

IPROnto: An Ontology for Digital Rights Management

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Abstract. Ontologies are a way to express semantics of concepts in a formal way. IPROnto is an ontology of the Digital Rights Management (DRM) domain. It has been specified to facilitate the development of e-commerce applications that need to be aware of rights associated to specific multimedia content. The paper describes the ontology and its possible uses. Since we started this work in the context of MPEG-21 standardisation, we are currently progressing in the development of applications that follow the DRM MPEG-21 standards, such as a REL (Rights Expression Language) and a RDD (Rights Data Dictionary), and aligning our ontology to those specifications.¹

1. Introduction

The main objective of this paper is to describe a specific ontology we have developed in our group. It is an attempt to specify in a semantic way the domain of Intellectual Property Rights (IPR). Since we are working in the area of e-commerce of multimedia content, we often talk about Digital Rights Management (DRM), that better express the scope, instead of IPR, that is a broader term.

The paper puts the ontology (IPROnto) into context by establishing the basis on which we have made our developments. We have been always trying to not *re-invent the wheel* by basing our work on existing activities, models and specifications.

IPROnto has two basic views: A static and a dynamic one. We start, in section 3 with the description of the static view. Since the ontology is rather complex and complete, we concentrate in the paper only on some aspects of it. In particular, we describe the concepts of IPR Agreement, including Contract and License (section 4), and some specific rights, such as Exploitation or Moral rights (section 5). The IPROnto LegalEntity element is then described in section 6, before briefly entering into the dynamic view, that defines a content life cycle for DRM and an example of sub-ontology.

The paper finalises with the identification of the next steps and some conclusions.

2. Development of an IPR ontology: IPROnto

There are many initiatives trying to build an IPR framework for Internet-wide management of intellectual property. For instance, MPEG-21 [1] or, in the W3C (World Wide Web Consortium) initiatives framework, the ODRL (Open Digital Rights Language) proposal [2].

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Most of these initiatives have one thing in common: they work at the syntactic level. Their approach is to make a formalisation of some XML DTDs and Schemas that define a rights expression language (REL), such as the MPEG-21 REL [3].

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 (RDD), for instance MPEG-21 RDD [4]. Rights dictionaries define terms in natural language, solely for human consumption; for this reason it is not easy to make an automatic processing of those terms.

However, the syntactic approach does not scale well in really wide and open domains like the Internet. An automatic processing of a huge amount 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.

Our idea is to facilitate the automation and interoperability of IPR frameworks integrating both parts, the Rights Expression Language and the Rights Data Dictionary. These objectives 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 [5] because it is naturally prepared for the Internet domain and thus we use web ontologies. The modularity of web ontologies allows their easy extension and adaptation.

Since a lot of work has been done in the area of IPR representation and definition, we started the development of our ontology, that we have named IPROnto, from selected specifications. The results from <indec> [6] and Imprimatur [7] projects were a suitable starting point because of their coverage in describing the IPR domain, so the terms definitions and their structure were adopted and formalised using web-ontology tools. This was complemented with previous work in our research group DMAG [8].

Furthermore, in order to provide a robust ontology basis for interoperability we rooted all our work in an upper ontology. We selected SUMO, a result of the SUO IEEE WG [9] attempt to establish a standard upper ontology. We are also considering other recent upper level alternatives like DOLCE [10] and LRI-core [11]. Finally, since the World Intellectual Property Organisation (WIPO) [12] is defining a common legal framework for IPR, we have used it to complete the legal aspects of the ontology.

These knowledge sources, identified in the IPROnto analysis phase, have been arranged as shown in Figure 1. Finally, during implementation phase, knowledge was acquired from the different sources and formalised using a Semantic Web ontology language, DAML+OIL [13].

