communication. This is just the skeleton of the value chain. In order to give a more detailed model each step in the value chain can be modelled as an event for the corresponding action.

Actions are modelled as event because they are not isolated entities, they are related to a bunch of entities that take part in the action. Moreover, there are space-time coordinates that situate the action. One thing that all actions have in common is that in natural language they designated by verbs. Therefore, in order to facilitate their modelling, we have incorporated into the framework concepts from the linguistics field related to the classification of verbs and their relation to other linguistic components.

These relations are called thematic roles or case roles (Sowa 2000) and are classified into initiator, resource, goal and essence. In Table 2, we show at the top the kinds of case roles we have considered and, on the left, the kinds of verbs they are related to (García, 2006). These kinds of verbs define verbs facets, not disjoint classes of verbs, and concretise the general thematic roles as shown in each row. Therefore, the same verb can present one or more of these facets. For instance, the play verb can show the action, temporal and spatial facets in a particular sentence.

Table 2. Case roles for verbs

	initiator	**resource**	**goal**	**essence**
Action	agent, effector	instrument	result, recipient	patient, theme
Process	agent, origin	matter	result, recipient	patient, theme
Transfer	agent, origin	instrument, medium	experiencer, recipient	theme
Spatial	origin	path	destination	location
Temporal	start	duration	completion	pointInTime
Ambient	reason	manner	aim, consequence	condition

Figure 4 shows an example of an action modelled as an event. Thematic roles relate the action verb to its participants and context in order to capture the whole event. In this case, it is a creation event where a manifestation is realised.

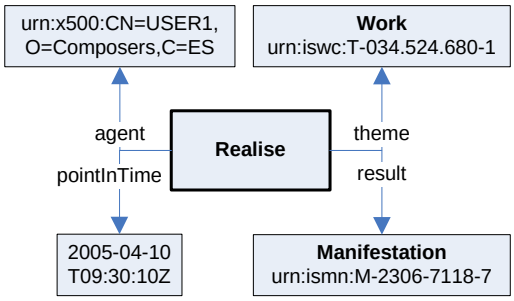

Figure 4. Action modelling example using thematic roles

This kind of event models based on the concepts and relations from the copyright domain constitute the basic building blocks of our “Rights Expression Language”. In section 3, we will show how to use them to model a whole scenario. It is also important to note that, in order to perform these actions, the involved agents must hold the necessary rights or licenses. In section 4, we show how the copyright ontology facilitates checking this.

2.4 Upper Ontologies

To conclude, the ontology is enriched with general concepts for time, space, tools, parthood, etc. They are taken from upper level ontologies, which define general concepts. For the moment, we have considered some upper ontologies: IEEE SUMO (Pease 2002), DOLCE (Gangemi 2002) and LRI-Core (Breuker 2004). Our intention is to make general concepts from upper ontologies interchangeable and make alignment of the copyright ontology to all these top ontologies possible.

3. Withdrawal Right Scenario

In order to show the capabilities of the copyright modelling framework detailed in the previous section, we are going to show how it can be used to model a complete copyright scenario. We have chosen a quite uncommon one because it does not deal with exploitation-oriented aspects.

The scenario is about moral rights, concretely the withdrawal right. In this scenario, the author exercises one of its inalienable rights to retire one of its works from the public scene, as he does no longer consider that it represents his personality. The whole scenario is considered; from the moment, the author creates the work, and correspondingly acquires full rights on his creation, until the consequences of its withdrawal. The scenario steps are detailed next.

3.1 First step: Creation and Acquisition of Moral Rights

In Figure 4 we saw an example of creation event model, i.e. when the author produces the first manifestation of the work. The creation event implies that the creator becomes the holder of all the copyright rights on the creation. This is modelled by the rule in Table 3, which is written down using a notation similar to the one employed to define Semantic Web rules (Horrocks 2004).

