Promoting Music Sampling by Semantic Web-enhanced DRM tools

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Abstract

The digital revolution has provided new incentives and facilities for content creation. Music has particularly benefited from this opportunity and creative processes like music sampling currently constitute their techniques in digital technologies. However, the digitisation has also carried some shortcomings, like the proliferation of DRM tools that menace traditional rights and usages.
This paper proposes to combine a sampling tool based on technologies and DRM tools developed by the Digital Media Project with a Copyright Ontology based on Semantic Web technologies. The ontology allows modelling copyright issues that traditionally allowed the creative process to continue without losing momentum.
In the context of sampling music, the private copy right is particularly important. It is modelled using the Copyright Ontology together with the whole sampling value chain in order to keep track of the involved works and actors. Users can enjoy the private copy right, but this does not mean that, if they make the results of their creative process public, the rights of the original creators are ignored. At this point, thanks to the tracking process and lightweight enforcement measures applied by the DMP-compliant sampling tool, the royalties' chain can be assembled and the corresponding measures based on metadata can take place.

1 Introduction

The authors of this paper are independent contributors to the Digital Media Project (DMP)[1]. Our goal is to use the DMP's Interoperable DRM Platform (IDP)[2] for a media and rights management system that facilitates and encourages media sharing and reuse in

[1] Digital Media Project, http://www.dmpf.org

[2] Chillout – IDP Reference Implementation, http://chillout.dmpf.org

the music sampling community. In order to do that, the DMP tools are combined with semantic web technologies and methodologies to build online communities where music is shared, reused and re-shared. The final objective is to build a copyright framework that formalises copyright law aspects as a conceptual and computable model. This framework, based on a copyright ontology, must be capable of incorporating what in DMP are called the Traditional Rights and Usages (TRUs) [1], i.e. the rights and usages that users of analogue media have enjoyed, many times backed by copyright law, and which are in risk in the DRM world.

A key TRU for sampling music is private copy, granted by the private copy right exemption in civil law countries, or the corresponding prerogatives in common law countries as part of fair use or fair dealing. Many DRM systems block any mechanism to copy, edit or store digital resources, even if the user intends to do so for private purposes. This fact makes sampling almost impossible in the digital world without circumventing measures applied by DRM systems. In order to produce a remix, sampling artists conduct an exploratory creative process, copying different samples from different musical works, adapting and merging them. All this is legal as long as all is kept private. Samples clearance must only take place when the creator wants to make the resulting creation public, i.e. to publish it online or to produce and distribute copies. If this exploratory and creative process is blocked by DRM systems, then sampling is clearly menaced.

Consequently, in this paper we explore mechanisms to take TRUs, and particularly private copy, into account when implementing a DMP-compliant sampling tool. First, we get into details about the problem statement in Section 2, which also presents an existing sampling tool and community, ccMixter. Then, Section 3 details the approach proposed in this paper. The sampling tool and the underlying DRM components are backed by a formal representation of the copyright framework, the Copyright Ontology. Section 4 shows how the Copyright Ontology can be implemented reusing Semantic Web tools in a quite straightforward way, how it is used to model the private copy right and how the DMP-compliant sampling tool supports the creative sampling process.

2 Problem Statement

A lot of music being released on the internet is protected by one of the Creative Commons licenses. The Creative Commons Sampling licenses[3] were designed to let creators and artists invite other people to use a part of their work and make it new. The ccMixter[4] site tries to solve the music sampling problem by building a web community where sampling artists can share their creations and permit sampling under Creative Commons licenses.

However, this license only applies on condition that sampled works are not used commercially, or the license grants also commercial use - which is not common - and it never applies when samples are intended for advertising. If a user wants to use one of the creations available at ccMixter to produce a work that is going to be used commercially, then the user must deal with the rights holder in the traditional way. No management system assists users during this process and no track remains in ccMixter. Moreover, users are restricted by the set of Creative Commons licenses available, just Sampling Plus

[3] Creative Commons, http://creativecommons.org

[4] ccMixter, http://ccmixter.org

and Non-Commercial Sampling Plus for the sampling domain. Finally, Creative Commons licenses are available in legal form for lawyers, in human readable "commons deed" for average users and in metadata form for computers. All in all, there is a lack of formal representations.