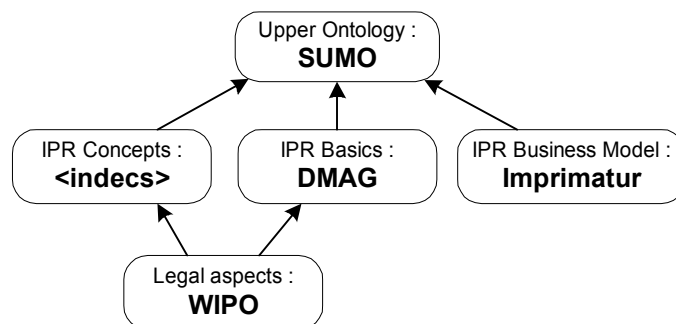


Figure 1. IPROnto knowledge sources design diagram

3. Static View of IPROnto

We can see the static view of IPROnto as a tree where elements are related from the bottom to the top. In Figure 2 we introduce a skeleton of the tree where only core elements, for simplicity, are presented. In the following subsections, some of the key elements are detailed to give a more complete view of the ontology. The root of the tree is an Entity, which may be Physical or Abstract. In turn, a Physical entity may be an Object or a Process, being this one more interesting, which might be an Event or a Situation. The only elements below Event that we will detail concern the concept of Agreement, including contract or license for the distribution of copyright protected electronic material.

In the other side of the tree, although several elements may belong to an Abstract entity, only the LegalConcept is presented in the skeleton. Nevertheless, other options, not sketched here, are possible, such as Relation or Quantity. While the LegalConcept might come from a few elements, only details are given for two cases: IntellectualPropertyRight and LegalEntity. The presence of dots in the tree means that other *brother* elements exist, but have not been included in the skeleton.

The most interesting part of the IPROnto related to legal aspects is that related to the LegalConcept and the Transaction elements. In the first case, the IntellectualPropertyRight IPROnto tree element and their derived rights specifically. These rights are associated to multimedia digital content for automatic e-commerce in the Internet. In the case of the Transaction element, it is specially interesting the Agreement tree element related to the conditions that define to whom to commerce with multimedia content and their associated rights. All elements of the tree below LegalConcept and Agreement, together with some leaves, are detailed in the following subsections. For a global graphical view of how IPROnto looks like, see [14].

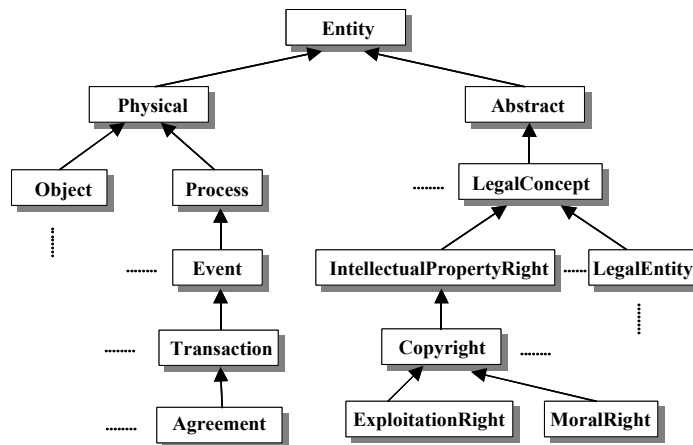


Figure 2. Core elements of the IPROnto skeleton

4. IPROnto Agreement

When a consumer wants to purchase, to a content distributor, audiovisual material subject to copyright, the content distributor presents an initial offer to the consumer. The process might finalise by accepting or not this offer. However, after the initial proposal, the negotiating entities might elaborate the contract, using a negotiation protocol, through a sequence of proposals and counter-proposals until a final agreement is reached, forming then the final electronic contract, which is signed by all the entities involved in the

agreement. We have been previously working on implement this kind of IPR negotiation and contract development [15][16]. Figure 3 shows the Agreement tree element together with its dependent elements, IPRContract and IPRLicense. The dots in the tree mean that other kind of contract and licenses exist, but we only detail some examples.

