Media Fragment Rights

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This section presents the semantic technologies promoted by the MediaMixer project in relation with computer supported copyright management. An overview of existing rights expression languages standards and initiatives are presented, together with their scope and limitations. Then, MediaMixer proposal based on semantic technologies and the Copyright Ontology is described.

The Copyright Ontology is a formal model of the copyright domain. It can be also informally described as a domain model, similar to what can be attained using software-modeling tools like UML, but using more expressive formalisms that also capture the domain semantics and use logic to facilitate their implementation.
The main difference, when compared to the previous rights expression languages, is that it does not focus just on the pieces required to model rights, what can an individual user or set of users do with a particular piece of content. The ontology goes to the roots from where what can be done with a creation is regulated, this is copyright law.

Consequently, the core of the ontology, as described next in more detail, are the rights defined by copyright law, the different forms creations take along their value chain and the particular events (verbs) that make creations move from one form to another (e.g. “to fix” generates a “recording” from a “performance”). Finally, to close the loop, the events are connected to the rights that govern them (e.g. the Reproduction Right regulates the “to fix” events).

These building blocks are at the core of copyright law and therefore are the basis for any contract or license dealing with creations. Therefore, the Copyright Ontology can be used as the way to formally describe any rights expression language and facilitate thus their implementation and the interoperability among them.

For instance, as described in the MediaMixer “User Generated Content Copyright Management”[1], the Copyright Ontology can drive digital operations decision support and help dealing in a scalable way with copyright management issues that require taking into account DDEX data2, one of the main standards for automating the exchange of information along the digital supply chain, together with clauses coming directly from talent contracts that set exceptions to be taken into account, for instance that Green Day doesn’t want their songs mixed with UGC showing violent images...

1 Purpose

Digitalization and the transition to a Web full of media, where video already amounts more than half of online consumer traffic[3], have introduced new scalability requirements like bandwidth exigencies, which technology is rapidly evolving to cope with. However, there are other limiting factors that are not scaling so well, especially those that have been traditionally slow moving like copyright.

As the amount of content made available through the Web grows, for instance 72 hours of video are uploaded to YouTube every minute[4], the problem of managing its copyright becomes even more relevant. Consequently, there is already a need to make rights management scale to a web of media, as pointed by recent initiatives like the Picture Licensing Universal System[5] or the Linked Content Coalition[6]. These initiatives, among others,

[1] MediaMixer UGC Use Case and Demo, http://rhizomik.net/mediamixer
[2] Digital Data Exchange (DDEX), http://www.ddex.net
[3] Cisco's Visual Networking Index,
http://www.cisco.com/en/US/netsol/ns827/networking_solutions_white_papers_list.html
[4] YouTube Statistics, http://www.youtube.com/yt/press/statistics.html
[5] PLUS, http://www.useplus.com
[6] Linked Content Coalition, http://www.linkedcontentcoalition.org

propose ways to represent and communicate rights so they can be automatically processed in a scalable way.

However, the issues associated with copyright management at a Web scale become even more complex when it goes beyond simple access control and takes into account also content reuse and the whole content value chain. In this case, rights representations need to be more sophisticated so they can capture the full copyright spectrum.

Proposed solutions should scale not just to a Web of media but also to a Web of media fragments. Fragments, accompanied by scalable copyright management for the full value chain, enable a potentially enormous re-use market.

The Copyright Ontology is implemented as a Web ontology that facilitates the representation and communication of rights and licensing terms over media assets in terms of their fragments. The ontology is based on Semantic Web technologies and integrates with the W3C Media Fragments Recommendation[7] to define and describe spatial and temporal media fragments.

The ontology makes it possible to underpin the media discovery and usage negotiation process, facilitating the automation of functionalities for rights management. Based on an explicit and interoperable semantic representation for the communication of rights, the ontology facilitates assessing the reusability of a given media asset fragment and eases bringing content onto this flourishing market. For instance, by interoperating with DDEX data[8], one of the main standards for automating the exchange of information along the digital supply chain.

2 Scenario

In order to contextualise the copyright technologies introduced in this chapter, an illustrative scenario about **User Generated Content** (UGC) copyright management is used. UGC is content created by users and shared through platforms like YouTube. Usually, it is the mix of content really generated by the user, like a wedding recording, combined with content owned by others, for instance the couple's favourite song by Adele.