3 Approach

The Digital Media Project (DMP) develops specifications and builds software prototypes from its 'Primitive DRM Tools'. These smaller DRM related functions can be used to assemble different value chains according to specific business needs. The DMP's Interoperable DRM Platform (IDP) starts with a set of notions of how content information is packaged in an XML-based file format that includes an identifier, metadata, rights information, and so on - mostly based on MPEG-21 [2] standards such as Digital Item Description Language (DIDL), Intellectual Property Management Protocol (IPMP), and Rights Expression Language (REL) [3].
Then it includes a small set of core DRM functions that are assumed to be present in every device that can exercise rights to content, such as play and store. Part of the technologies specified within DMP has been submitted to MPEG for standardisation, e.g. ISO/IEC 23000-5 Media Streaming MAF [4].
Rights Expression Languages (REL) are used to express the rights to use content in a machine-readable form. For example, they could define embargos on pre-distributed content or make the end-user fill out a questionnaire before listening to some content. The main RELs are MPEG-21 REL, a standard which is based on XrML and is part of the MPEG-21 multimedia framework, and Open Digital Rights Language (ODRL) [5], the source for the REL used by the Open Mobile Alliance (OMA) [6].
The current DMP tools are backed by RELs that do not provide means to model the underlying copyright particularities. As it has been introduced, our main concern are Traditional Rights and Usages and particularly, in the case of music sampling, private copy. Consequently, we integrate DMP tools with an alternative approach to rights modelling, based on an ontology. The objective is to take profit from its greater expressive power, as compared to XML, in order to formalise the underlying copyright features, including the private copy right.

3.1 A Semantic Web Approach to DRM

The Semantic Web approach presented in this section aims at solving the limitations of the set of Creative Commons licenses available for sampling scenarios, but also for any other copyrighted content management scenario. This approach also complements and extends existing DRM technologies, more concretely the rights representation tools that these technologies incorporate. In the latter case, existing RELs lack the representation means to capture and formalise aspects related with the underlying copyright law.
The proposed framework must deal with the underlying legal aspects and, simultaneously, be automated in order to benefit from computerised support. This would make possible to extract all the potential from Internet-wide knowledge sharing and reuse with the support of accurate copyright management mechanisms.

The first objective is to overcome the limitations of purely syntactic approaches, like XML, and their lack of formal semantics. The best way to formalise semantics is to use ontologies in order to build an expressive and flexible computer-supported copyright management.
Moreover, as we want to operate through the Internet, the best choice is to use an ontology language that can operate through this medium. The clear choice is a Semantic Web ontology based on the OWL standard [7], which provides a set of primitives that make possible to build web-sharable conceptualisations.
The increased expressivity of web ontologies allows us to include the underlying legal framework into the formalisation and to build the rest of the system on top of it. This is a key issue because, in order to build a generic framework that facilitates interoperability, the focus must be placed on the underlying legal, commercial and technical copyright aspects.
This is the approach for the Copyright Ontology[5], detailed in the following section. The expressiveness and generality of the resulting conceptualisations allows coping with the shortcoming of existing approaches and, additionally, it can be used as an interoperability facilitator for the main DRM standards [8].
The ontology is implemented as an OWL Web ontology based on the Description Logic (DL) variant [9], OWL-DL. This implementation facilitates DRM systems development as license checking is implemented using existing Semantic Web reasoners.

3.2 The Copyright Ontology

The copyright domain is quite complex so we face its conceptualisation in three phases. Each phase concentrates on a part of the whole domain. First, the objective is the more primitive part, the Creation Model. Second, there is the model for the rights part, the Rights Model, and finally a model for the available actions, the Action Model, which is built on top of the two previous ones.

3.2.1 Creation Model

The Creation Model conceptualises the different forms a creation can take, which are classified depending on the top ontological points of view [10]:

- Abstract: something that cannot exist at a particular place and time without some physical encoding or embodiment.
    - **Work**: is a distinct intellectual or artistic creation. It includes literary and artistic works, music, pictures and motion pictures, but also computer programs or compilations, like databases.
- Object: corresponds to the class of ordinary objects and includes digital objects.
    - **Manifestation**: the materialisation of a work in a concrete medium, a tangible or digital object.
    - **Fixation**: the materialisation of a performance in a concrete medium, a tangible or digital object. Also known as recording.
    - **Instance**: the reproduction, copy, of a manifestation, a fixation or another instance.

[5] Copyright Ontology, http://rhizomik.net/ontologies/copyrightonto

- Process: something that happens and has temporal parts or stages.
    - **Performance**: the expression in time of a work. Performers or technical methods might be involved in the process.
    - **Communication**: the transmission of a work among places at a given time. It is a process performed when the public is not present at the place and or time where the communication originates. It includes broadcasts, i.e. one to many, but also communications from a place and at a time individually chosen.