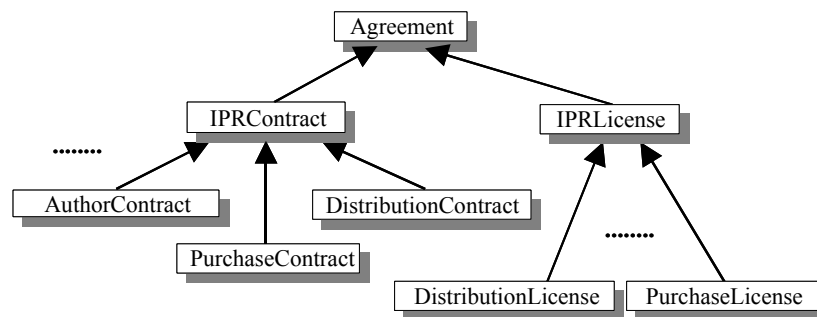


Figure 3. IPROnto Agreement

With IPRContract, we are grouping different kinds of contracts. One of them is *author's contract*, which represents the following scenario. Initially, the creator (writer, composer, actor, software programmer, etc.) of an intellectual work is holder of all the rights over it. Authors may not have the economic power to exploit their creations in an effective way, in such case, exploitation rights can be transferred to publishers/producers specialised on this task (a Rights Holder). Through *author's contract*, a publisher/producer becomes the exploitation rights holder of the work. As a counterpart, the original creator will receive royalties for the benefits derived from the exploitation of the work, or/and an initial fix revenue.

Another scenario represented by IPRContract is the one related with publishers/producers. They do not usually have direct contact with end-users. They commercialise works through distributors, entities specialised in acquiring part of the rights of copyrighted works to allow them to satisfy final users demand of these works (a Media Distributor). Formalisation of these agreements is made through *distribution contracts*, that may transfer some constrained exploitation rights or be mere licenses allowing the required actions to complete the commercialisation to end-users.

An IPRLicense represents the legal instrument by which a rights holder conveys usage rights associated to a resource to certain conditions to a consumer. Generally speaking, a license contains the following information:

- Entity that issued it. Typically, this entity has an associated authentication mechanism by which can prove its identity.
- Rights: Specifies an action or activity that an entity may perform using a resource.
- Resource: Identifies the object with associated rights to be used in a license.
- Conditions: Specifies the terms, conditions and obligations under which rights can be exercised, i.e. a time interval within which a right can be exercised, a limit to the number of times a right can be exercised, a fee that must be paid, etc.

For example, a *distribution license* is a kind of license in which a RightsHolder authorises a MediaDistributor the dissemination of a certain creation in a determined set of conditions. Copyrighted works arrive to their consumers through distributors. End-users acquire the right to access and use them by *purchase licenses*.

5. IPRonto IntellectualPropertyRight

Intellectual Property Rights (IPR) are legal instruments that provide a limited monopolistic right to the owner of things such as patents, trademarks or copyrighted works. They provide an incentive for the creation of and investment in new works (music, films, print media, software, performances, broadcasts, etc.) and their exploitation, thereby contributing to improved competitiveness, employment and innovation.

Some of the Intellectual Property Rights considered in IPRonto are shown in Fig. 4. This description is based on the Berne Convention [17] and the WIPO Copyright Treaty [12]. It is, as the sources state, broadened enough to ensure international applicability. There are local initiatives to implement these recommendations, as the EC Directive on Copyright 2001/29/EC [18] or the US Digital Millennium Copyright Act [19].

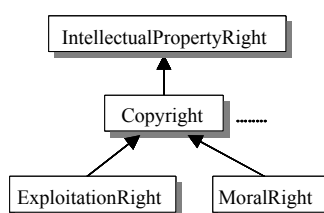


Figure 4 IPRonto IntellectualPropertyRight

All intellectual property rights are automatically given to originators of works (creators) by the simple fact of their authorship. They include moral rights that are independent of the author's economic rights and even after their transfer and exploitation right (economic rights), which are oriented to guarantee financial profit to originators of works. Figure 4 shows the relationship between Copyright, ExploitationRight and MoralRight.