Table 3. Rule to assign author rights

Create(?c) ∧ Work(?w) ∧ Manifestation(?m) ∧ agent(?c,?ag) ∧ theme(?c,?w) ∧ result(?c,?m) ∧ pointInTime(?c,?t) ⇒ MoralRights(?mr) ∧ ExploitationRights(?er) ∧ agent(?mr,?ag) ∧ agent(?er,?ag) ∧ essence(?mr,?w) ∧ essence(?er,?m) ∧ start(?mr,?t) ∧ start(?er,?t)

Figure 5 shows the situation resulting from applying this rule to the previous creation event. From this situation, the rights holder can initiate the creation exploitation by transferring or licensing some of the rights he holds. However, we are not going to deal with the exploitation part, but we are going to concentrate on moral rights, and more concretely on the author's right to withdraw his work. The withdrawal right is included in the moral rights "pack", so it is also hold by the author, and grants the author the act to withdraw its work.

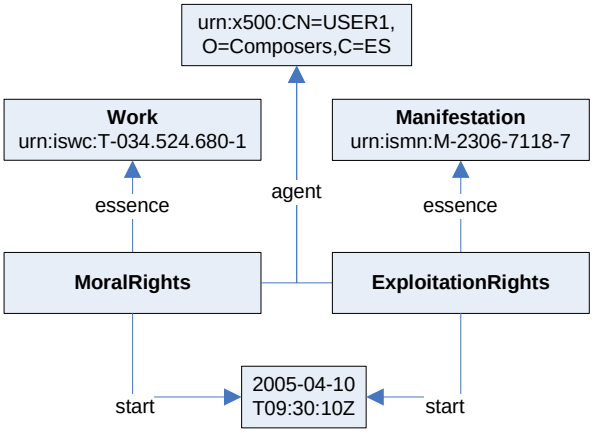

Figure 5. Rights situation achieved from the creation event

3.2 Third step: Withdraw and Compensation

From the previous step, the author is now authorised to withdraw his work. However, this act will have its consequences. Generally speaking, the consequence is that he should compensate the third parties with which he has established exploitation agreements for the economical damages this act may impose them.

These compensations can be explicitly anticipated in the previous agreements or inferred from additional rules or external systems when withdraw is performed. Figure 6 shows one exploitation agreement for communicating the work in exchange for compensation to the author, in the figure named *Transfer A*. There is an additional provision in this agreement, another transfer from the author to the other party that is conditioned to the exercise of the withdraw act of the work, *Transfer B*.

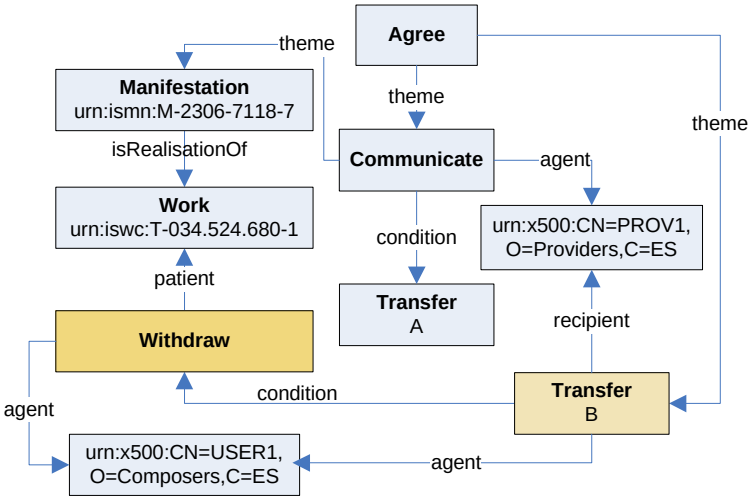

Figure 6. Agreement with withdraw compensation provision

4. Implementation

The previously detailed models, i.e. Creation, Rights and Action Model, plus the required concepts from upper ontologies build up our ontological framework for copyright. This conceptual model has been implemented using Semantic Web ontologies and rules languages.