There are many relations among the different forms a creation can take during its life cycle as it evolves from an abstract idea, i.e. a *Work*, towards something that can be consumed by end users, e.g. an *Instance* or a *Communication* or *Performance*. These relations are named following the same pattern, e.g. for a *Manifestation* there is the relation *isManifestationOf*, which relates it to the original *Work* that it materialises, and the reverse relation *hasManifestation*, that relates a *Work* to all its manifestations. Another interesting relation, in the context of this paper, is *isAdaptationOf*, which relates a work and all its manifestations to the work from with they derive.

3.2.2 Rights Model

The Rights Model follows the World Intellectual Property Organisation recommendations. It includes economic plus moral rights, as promoted by WIPO, and copyright related rights, see Fig. 1.

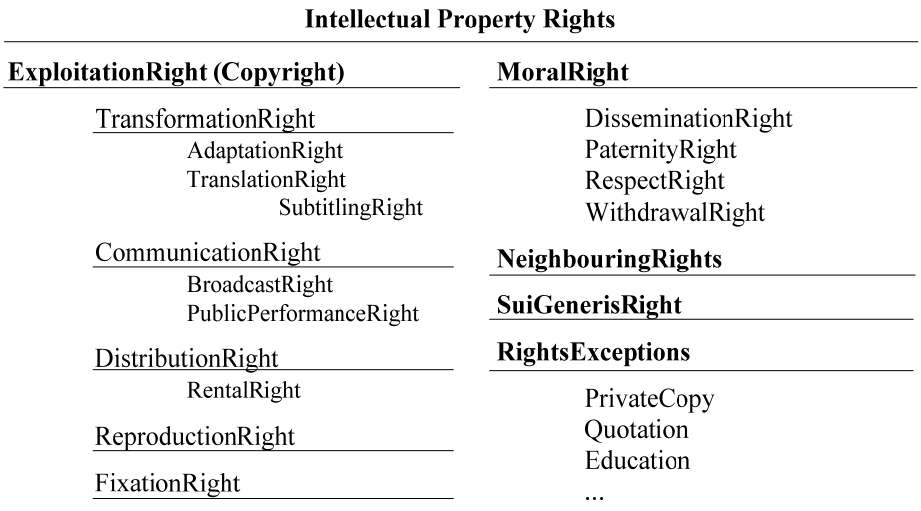

Fig. 1. The Rights Model in the Copyright Ontology

The most relevant rights in the context of DRM systems are economic rights as they are related to the production and commercial aspects of copyright. Reproduction, Distribution, Public Performance, Fixation, Communication and Transformation Right are the economic rights.

3.2.3 Action Model

The last model, the Action Model, corresponds to the primitive actions that can be performed on the concepts defined in the Creation Model, as it is shown in Fig. 2. Actions are regulated by the rights in the Rights Model. For the economic rights, these are the governed actions:

- **Reproduction Right**: *reproduce*, commonly speaking *copy*.
- **Distribution Right**: *distribute*. More specifically *sell*, *rent* and *lend*.
- **Public Performance Right**: *perform*; it is regulated when it is a public performance and not a private one.
- **Fixation Right**: *record*, or *fix*.
- **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 specialisations are *adapt* or *translate*.

One of the biggest criticisms against DRM systems is that they do not respect some special permissions that many copyright legal systems provide to end-users. These permissions are commonly called fair use, fair dealing or user rights. Although some of them are referred to as rights, e.g. the right to quote, they constitute exceptions to copyright and should be considered as end-user privileges and not rights.
These privileged actions, normally restricted by copyright, may be done without the authorization of the copyright owner in circumstances specified in the law. Moreover, these exceptions do not mean that the exceptional use is always free. Some require the user to pay a compensation. For instance, in some countries, there are levies on digital recording equipment and media.

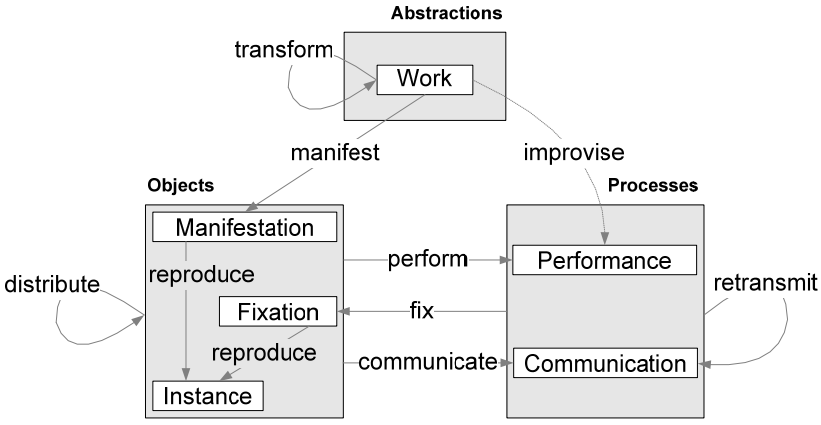

Fig. 2. Relations between the Action and Creation Models

These are the main copyright exceptions:

- **Quotation Right**: quote, a limited extent *reproduce* action of a source protected work, which is clearly mentioned.
- **Education Right**: educational act, any *reproduce*, *communicate* or *perform* action with educational or research purposes.