To preserve rights holders rights on copyrighted pieces of content used without permission, UGC platforms provide content identification services so owners can register their content and be warned when it is reused. Though the first reaction might be to just block content reusing copyrighted media without authorisation, **UGC** platforms have generated a **new revenue stream** by sharing part of the **advertisement** revenue generated by content views if it is kept in the platform.

This is becoming an important revenue stream for owners of hits in UGC. However, this requires a big mind change in media management. To foster media remixing and viral reuse of content, content owners should move **away from content protection** measures like DRM that might prevent their content from being remixed. They should, however, focus on technological measures that **facilitate reuse** while **tracking** it and then **managing copyright**, not just at the end-user level but through the whole value chain of mixes and remixes.

The MediaMixer semantic technologies for copyright management are **based on copyright law** and thus provide the modelling tools to capture copyright statements from sources ranging from digital operations to talent contracts, as detailed in the Approach and Conceptualisation sections. Moreover, thanks to the reasoning features these technologies provide, these semantic models can be then used to support **intelligent decision support** at the **scale** of a media repository and its associated copyright statements. This is detailed in the Implementation section.

For instance, it is possible to help deciding the reaction to detecting that a song by Green Day, whose rights an organisation is managing, is being reused in YouTube, as shown in Figure 1. Should it be monetized and

[7] Troncy, R., Mannens, E., Pfeiffer, S., Van Deursen, D. 2012. Media Fragments URI 1.0 (basic). W3C Recommendation, 25 September 2012. http://www.w3.org/TR/media-frags/
[8] Digital Data Exchange (DDEX), http://www.ddex.net

streamed together with advertisements or simply blocked? With MediaMixer technologies it is possible to go beyond just choosing to monetize based on the limited information available at the digital operations stage. The objective is to **avoid the legal troubles** that might arise from ignoring, at that particular decision point, the fact that the talent contract with Green Day states "*we do not want our creations mixed with war images*".

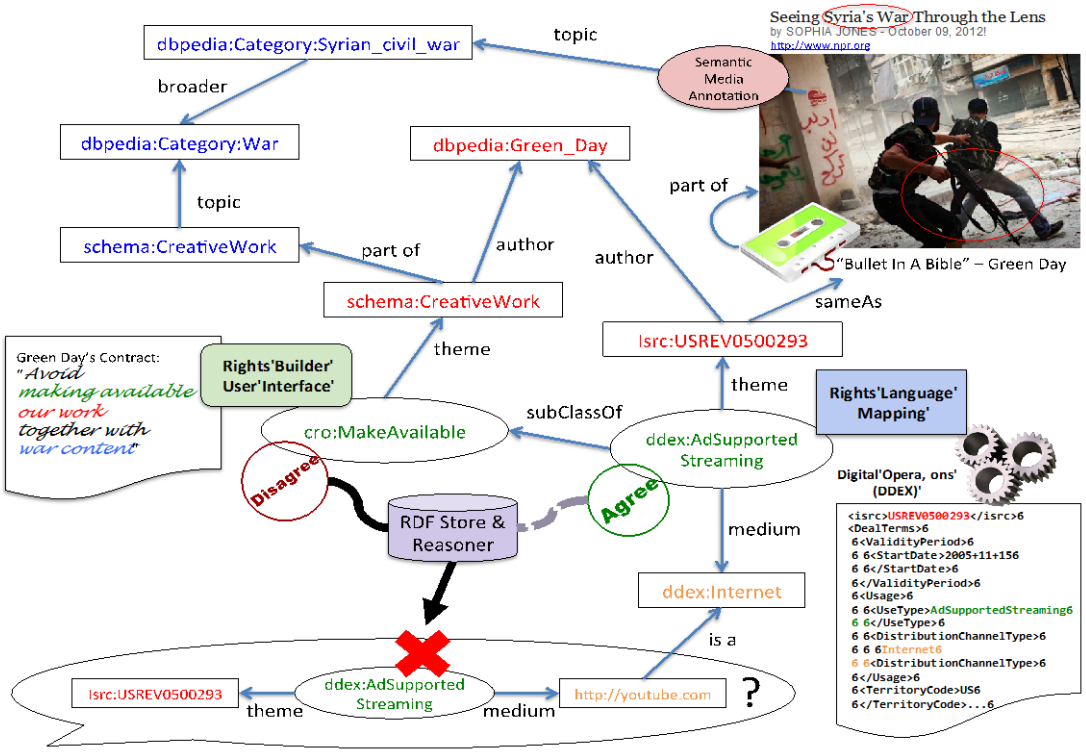

Figure 1: Using semantic data for decision support in the "UGC using Green Day's work with war images" scenario