The main objective has been to provide a straightforward and efficient implementation. In order to do that, in the context of web ontologies, we have

chosen OWL-DL (Pan, J.Z. 2004). OWL-DL is a Web Ontology language that is also a Description Logic (DL). Therefore, it can be directly fed into DL classifiers, which are specialised logic reasoners that deal with class definitions and instances. They guarantee computable results for class subsumption checking and instance classification.

DL classifiers are employed to check copyright-governed events against copyright rights and the action patterns specified in copyright situations, agreements and offers. This facilitates checking if a particular action, once modelled as an event, is allowed or not. It is even possible, if the action is not disallowed, to look for offers that grant action patterns that would enable it, once an agreement is reached.

In order to do that, all has to be modelled as OWL classes. Rights are classes of actions as shown in the Rights Model. Agreements and offers grant classes that model action patterns. Finally, events are also modelled as classes. It is possible to build class definitions using instance level resources, e.g. a concrete user or a specific location. Therefore, very concrete events can also be modelled as classes. Then, it is possible to check if the action modelled by the event is enabled or not simply by checking subsumption using the DL classifier.

DL classifiers can be directly reused so there is no need to develop ad-hoc applications to perform this function. The more complex behaviours that are not captured by OWL-DL are modelled using Semantic Web rules (Horrocks 2004), as it has been shown in the withdraw scenario. However, this is just the implementation at the ground level. All this must be complemented with a metalevel that reasons about the deontic aspects and guides the DL checks that have to be performed in order to capture the semantics of the implicit obligations, permissions and prohibitions.

User actions are checked against the repository of agreements in order to see if the action is allowed. Therefore, there is an implicit deontic operator that is implemented using the DL reasoner. The class modelling the action is classified against the set of agree classes and their associated usage patterns, i.e. their themes. Then, the user action is permitted if it is classified as a subclass of any of the usage patterns included in the agreements repository.

It is not effectively permitted yet because two more conditions have to be checked. First, in order to be a permission, the usage patterns where the user action has been classified must be the theme of an *Agree*. On the other hand, if it is the theme of an *Offer*, the idea is to trigger a negotiation process that might eventually make the action permitted if an agreement is reached.

In addition to the previous check, the usage patterns usually specify an obligation for the user in order to perform the action. This is specified by the condition case role. It can be viewed as an implicit obligation deontic operator. Therefore, in this case, the second condition is to check that the obligation has been fulfilled. This is also done using DL mechanisms. The obligation range is also a class that models an event. The obligation is satisfied if the is a resource in the repository that has been classified as an instance of the obligation pattern.

To conclude, it is also possible to model prohibitions. This is done using "owl:complementOf" in order to get negated classes, e.g. a class defined as "complement of location equal to DVD Zone 3" and then intersected with the usage pattern with "owl:intersectionOf". There are more details in the following scenario.

4.1 Implementation Scenario

The use of DL classifiers for digital rights management in the context of the copyright ontological framework can be exemplified with the following scenario:

1. The initial situation is “USER1 is trying to access a given video stream from a given streaming server at 9:30:10 UTC on 2005-04-10”. The streaming server implements digital rights management so it inquires the license manager if the current usage instance is permitted. In order to do that, the streamer models this usage as shown in Figure 7, and sends it to the license manager, e.g. as a RDF/XML serialisation.