- **Information Right**: *inform*, any copyright governed act with informative purposes.
- **Official Act Right**: official act, any copyright governed act that is part of an official act.
- **Private Copy Right**: reproduce privately, a *reproduce* act that produces a reproduction solely for private consumption.
- **Parody Right**: parody, any copyright governed act with parody or caricature purposes.
- **Temporary Reproduction Right**: reproduce temporally, a *reproduce* act that produces a temporal reproduction.

The action concepts are complemented with a set of relations that link them to the action participants. This set is adopted from the linguistics field and it is based on case roles [11]. The case roles in the Action Model are shown in Table 1. For instance, the *theme* case role links an action, i.e. a verb, to an object of the action that remains unchanged after the action completes, as opposed to *patient* that point to an object that suffers some sort of change as a result of the action. There are four case role categories, table heading, and six verb facets, first column.

	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

Table 1: Action Model case roles

The previously introduced pool of primitive actions and case roles allows building models for events and value chains in the copyright domain. For instance, Fig. 3 shows how we can build a model for the sampling value chain.

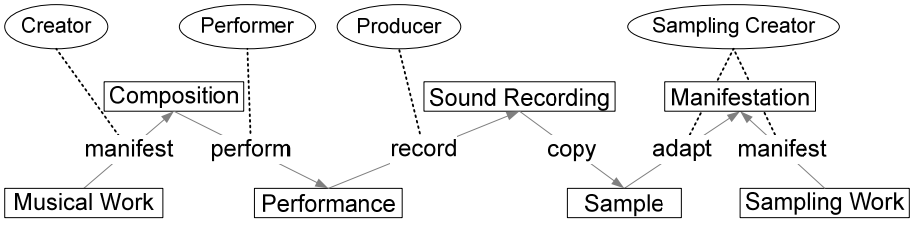

Fig. 3: Sampling value chain

This is just the skeleton of the value chain. In order to give a more detailed model, each step in the value chain should be modelled as an event for the corresponding action and associated participants through case roles.
However, the objective is not just to model the actual events that capture the life cycle of a given creation. Prior to these events, licenses among the involved parties are established in order to govern the value flux. Consequently, the ontology must be enriched with permissions, prohibitions and obligations [12].

3.2.4 Modelling Copyright Licenses

Copyright provides a legal framework that governs creations life cycle and tries to assure a fair compensation for all the involved parties, from authors to consumers. Copyright licenses are built on top of this legal framework and establish the terms for concrete interaction among these parties.
Licenses should capture the obligations, permissions and prohibitions that make sense in the copyright domain. The semantics of the license terms are captured by the ontology described so far, but it lacks the terms that capture the semantics of obligations, permissions and prohibitions.
In order to produce a homogeneous and usable conceptualisation, we have incorporated these terms in the ontology using the concepts that capture the semantics of obligations, permissions and prohibitions as they appear in licenses from a natural language point of view, i.e. using the corresponding actions and case roles (e.g. the verb to agree on a specific action as the natural way to model a permission).
The first building blocks for licenses are event patterns. They are the way to state what is obliged, permitted or prohibited by a license and referenced from policies that establish their modality. The ontology terms described so far capture them naturally because the proposed actions and case roles are used to model event patterns in the copyright domain.
For instance, Fig. 4 shows a pattern for a copy event in a sampling scenario. It is performed by an agent, the sample creator identified by its X500 certificate, who copies a sound recording identified by its ISRC[6] code and gets any sample, i.e. any object that *IsPartOf* the original fixation.