3 Related Tools

The DRM Watch review on DRM standards [R08] shows that interoperability is a key issue for DRM systems. For instance, it arises in the content distribution scenario when a user wants to consume content in any of the devices they own. Interoperability is also critical in the organisation scenario, when content flows through organisations or external content is used in order to derive new one.

The main response to DRM interoperability requirements has been the settlement of many standardisation efforts. The main ones are ISO/IEC MPEG-21 [WDWPB05] and ODRL[9], and in both cases the main interoperability facilitation component is a Rights Expression Language (REL).

The REL is a XML Schema that defines the grammar of a license modelling language, so it is based on a syntax formalisation approach. There is also the MPEG-21 Rights Data Dictionary and a ODRL Data Dictionary Schema (DD) that captures the semantics of the terms employed in the REL, but it does so without defining formal semantics [GD05].

This syntax-based approach is also common to other DRM interoperability efforts and one of main causes of the proliferation of interoperability initiatives that cannot interoperate among them, like in the e-books domain [R09]. Despite the great efforts in place, the complexity of the copyright domain makes it very difficult to produce and maintain implementations based on this approach.

[9] Open Digital Rights Language (ODRL), Version 2, 2012. http://www.w3.org/community/odrl/two/

The implementers must build them from specifications that just formalise the grammar of the language and force the interpretation and manual implementation of the underlying semantics. This has been feasible for less complex domains, for instance when implementing a MPEG-4 player from the corresponding specification. However, this is hardly affordable for a more complex and open domain like copyright, which also requires a great degree of flexibility.

Moreover, the limited expressivity of the technical solutions currently employed makes it very difficult to accommodate copyright law into DRM systems. Consequently, DRM standards tend to follow the traditional access control approach. They concentrate their efforts in the last copyright value chain step, content consumption, and provide limited support for the other steps.

In fact, just Internet publishing risks are considered and the response is to look for more restrictive and secure mechanism to avoid access control circumvention. This makes DRM even less flexible because it ties implementations to proprietary and closed hardware and software security mechanisms.

The limited support for copyright law is also a concern for users and has been criticised, for instance by the Electronic Frontier Foundation [D05]. The consequence of this lack is basically that DRM systems fail to accommodate rights reserved to the public under national copyright regimes.

Consequently, the DRM world remains apart from the underlying copyright legal framework. As it has been noted, this is a risk because DRM systems might then incur then into confusing legal situations. Moreover, it is also a lost opportunity because, from our point of view, ignoring copyright law is also ignoring a mechanism to achieve interoperability. Therefore, DRM must evolve to Copyright Management.

It is true that copyright law diverges depending on local regimes but, as the World Intellectual Property Organisation[10] promotes, there is a common legal base and fruitful efforts towards a greater level of copyright law worldwide harmonisation.

A new approach is necessary if we want profit from the Internet as a content sharing medium. The existence of this opportunity is clear when we observe the success of the Creative Commons initiative, whose objective is to promote content sharing and reuse thorough innovative copyright and licensing schemes.

However, despite the success of Creative Commons licenses, this initiative is not seen as an alternative to DRM. The main reason is the lack of flexibility of the available licensing terms. There are mainly six different Creative Commons licenses, all of them non-commercial, and just an informal mechanism for extension and adoption of alternative licensing schemes, CC+[11].

A more generic and flexible step in this direction is the one by the Linked Content Coalition (LCC[12]). This initiative is promoting among industry a Rights Reference Model (RRM), which is formalised in the corresponding specification and a set of XML Schemas. However, though it is a rich and versatile model, based on accumulated experience and industry consensus, the model lacks a formalisation that facilitates validating the model, checking its consistency and streamlines its implementation. Here is where the semantic technologies promoted by the MediaMixer project can be put into practice to overcome these limitations, as shown in the next sections.