Exploitation rights (so called economic rights) are oriented to guarantee financial profit to originators of works. The ExploitationRight includes:

- ReproductionRight: Exclusive right to authorize the reproduction, direct and indirect, permanent or temporary, in any manner or form.
- Communication to the Public Right (CommunicationRight): Exclusive right for the authorisation of any communication to the public of their works. These includes that members of the public may access them from a place and at a time individually chosen by them. Examples are: public performance, broadcasting, interactive on-demand transmission, etc.
- DistributionRight: Exclusive right to authorize the making available to the public of the original or copies of the work by sale or other transfer of ownership. Relevant only to tangible objects.
- TransformationRight: Exclusive right to authorize the manipulation of their works in any manner or form.

6. IPRonto LegalEntity

A LegalEntity relates to a LegalConcept, that is a concept defined by law, statute or international convention. Its terms are generally understood and defined in a series of international conventions and treaties and under national laws. An entity possessing capacity in law to exercise or enjoy an intellectual property right is a LegalEntity. It can be divided into two categories, CorporateLegalEntity, which refers to a legal entity inside a corporation and a NaturalLegalEntity, which could also be seen as a person in the real world.

Different business models, such as the IMPRIMATUR one [7], identify a series of entities that may take different roles, such as Creator, Provider, Rights Holder or Distributor. The relationships we have specified in IPROnto are sketched in Figure 5. Figure 6 shows a DAML+OIL serialisation of the LegalEntity shown in Figure 5. They include the following elements:

- Creator: Owner of the copyright in a work. He/She holds the exclusive right to use or authorize others to use the work on agreed terms.
- Rights Holder: Provides a license to exploit the creation on terms, which may be either predefined subject to negotiation.
- Content Provider: It acts in name of the Rights Holder, compiles and packs creations to provide to the distributors with multimedia content.
- Media Distributors: Apply to a Rights Holder for a license to exploit the creation.
- Customer: Person who wants to make use of a creation.

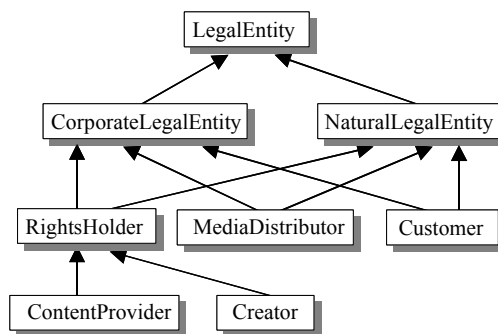


Figure 5. IPROnto LegalEntity

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...
<daml:Class rdf:about="#CorporateLegalEntity">
  <rdfs:subClassOf rdf:resource="#LegalEntity" />
  <daml:disjointWith> <daml:Class rdf:about="# NaturalLegalEntity " /> </daml:disjointWith>
</daml:Class>
<daml:Class rdf:about="#NaturalLegalEntity">
  <rdfs:subClassOf rdf:resource="#LegalEntity" />
  <daml:disjointWith> <daml:Class rdf:about="# CorporateLegalEntity " /> </daml:disjointWith>
</daml:Class>
...

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Figure 6. DAML+OIL fragment for IPROnto LegalEntity

7. Dynamic view of the IPR Ontology

The dynamic view of IPROnto allows the construction of IPR business models for its use in electronic commerce. This includes the possibility of defining events in the IPR domain. Some examples of events inside this context are Create or IPRContract. The description of these events and some other can be found in [20].

In the following subsections, we describe in more detail the creation process life cycle and the creation process subontology, a subontology derived from IPROnto.

7.1 Content life cycle

Concepts and relationships defined in IPROnto can be used to represent typical processes inside the IPR domain, together with the agents and resources they involve. These

representations can be automatically tested to check semantic consistency, thanks to the explicit semantics that emerge from the ontology structure of concepts and relationships.

To show the expressive power of this semantic IPR approach, we present a detailed view of the creation life cycle in Figure 7.