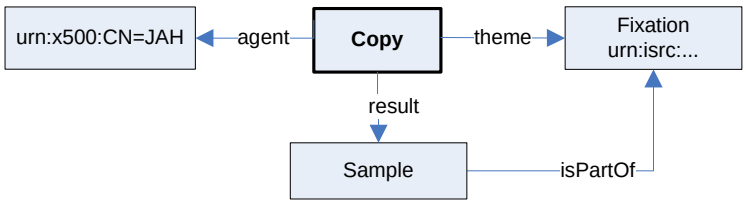

Fig. 4: Pattern for an action in the sampling scenario

Then, there are the terms to state the modality of these event patterns in copyright contracts. The objective is to state that the set of actions corresponding to the event pattern is permitted, obliged or prohibited, depending to the particular term that is attached to the pattern.
Permissions are captured by a new action class, *Agree*, and the permitted pattern is linked using the *theme* case role, whose semantics are to point to the object of an action.

[6] International Standard Recording Code: standard identifier for audio and video recordings

Following with the example in Fig. 4, in order to authorise the pattern that it models, an agreement like the one shown in Fig. 5 can be modelled. The agreement by the rights holder of the sampled sound recording authorises the pattern pointed by the *theme* case role, the copy pattern in Fig. 4.

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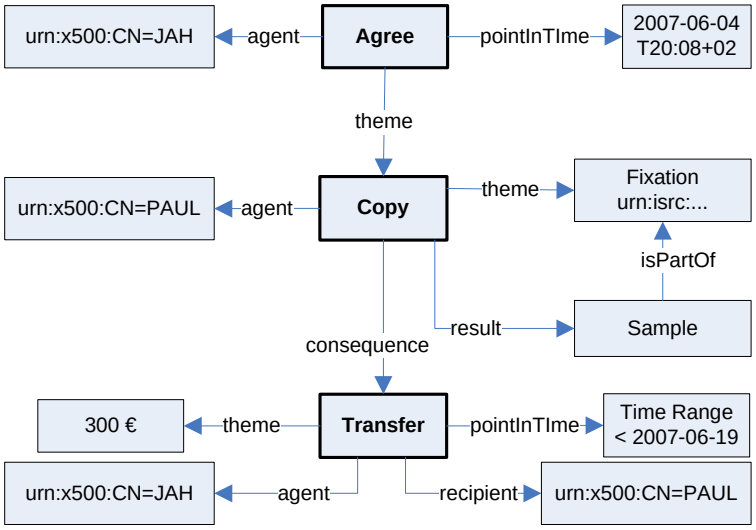

Fig. 5: Agreement that allows copying a sample of a sound recording and whose consequence is an economic obligation

Obligations are captured as event patterns that must be satisfied at some time point after the event pattern that triggers the obligation is exercised. They are modelled using the *consequence* case role that links the triggering pattern to the one that is obliged.
For instance, in the bottom part of Fig. 5 it is stated that, if the copy action is exercised, the consequence is that sample creator Jah must transfer 300 euros to the sampled fixation rights holder Paul before a given date specified by a time range.
On the other hand, prohibitions are captured by another action, *Disagree*. Like for the *Agree* action, the *theme* case role is used to link it to the object of the action, in this case to the pattern that is prohibited.
Finally, there are also patterns that must be satisfied in order to activate the evaluation of another event pattern, thus acting as a precondition. The *condition* case role is used to model guards. It is applied to the pattern that is guarded and it links to the pattern that establishes the precondition. The approach is similar to the obligation case captured by the *consequence* case role but, in this case, the *condition* case role establishes an a priori condition.

3.3 OWL Implementation

The previous conceptualisation is just an abstraction of the copyright domain. An implementation is required if we want to use it to build a computerised copyright management system. The Semantic Web approach is also productive in this respect because existing tools can be used to make the implementation quite straightforward.

The ontology has been implemented using the DL variant of the Web Ontology Language (OWL-DL), which is constrained in order to be managed by Description Logic (DL) reasoners. Such reasoners guarantee that OWL-DL ontologies can be put into practice, i.e. reasoned over, in a decidable and tractable way.
Existing DL reasoners are used to automatically check if actions on copyrighted content are authorised or not. As it has been shown, licenses are composed of *Agree* or *Disagree* actions, linked through a *theme* relation to patterns of actions that are correspondingly authorised or forbidden.
The pattern is implemented as an OWL class made up from the combination of classes for actions, e.g. *Copy* or *Access*, and a set of OWL Restrictions. Each restriction defines a constraint on how members of the class, the domain, are related through the specified property to other ones, the range class. The available restrictions are:

- **allValuesFrom**: all the values for the range of the restricted property must pertain to the given class. For instance, all values of the *agent* relation must pertain to the *Publisher Subscribers* class or, for the *pointInTime* relation, to the time range [2007/01/01–2007/06/30]. In order to support the later, custom datatypes reasoning is required [13].
- **someValuesFrom**: there is at least one value that pertains to the given range class.
- **hasValue**: the range is limited to a specific individual, not a class of them. For instance, the *theme* of a *Copy* action must be the individual "doi:10.1032/…".
- **cardinality**: this restriction limits the number of individuals that can be connected through the restricted property. A maximum, minimum or exact cardinality can be defined. For instance, the *recipients* of an action can be limited to just two individuals.