[10] WIPO, World Intellectual Property Organization, http://www.wipo.int
[11] http://wiki.creativecommons.org/CCPlus
[12] http://www.linkedcontentcoalition.org/

4 Approach

The Copyright Ontology modeling approach is event-oriented, i.e. the central elements of models based on the Copyright Ontology are events, things that happen. The process is inspired by the way we actually model the dynamic aspects of the world using our main knowledge representation tools, i.e. natural language. The central piece is the verb, which models the dynamic aspects and constitutes the core of natural language sentences.

Consequently, when modeling the ontology, the first step was to identify the verbs corresponding to the processes, situations, events, etc. in the copyright domain. These concepts constitute the main part of the model from the dynamics point of view, just the same role verbs play in natural language sentences.

This first step just identifies some concepts that are not enough to build complex expressions. In order to do that, the inspiration is also from how natural language sentences work. In sentences, the verb is connected to other sentence constituents, i.e. participants, in order to build expressions that fully model a process, event or situation.

This approach has been extensively used in the Natural Language research domain and more recently it has been also used in ontology and metadata vocabulary engineering, like in the schema.org[13] vocabulary. Table 1 shows some examples of case roles

Table 1: Case roles for event-oriented ontology modeling

Facet	Main role	Other roles
Who?	agent	participant (indirect co-agent), recipient
When?	pointInTime	start, completion, duration
Where?	location	origin, destination, path
What?	object	patient (changed), theme (unchanged), result (new)
With?	instrument	medium
Why?	aim	reason
How?	manner	
If?	condition	
Then?	consequence	

5 Conceptualization

This section details the Copyright Ontology conceptualization activity. This activity is guided by event-oriented pattern presented in the previous section. Due to the complexity of the copyright domain, the conceptualization is divided into two phases. The first one concentrates on the static aspects of the domain. Moreover, the static aspects are further divided into two different submodels due to its complexity.

First, there is the creation submodel, shown in Figure 2. This model is the basis for building the conceptual models of the rest of the parts. It defines the different forms a creation can take, which are classified following the three main points of view as proposed by many ontologies:

- **Abstract**: Work.
- **Object**: Manifestation, Fixation and Instance.
- **Process**: Performance and Communication.

[13] http://schema.org/Action

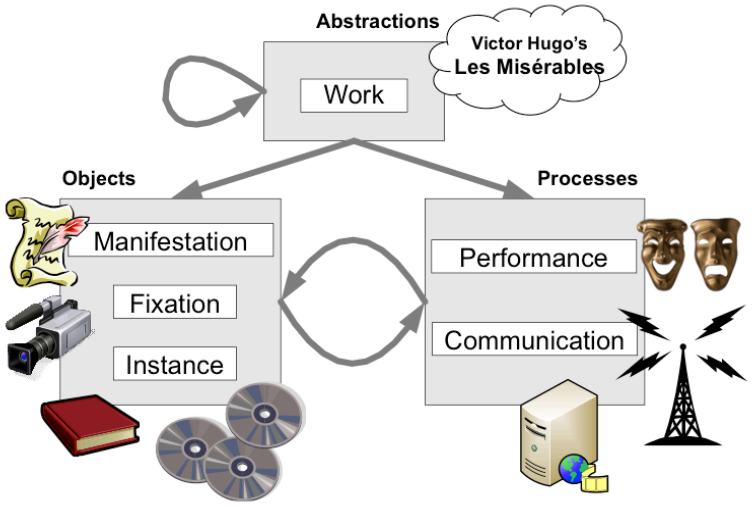

Figure 2: The creation model provided by the Copyright Ontology

Second, there is the rights submodel, which is also part of the static part model. The Rights Model follows the World Intellectual Property Organization (WIPO[14]) recommendations in order to define the rights hierarchy. The most relevant rights in the copyright management domain are economic rights as they are related to productive and commercial aspects of copyright. All the main rights in copyright law are modeled as concepts as shown in Figure 3.