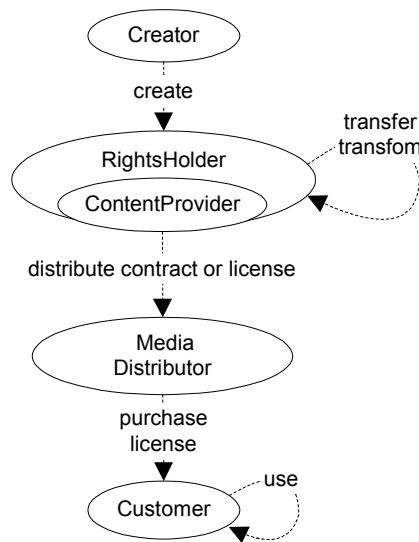


Figure 7. Content life cycle

The creation life cycle shown in Figure 7 involves roles (the ellipses) and actions (the arrows between ellipses). This generic business model has been inspired in the one defined by the IMPRIMATUR Project [7]. In the following paragraph, the content life cycle explanation, we are using italics to indicate that a concept appears in Figure 7.

The life cycle starts when someone with the role *Creator* originates a creation. This is the first role performing an action, *create*. Automatically, someone becomes the *RightsHolder* of the rights over this creation. The *RightsHolder* can be either the *Creator* or another legal entity with which the *Creator* has a contractual liaison.

At this point, the creation can be transferred (*transfer* action), changing the rights owner, or transformed (*transform* action), e.g. edited as a book. Also at this point, a *ContentProvider*, a kind of *RightsHolder* specialised in managing creations, may initiate its distribution. This is done through a *MediaDistributor*, who can hold rights or not depending on the contract agreed with the *ContentProvider*. We have considered two ways of allowing the distribution of the creation, through a contract or through a license. Finally, the last role involved is the *Customer* who receives the permission to *use* the content purchasing a license from the *MediaDistributor*.

7.2 Subontologies

The hierarchy of concepts and relations from the static view of the ontology, plus some of their interrelation constraints, has to be translated to a machine aware form. This leads to situations in which the relationship between concepts is difficult to explain in a tree, so we need a more complex graph. An example is shown in Figure 8.

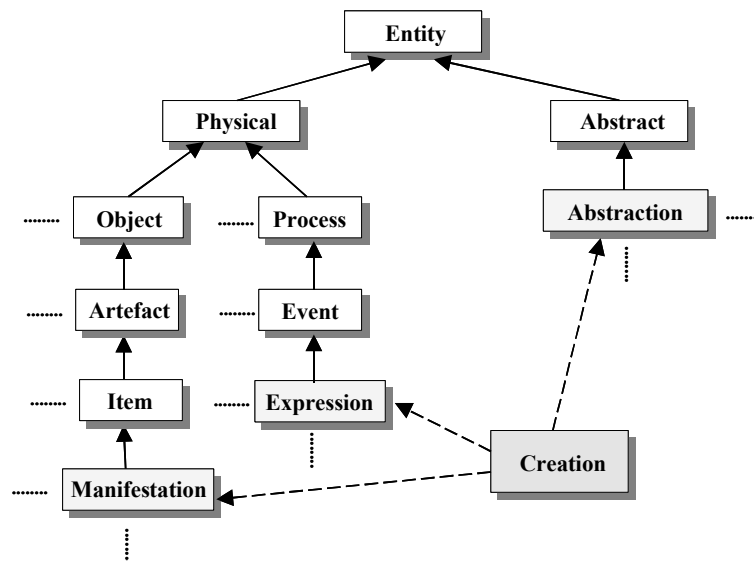


Figure 8. IPROnto Creation graph

Figure 8 shows the special relationship among the Manifestation, Abstraction and Expression elements of the IPROnto tree, being a Creation the union among the three elements. The broken line arrows in Figure 8 represent this special relationship, a union. The rest of arrows represent an is-a relationship among elements.

Apart from relating the Creation with some other elements of the IPROnto tree, we have developed a new subontology derived from IPROnto, shown in Figure 9, that goes one step further from the static view.