The constraints on the kinds of actions, their agents, time points, etc. are implemented using OWL Restrictions, which are combined using the logical operator in the OWL language, i.e. intersection, union and complement. Table 2 shows the pattern build up from the combination of such kind of restrictions for the example presented in Fig. 4 using DL notation. Note that the consequence is not considered at this stage, as it is checked a posteriori. However, the implementation approach for consequences checking is the same, i.e. using DL and a reasoner.

Pattern ≡	Copy ⊓	(1)
	∃theme.{urn:isrc:…} ⊓	(2)
	∃result.SamplesOfGivenWork ⊓ (= 1 result) ⊓	(3)
SamplesOfGivenWork ≡		(4)
	SoundRecording ⊓ ∃isPartOf.{urn:isrc:…}	(5)

Table 2. OWL-DL Class that implements the copy action in Fig. 4

Each intersected restriction reduces the initial set of actions, which corresponds to all the *Copy* actions (1). First, (2) restricts to just copies of the particular sound recording urn:irsc:... through the *theme* case role. Then, (3) states that the *result* of the action is just one instance of the SamplesOfGivenWork class. This class, defined in (5), corresponds to all sound recordings that are part of the sound recording urn:isrc:... that is the *theme* of the copy action.

From this point, the implementation is quite straightforward. DL reasoners are specially suited for classifying individuals into classes when the later are based on necessary and sufficient conditions. They can answer if an individual, considering its relations to other individuals and attribute values, satisfies all the restrictions of a class pattern and, thus, can be classified as an instance of that class.
In the context of the Copyright Ontology implementation, this functionality is used to check if a particular action, modelled as an individual, is allowed or not by a license. This corresponds to the fact that the action individual is classified into a class pattern that is the *theme* of an *Agree*. Another reading is that the license agrees on performing a set of actions that includes the requested one.
However, before the actions are authorised, it is also necessary to check that any existing *condition* is met and that there is not a single disagreement on the actions. The DL reasoner is also useful for this part. It checks if the precondition pattern is instantiated, so the precondition is satisfied, and that the checked action is not classified into a class pattern that is the theme of a *Disagree*.
To sum up, it is checked that there is an agreement on the action and no disagreement, and that the precondition is satisfied. This behaviour allows modelling complex licenses and revocation. When the expressivity of OWL-DL is not enough, Semantic Web rules [14] can be combined with OWL-DL expressions in order to get increased expressivity. This is particularly useful when named variables are needed because OWL-DL does not provide them. More details about the Copyright Ontology implementation in order to get a Semantic DRM System are available from [15,16].

4 A DMP compliant sampling tool

The ccMixter initiative introduced in Section 2 illustrates how a web community and some permissive licenses can liberate artistic development that would have been limited by restrictive copyright practices.
However, ccMixter is useless for the commercial deployment of musical works, because commerce requires a more sophisticated model for rights clearing. The ccMixter platform is missing methods and techniques for trading the rights to utilize existing works between rights holders and creators of new works.
The Interoperable DRM Platform (IDP) specified by DMP handles the protection of those resources a user wants to publish in a governed fashion. Resources (e.g. musical works) can be governed only by means of a license (Open Release-like approach) or by means of additional DRM-Tools (e.g. tools to encrypt resources). The DMP Content Creation Device (CCD) allows the content creator to apply the DRM-Tools of his choice when content is authored. Governed content will be exchanged between IDP Users as Digital Items (DI) with unique content identifiers.
We can think about a resource with a license that grants the right to create samples, as shown previously in Table 2, and also to use them in order to produce a new work, as shown in Table 3.
Then, A DMP compliant sampling tool, which can be considered a DRM-Tool, could enable a creator (e.g. a music performer) to edit and remix samples of existing governed content in order to create new resources.

AdaptPattern ≡	Adapt ⊓	(1)
	∃source.SamplesOfGivenWork ⊓	(2)
	∃theme.{urn:isrc:…} ⊓	(3)
	∃result.SamplingWork ⊓ (= 1 result)	(4)
SamplingWork ≡		(5)
	SoundRecording ⊓ ∃isAdaptationOf.{urn:isrc:…}	(6)

Table 3. OWL-DL Class that implement the Adapt pattern

For this purpose the music performer's Content Creation Device (CCD) un-packages Digital Items (DI), decrypts their resources and accesses the samples with a sound editor. The music performer modifies and remixes the samples using the editor assuming that through his music sampling he is creating an original work. The resource containing the finalized remix will be packaged by the music performer's CCD as a new Digital Item.