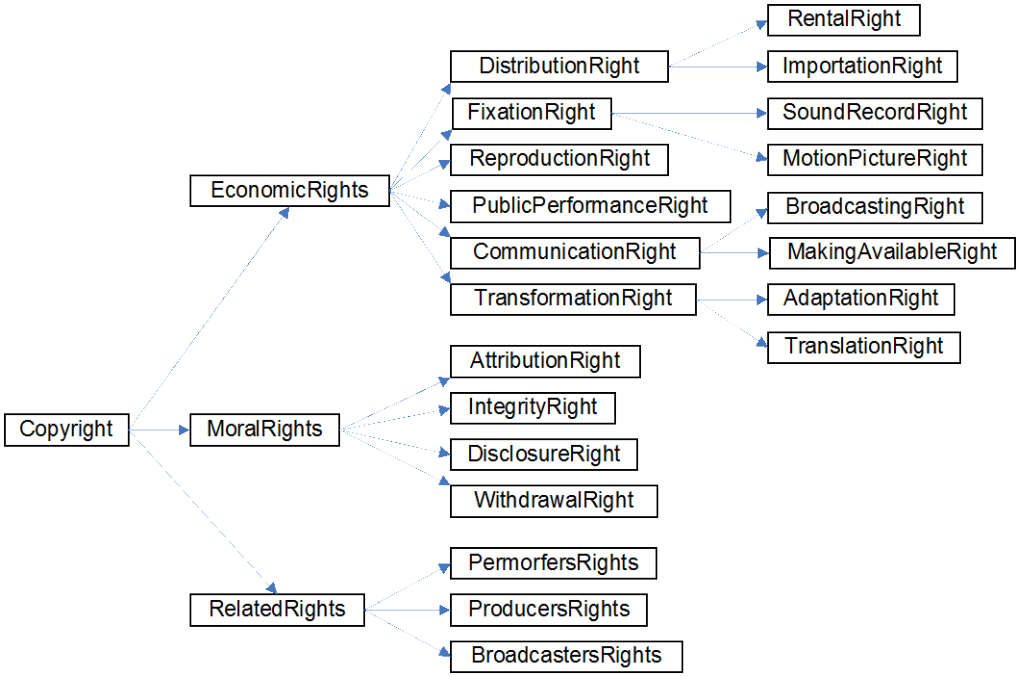

Figure 3: Rights Model in the Copyright Ontology

Each right governs a set of actions, i.e. things that the actors participating in the copyright life cycle can perform on the entities in the creation model. Therefore, it is time to move to the dynamic aspects of the domain. The model for the dynamic part is called the Action Model and it is built on the roots of the two previous ones.
Actions correspond to the primitive actions that can be performed on the concepts defined in the creation submodel and which are regulated by the rights in the rights submodel. For the economic rights, these are the

[14] WIPO, http://www.wipo.int

actions:

- **Reproduction Right**: *reproduce*, 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* when the subject is an object or *retransmit* when communicating a performance or previous communication, e.g. a re-broadcast. Other related actions, which depend on the intended audience, are *broadcast* or *make available*.
- **Transformation Right**: derive. Some specializations are *Adapt* or *Translate*.

At this point we have completed the first phase of the dynamic model part, i.e. the verb concepts have been identified. They constitute the key elements in order to build expressions that represent the processes, events and situations that occur in the copyright domain, as shown in Figure 4.