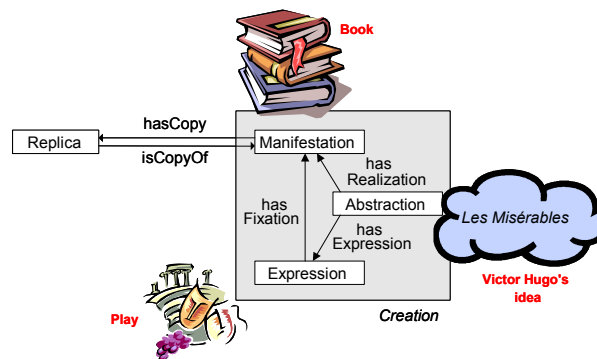


Figure 9. Creation subontology

Figure 9 shows the Creation subontology (the union of its abstract, material and temporal forms). These are the three points of view of a creation, the abstract, object and event perspectives that relate it to the upper level ontology from SUMO. For instance, if we take the creation *Les Misérables*, we observe its object view in a script, a book, etc. At the same time, its film projection would be the event part and all (script, book, film...) have in common an abstraction that comes from the original Victor Hugo's idea.

8. Implementation

IPROnto has been put into practise in the NewMARS project [21]. This project implements a broker-based application for digital content management. NewMARS supports a content

life cycle based on the IPROnto one presented in Figure 7. The web interface of the application offers two IPR roles: Customer and Content Provider.

The customer can search the IPR database where IPROnto based metadata is stored. The first step is to locate an interesting digital content. Currently, this can be done using the Dublin Core and MPEG-7 metadata attached to the digital contents managed by NewMARS. Once a digital content has been selected, we enter the IPR related area. The customer can look for available offers for that content. The offers can be accepted or negotiated.

On the other hand, content providers can register digital contents in the NewMARS IPR database. The registration is performed uploading IPROnto based descriptions that model the life cycle of the contents they are offering. These descriptions can model all the digital content life cycle events except the purchase license, which is created when a customer accepts an offer. The events the content distributor can register are creations, rights transfers, transforms and distribution contracts and licenses. Moreover, distributors can register offers for the content they manage in order to meet their customers.

The distributor methods have not been integrated in the web interface yet and IPR information is only available for video contents. However, all IPR events information can be viewed through the administrator's free search web interface.

9. Next steps

Since IPROnto tries to cover as much as possible of the IPR or DRM domain, it is open by definition. Although we have a stable version, different approaches or deeper details of some covered aspects could lead to an extension or modification of the ontology.

Many possible uses of IPROnto exist. We have explained one, NewMARS, an e-commerce application where we use IPROnto for negotiating digital rights.

However, we have new plans of work in the area, coming from our experience in MPEG-21. This standard is a multimedia framework that complements the previous MPEG standards that specify coding mechanisms for audiovisual material (such as MPEG-1, MPEG-2 and MPEG-4), and metadata schemas for content retrieval (MPEG-7). A few new parts of the MPEG-21 under-development standard deal with DRM aspects. The most relevant ones to this paper are a REL (Rights Expression Language) and a RDD (Rights Data Dictionary). These two standards, currently in the ISO/IEC FDIS (Final Draft International Standard) status since July 2003, specify how conformant applications interchange digital rights information, such as licenses.

One of our activities here is the development of the REL Reference Software [22], but we are also specifying a new DRM ontology that strictly follows the MPEG-21 RDD standard, so we have a clearly delimited scope.

10. Conclusions

We have introduced IPROnto, an ontology for the domain of Intellectual Property Rights (IPR). However, we are focussing on e-commerce applications in which multimedia content subject to rights is distributed, so we rather talk about Digital Rights Management (DRM).

IPROnto has a static and a dynamic view. The static view could be partly seen as a tree, where the different concepts are related. The paper gives some details on Agreements (Contracts and Licenses), Rights (Exploitation, Moral, ...) and the LegalEntity concept.

Furthermore, a content life cycle helps putting actors, events and rights into context.

The ontology helps developing DRM applications, like NewMARS, by changing the current syntactic approach of standards such as MPEG, to a more semantic-oriented approach.

We started IPRonto a few years ago at the same time that current REL (Rights Expression Language) and RDD (Rights Data Dictionary) MPEG-21 standards, but the current scope of IPRonto is wider. We are currently working in a subset of IPRonto that strictly follows these new standards so we can guarantee compatibility of applications.

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