The Copyright Ontology can be used to build a generic framework where different sampling policies can be plugged in giving rise to different sampling business models and communities. The idea is to use the *isPartOf* and *isAdaptationOf* relations, which are metadata that the tool must generate in order for the copy and adapt actions to be granted. These metadata will facilitate royalties sharing when a work in the chain is used for commercial purposes.

The DMP compliant sampling tool will allow for any copyrighted Digital Item containing a musical work to be sampled, track user actions and generate metadata for the *isPartOf* and *isAdaptationOf* relations augmented with information about the size relative to the original works. As long as a remix stays in the private domain of the music performer's Content Creation Device, it can be considered a private copy. Thus remixing and sampling of governed content will be possible within the DMP environment.

If a music performer wants to publish a remix, he can use these metadata to find out the licensing fees demanded by the owners of the copyright for the sound recordings and the owners of the copyright for the underlying musical works. This freedom to detect the license fees for sampling a musical work will be a major advantage compared to the current legal uncertainty.

If the licenses of the samples require attribution of the original authors, the music performer knows that he must include information about them in the metadata of his content. If the licenses of the samples allow the creation of derivative works (e.g. adaptations), the music performer knows that he is on the safe side.

However, in a DRM environment it could be a problem that sampling is impossible because licenses are not explicit about the sampling policy and because all copy actions are blocked by default, even if they are intended for private purposes. At this point, we argue that this situation can be smoothed out thanks to the fact that the Copyright Ontology models the underlying copyright issues and these include the private copy right, as it is detailed in Section 4.1.

Therefore, a copy action for private purposes can be allowed within the DMP environment and allow the creative process to continue. The freedom to make a private copy does not mean that the corresponding metadata connecting music works, their samples and their derivations is not generated using the *isPartOf* and *isAdaptationOf*. These metadata are generated and kept private by the sampling tool as long as the

resulting remix is kept private. If music sampling works created this way are made public, then metadata will be used in order to detect the involved parties and compute the rights clearance of the involved samples, or to trigger the license negotiation process that establishes the corresponding conditions.

4.1 Private Copy

All copy actions performed by any person on any content instance that have as a result a replica instance and whose aim is private should be allowed. The corresponding model is shown in the upper part of Fig. 6. The *private* term is modelled as the value of the *aim* case role.

In order to detail further this key aspect, there is also an agreement on any use of the resulting instance by any agent directly related to the person that produced the private copy, which is shown in the bottom part of Fig. 6. Any other use by persons not directly related is not allowed if it is not explicitly granted.

Two things must be highlighted about the second agreement. First, the *isDirectlyRelatedTo* relation is used as a way to model direct relations among people and tries to capture the private essence, e.g. family, friends, etc. Second, the variables "?x" and "?y" are used in order to state that the relation must hold to the same person that performed the copy and to the same resulting instance.

Named variables are not available in OWL-DL so they are captured by Semantic Web rules. In this case, a rule is in charge of generating the event pattern and the second agreement using the copy pattern as input. Whenever an action is classified as an instance of the copy pattern, the rule is triggered and it asserts the agreement with the event pattern class for the concrete person and instance.

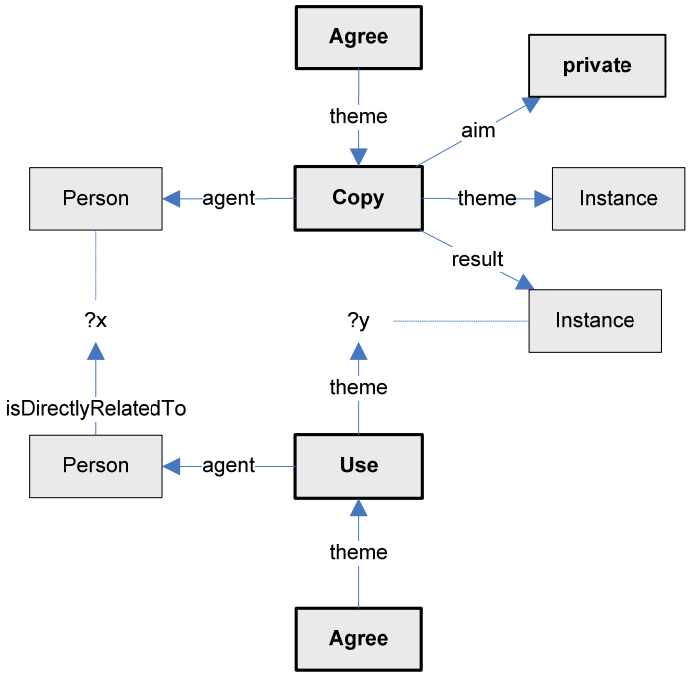

Fig. 6. Model for the "Private Copy Right"