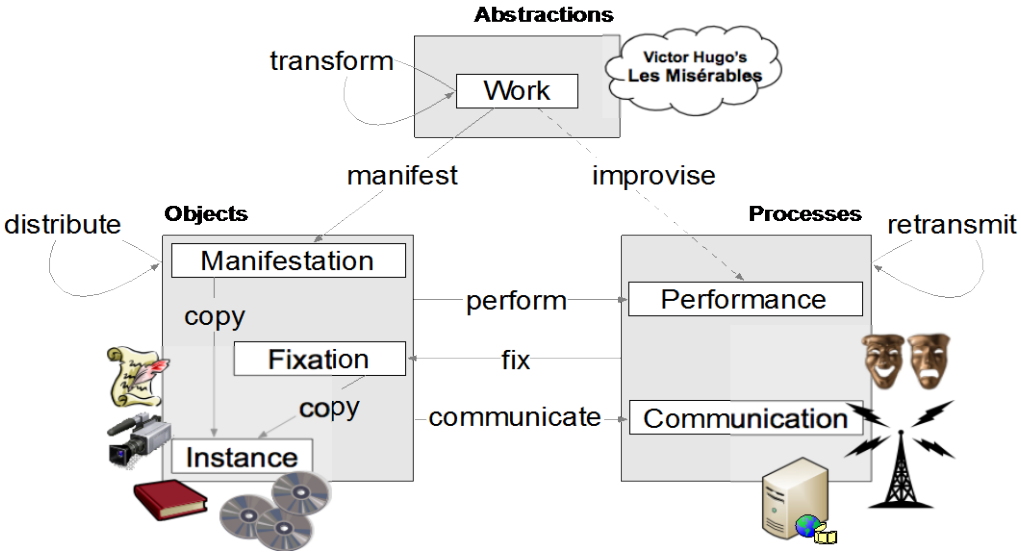

Figure 4: The creation model with actions moving creations along their value chain

With the previous pieces, it is possible to model a value chain, like the one shown in Figure 5 for a particular media asset, connecting the different creations involved and their evolution through the relevant actions to be performed to do so, which at the same time are connected to the rights governing them as presented before. For a detailed explanation of the Copyright Ontology as a media value chains modeling tool, and comparisons of it to other ways of modeling them like FRBR[15], there are more details in [GG10].

[15] Functional Requirements for Bibliographic Records, http://www.ifla.org/publications/functional-requirements-for-bibliographic-records

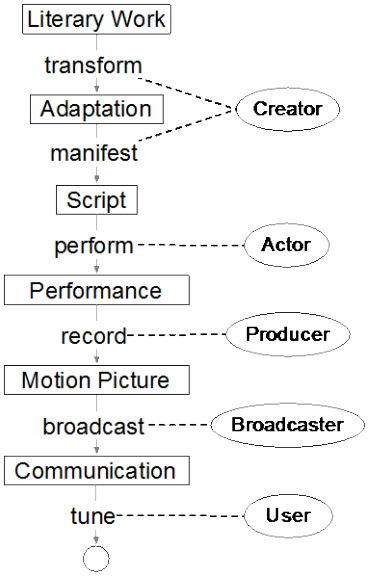

Figure 5: Value chain for a literary work, adapted into a script for a film that is then broadcasted

Finally, in order to build rights expression and relate the verb concepts to the other participants (persons, organizations, places, the asset being acted on, etc.), it is time to complete the dynamic model and detail for each verb concept the corresponding case roles.

For instance, if we consider the *Copy* action, copies have been traditionally the basic medium for *Work* commercialization. They are produced from a *Manifestation*, from a *Fixation* of a *Performance* or from another *Instance*. Therefore, these are the *theme* of the *Copy* verb as it is shown in Table 2. Another example of case role characterization for the Copy action is *result*, which has an *Instance* as expected value as this item employed for the physical commercialization of works, e.g. a DVD.

Table 2: Copy case roles

Case role	**Range**	**Cardinality**
agent	Person (Natural or Legal)	1..N
theme	Manifestation OR Fixation OR Instance	1
result	Instance	1
pointInTime	e.g. ISO8601	1
location	e.g. ISO3166, URL, ...	1
...	...	...

Based on the previous building blocks, the central part of Figure 6 shows an example model for expression build using the proposed pattern as it is applied to the *Copy* action. This kind of action patterns are also used to model licenses. Therefore, two additional verb concepts are identified and detailed using case roles: *Agree* and *Disagree*. They are the building block of any license. The figure also shows a license for the *Copy* action. As it is shown, the *condition* case role is used in order to introduce a compensation for the agent that grants the copy action, a 3€ transfer from the granted agent.