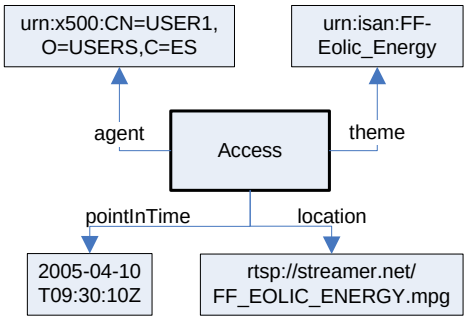

Figure 7. Usage instance modelled by the streaming server

2. The license manager contains licenses modelled using the same approach, among others the one shown in Figure 8. This license grants a usage pattern for a creation located at the streaming server that can be performed by a class of agents for a given period starting on a given date. Moreover, the license manager has additional metadata stating that USER1 is an instance of the users’ pattern class.
3. The license manager checks if there is any license that grants a usage pattern that subsumes the usage instance. This can be performed easily and efficiently using a DL classifier. However, before that, it is important to note that usage patterns define the time interval using a start time and duration, while the usage instance defines a time point. In order to check if the time point is included in the time interval, we must use a DL classifier capable of dealing with custom datatypes reasoning (Pan, J.Z. 2005). Then, the time interval is translated to a real interval, i.e. *pointInTime* is greater or equal than 20050401 and smaller or equal than 20060401, and the time point to a real, i.e. *pointInTime* is equal to 20050410.093010.

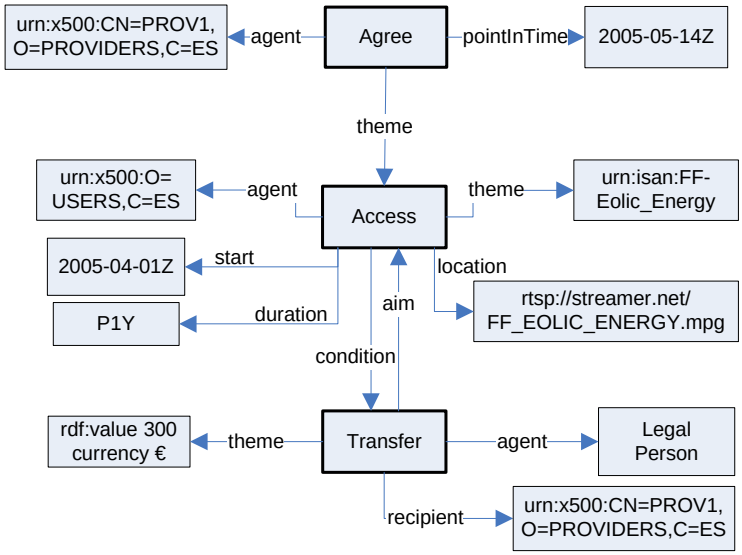

Figure 8. Use license model defining permitted usage pattern and condition

4. After applying the previous adjustment, subsumption is computed. The usage might be classified in one or more usage patterns. In this case, it is tested if the usage pattern is the theme of an "Agree" concept. Then, if there is an instance of the condition, i.e. it is satisfied, the license manager tells the streaming server that the use is authorised. Otherwise, the use is not authorised.

This is a simple scenario for illustrative purposes. It could be extended in many ways. For instance, if the usage pattern is the theme of an offer, another possibility is to recommend the user the possibility to negotiate it in order to arrive to a new agreement. From this point, it can be connected to negotiation architectures previously designed by in our research group (Delgado 2002) (Gil 2003).

5. Conclusions and Future Work

As it has been shown, the copyright ontology (García 2006) that has been built constitutes a complete framework for representing copyright value chains and the associated flow of rights situations, agreements, offers, etc. All this can be performed consistently with a general framework for copyright law that comes from international recommendations.

In addition to its representational features, the ontology can be easily put into practice with the help of logical tools. It is implemented as an OWL-DL ontology so Description Logic reasoners can be directly used in order to reason about it. Copyright rights, statements and concrete actions are all modeled as classes and class subsumption is computed in order to determine if an action is valid or not.

We are currently working on the integration of this copyright ontology with MPEG-21 and ODRL (Gil 2005, García 2005). In order to do that, the XML Schemas that define these rights expression languages are mapped to OWL using ReDeFer[6]. From this point, we are developing the necessary mappings to the copyright ontology in order to propagate the advantages of a semantic approach to MPEG-21 and ODRL.

[6] ReDeFer XSD2OWL, http://rhizomik.net/redefer

Finally, all these ideas and tools are being put into practice in order to build semantics-enabled Digital Rights Management Systems (García 2004). Such a system will be able to take profit from the copyright ontology capabilities and provide a framework for integrating different rights expression languages and perform digital rights management for the whole copyright value chain.

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