Fig. 7 shows how the action checking works for the private copy permission. The event pattern appears as a subset of the general Copy class because it is built from the intersection of Copy and the other restrictions. A particular copy action is shown and as it states that its aim is private and that it is performed by a person on an instance producing another instance, it is classified inside the previous event pattern. The pattern is the theme of an *agree*, as shown in Fig. 6, consequently the action is granted.

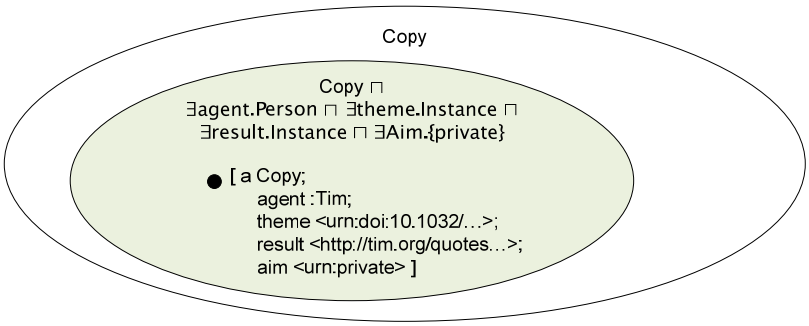

Fig. 7. Implementation of the Private Copy TRU using
classes (DL notation, ovals) and an instance (N3 notation, dot)

The previous event pattern matching also triggers a rule that asserts the event pattern that grants people directly related to the replica creator to use it. Consequently, from this moment, any use that is classified into the class corresponding to the pattern will be granted.

To conclude, it is important to note that the ontology focuses on modelling the TRU, not on enforcing it. In fact, the ontology might be also used to support DRM systems based on accountability. The previous actions are just annotated and they are legal as long as there is not any counter evidence.

For instance, it could be discovered that the person using the copy is in fact not directly related to the replica maker. Consequently, the DL reasoner would detect an inconsistency because the class of persons directly related to another one is disjoint with the class of persons that are not directly related to this same person.

However, if DRM enforcement is in place, the private use part of the model, and more specifically the *isDirectlyRelatedTo* relation, can be enforced, for instance using some sort of device domains and encryption measures as the ones specified by OMA [6].

5 Conclusions

Traditionally “private use” implied to use personal property without any reference to another authority. With the introduction of DRM system the concept of private use of content undergoes a radical change. A rights-holder expresses in a license how an end-user can use a device in conjunction with a content item. By accepting the license terms the end-user confirms that she will use the content in the way intended by the rights-holder.

Some DRM functionalities are on the verge of doing away with private use. For instance the MPEG-21 Event Reporting technology (ISO/IEC 21000-15) enables rights-holders to

track the actions end-users and send back so-called event reports to the rights-holders device. We believe that a license agreement requiring Event Reporting for content usages in the private sphere underpins the freedom of art.
Artistic freedom means that rights-holders must not seek to affect the manner in which a music performer goes about his business, the material he selects, or the way in which he treats it, and certainly not seek to narrow the area in which he may operate or lay down general rules for the creative process. Permanent monitoring inhibits the free development of the creative artistic endeavor.
As traditional rights and usages of digital content are gradually constitutionalised through DRM it is therefore essential to technically maintain and support license agreements that permit creative usages and the idea of an autonomous private domain where the end-user can act on digital content of his choice in ways that were not anticipated by anybody.
The proposed Semantic Web approach to copyright management constitutes an alternative because it allows to model copyright exceptions that traditionally safeguarded the creative process to continue without losing momentum.
In the context of sampling music, the private copy right is particularly important. It has been shown how this right can be modelled and, at the same time, how the whole value chain can be modelled in order to keep track of the involved works and actors. Users can enjoy the private copy right, but this does not mean that, if they make the results of their creative process public, the rights of the original creators are ignored.
At this point, thanks to the tracking process and lightweight enforcement measures applied by the DMP-compliant sampling tool, the royalties' chain can be assembled and the corresponding measures based on this metadata can take place.

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