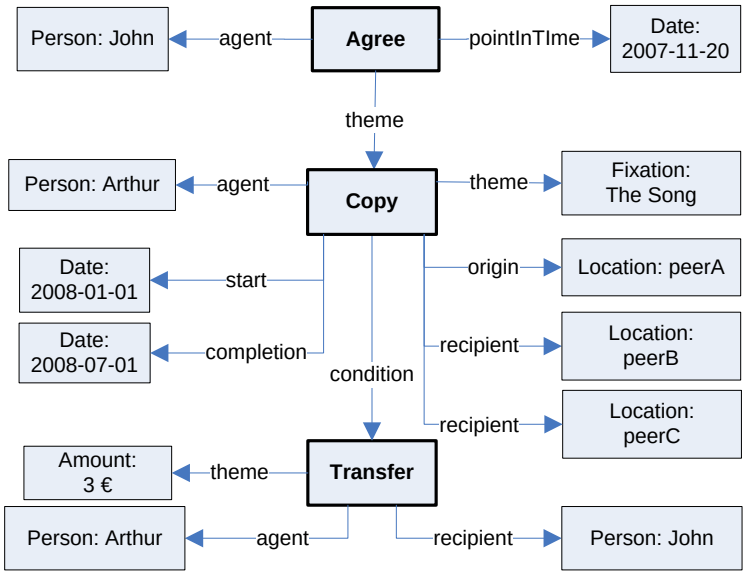

Figure 6: Model for an agreement on a copy action pattern plus a condition

The agreement *theme* corresponds to an implicit permission, i.e. the theme of an agreement is permitted. The *condition* relation corresponds to an obligation, i.e. in order to fulfill the theme action it is necessary to satisfy the pattern defined by the condition property object. Finally, it is also possible to model prohibitions using the *Disagree* verb concept and placing the prohibited action in the corresponding *theme*.

6 Implementation

A part from the Copyright Ontology conceptualisation presented in the previous section, there is an implementation[16] based on the Web Ontology Language (OWL). This implementation can be used to develop semantics-powered Copyright Management systems based on ontology reasoning [GG10]. Reasoners can be then used to provide:

- **Consistency checking**: detect if a set of licenses is consistent and thus it is authorising a set of actions that is not empty.
- **License checking**: based on the subsumption service provided by the reasoners it is possible to detect how licenses interact, for instance detecting licenses that completely include other licenses making them not necessary. It is also possible to perform license search based on example licenses, so it is possible to detect if there is a license that would provide the functionality of a fictitious one.
- **Usage checking**: based on the reasoned instance classification service to detect if a particular action, for instance copying a media fragment, is authorized by a set of licenses. This feature is based on the ability of reasoners to check if the action satisfies all the restrictions set by a license. For more details about this feature see[17].

The Copyright Ontology has been applied in real use cases, for instance involving DDEX rights data. DDEX data is used in this case as the way to communicate the rights associated to assets along the value chain. However, DDEX data does just model deals, which capture the kind of actions that can be performed with a particular asset or fragment in a given territory, time point, etc. They do not capture the existing copyright agreements that might make those particular actions legal or not. **Table 3** includes a DDEX example on the left column.

Consequently, if there is a dispute because an asset or fragment is detected under a conflicting use, it is difficult to determine if there is legal support to claim compensation. Many different DDEX deals might be involved and

[16] Copyright Ontology, http://rhizomik.net/ontologies/copyrightonto
[17] Copyright Reasoning Explained, http://community.mediamixer.eu/materials/presentations/copyright/view

even the agreements related with the involved assets might have to be manually checked. This is not feasible if the amount of disputes to deal with grows.

Table 3:DDEX data example (on the left) and the corresponding model based on the Copyright Ontology with a reference to a media fragment (on the right)

```
<Deal>
  <DealTerms>
  <CommercialModelType>PayAsYouGoModel
      </CommercialModelType>
    <Usage>
      <UseType>OnDemandStream</UseType>
      <DistributionChannelType>Internet
        </DistributionChannelType>
    </Usage>
    <TerritoryCode>ES</TerritoryCode>
    <TerritoryCode>US</TerritoryCode>
    <ValidityPeriod>
      <StartDate>2013-01-01</StartDate>
    </ValidityPeriod>
  </DealTerms>
</Deal>
```

```
<http://media.com/deals/3> owl:Class, msp:Deal;
  co:start "2013-01-01" ;
  co:aim  ddex:PayAsYouGoModel ;
  owl:intersectionOf (
    ddex:OnDemandStream
    [ a owl:Restriction ;
      owl:onProperty co:theme ;
      owl:hasValue
        <http://my.tv/video.ogv#t=60,100> ]
    [ a owl:Restriction ;
      owl:onProperty co:medium ;
      owl:someValuesFrom ddex:Internet ]
    [ a owl:Restriction ;
      owl:onProperty co:location ;
      owl:someValuesFrom
      [ a owl:Class ;
        owl:oneOf (territory:ES territory:US) ]
    ]) .
```

Parts of DDEX has been mapped to the Copyright Ontology, so DDEX data can be converted into Semantic Web data based on this ontology. This way, many different deals can be combined and taken into account to decide a dispute. Moreover, they can be also combined with other sources of information, like existing agreements once they are also formalized using tools like MediaMixer Rights Builder User Interface described in the MediaMixer "User Generated Content Copyright Management" use case[18].

Once combined, it is possible to use reasoners to easily implement the process of checking if the dispute being considered is supported by any of the existing deals or agreements. To do that, deals are modeled as OWL classes based on the intersection or union of restrictions on the deal action and its case roles.

These expressions define the set of actions that are authorized by a deal. The reasoner can be then used to check if, for example, an intended use modeled as an instance is inside the set defined by the OWL class and consequently it can be interpreted as supported by the deals and agreements under consideration. Or, on the other hand, if it is matched by a disagree, the it is interpreted that it is disallowed even if it also might match an agreement, as illustrated in Figure 7.

[18] MediaMixer UGC Use Case and Demo, http://rhizomik.net/mediamixer

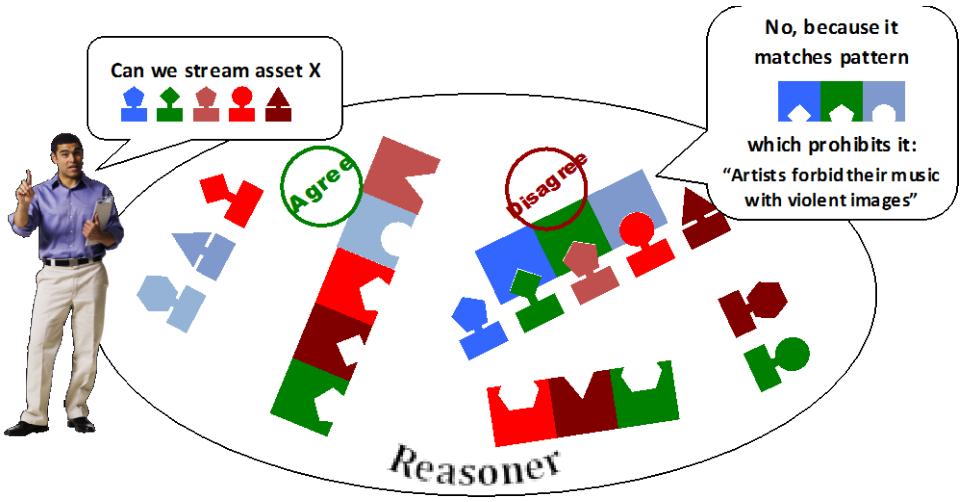

Figure 7: Copyright reasoning using the Copyright Ontology implementation

7 Licensing

The Copyright Ontology is licensed under a Creative Commons Attribution license (CC-BY). Therefore, it can be reused just requiring attribution of the original source.

The ontology is available from:
http://rhizomik.net/ontologies/copyrightonto/

In order to generate a license interactively, and based on the Copyright Ontology, there is the Rights Builder UI web tool freely available from:
http://rhizomik.net/mediamixer/rightsbuilderui/

Alternatively, if your organization already has the rights information available using a standard or custom rights expression language, it is possible to develop translator from them to the Copyright Ontology.

Right now, a DDEX to Copyright Ontology mapping service is freely available from:
http://rhizomik.net/ddex2rdf/

In order to visualize all the semantic data and navigate it, it is possible to use the generic tool Rhizomer, which can be downloaded from the corresponding project home, where its source code is also available under a GNU GPL license:
https://code.google.com/p/rhizomer/

Finally, in order to store and reason with statements based on the Copyright Ontology, a Semantic Web and Web Ontology Language enabled repository is necessary. MediaMixer has not developed a custom repository but uses one of the commercially available ones: OWLIM.

OWLIM can be downloaded from:
http://www.ontotext.com/owlim

There is an OWLIM-Lite version that can be downloaded and used free of charge for any purpose. Restricted versions of OWLIM-SE and OWLIM-Enterprise can be obtained free of charge for evaluation purposes.

8 References

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