Enhancing Electronic Contracts with Semantics. The Case of Multimedia Content Distribution

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Abstract. Multimedia content can be digitally distributed to end users or in B2B transactions. While B2C distribution has been extensively carried out by digital platforms governed by digital licenses, B2B multimedia content exchange has received less attention. The digital licenses for end users have been expressed either in proprietary formats or in standard Rights Expression Languages and they can be seen as the electronic replacement of distribution contracts and end user licenses. However RELs fail to replace the rest of the contracts agreed along the complete Intellectual Property value chain. To represent their corresponding electronic counterpart licenses, an schema based on the Media Value Chain Ontology is presented here. It has been conceived to deal with a broader set of parties, to handle typical clauses found in the audiovisual market contracts, and to govern every transaction performed on IP objects. Contract clauses are modelled as deontic logic propositions, and an event-based system is described to allow a DRM system the execution of the contract.

Keywords: Contract, license, DRM, Intellectual Property, Ontology, MPEG-21, REL, ODRL, Semantic Web.

1. Introduction

DRM (Digital Rights Management) systems for the distribution of multimedia content have been present since the last decade. On despite of the controversy arisen around its mere existence, DRM systems have striven to preserve the Intellectual Property (IP) of artistic creations in digital format.

However, consumers have been reluctant to accept the restrictions imposed by these DRM systems, and content distribution has been diverted to a large extent in alternative channels where Intellectual Property rights have been ignored. Nevertheless, although DRM systems for distribution of multimedia content to the end user may have failed to prevent illegal copies, they have proved to be a technological success and they have provided solid channels for a fair trade. On despite of the folk conceptions, '*DRM*' is not only protection, but also, and essentially, management.

The market of audiovisual content is a complex ecosystem with many different players and commercial interests besides the B2C segment. From the very original idea in an author's mind until the final product, there have been some other intermediate IP objects along this process (this process is

called *value chain*), and they are subject to possible trade too. It is the case of the B2B trading of rights on compositions, concerts, editions, broadcastings, etc. In this B2B sector the regulations and commercial agreements have remained largely up to date in the analogue world. These contracts include author contracts, performance contracts, synchronization contracts and edition contracts among others and all of them revolve around the idea of IP.

For the case of B2B commerce of multimedia content, the need for controlled trade under the terms of the law has been undisputed, but only timid ecommerce platforms have been deployed. When multimedia material is purchased not for venial leisure time but for business, formal written contracts are offered, agreed and observed. These contracts are paper contracts (often referred as *narrative contracts*) and they are signed personally. Their negotiation, management and execution rely in the traditional methods, and its expression is not substituted at all by digital licenses.

Lack of trust on electronic transactions is not the only reason explaining the disappointing spread of DRM systems in the B2B transactions of multimedia material. We can find the reasons in the insufficient scope of current Right Expression Languages (REL) and the lack of formalism in electronic contract representations among other problems.

RELs allow the specification of licenses in digital files, usually as XML, in which one party gives another party certain rights over a resource given that certain conditions are satisfied. However, current RELs are not expressive enough to model the agreements arranged along the Intellectual Property Value Chain, and this chapter gives an overview of new more expressive representations based on the Web 3.0 technologies.

On the other hand, the existing electronic contract representations lack the required formalism for ecommerce platforms to be governed.

This chapter will show how to integrate the most prominent electronic contract format (OASIS eContracts) with formalised expressions able to run B2B DRM platforms. The Media Value Chain Ontology (MVCO), a domain ontology of the IP value chain, will serve as a basis model to represent the core information of the agreements and eventually govern a DRM system. This representation will be able to express contract clauses (obligations, permissions or prohibitions) appearing in typical contracts.

2. Overview of electronic contracts formats

This section reviews the existing electronic contract formats and studies their ability to govern a DRM system.

Contracts are legally binding agreements and they are made of mutual promises between two or more parties to do (or refrain from doing) something. The terms of a contract may be expressed written or orally, implied by conduct, industry custom, and law or by a combination of these things. Contracts can also be digitally represented: a contract whose representation can be understood by computers is called *electronic contract*, and it may allow DRM systems to control it and execute it or enforce it automatically.

Narrative contracts are passive in the sense that once they are signed, their prominence only arises in case of dispute. Electronic contracts in a DRM system are active as they play an important role in the execution of the contract.

The earliest electronic contract representations were born together with the electronic commerce and the first Electronic Data Interchange (EDI) standards. EDI has been of huge importance in the industry, and comprises a set of standards for structuring information to be electronically exchanged between and within businesses, organizations, government entities and other groups.

COSMOS (Kobryn, 1998) was an e-commerce architecture supporting catalogue browsing, contract negotiation and contract execution. It defined a contract model in UML and proposed a CORBA-based software architecture in a coherent manner. UML is a highly expressive language, but its representation cannot be directly mapped to a formal system.

DocLog (Yao, 2000) was an electronic contract representation language introduced in the 2000 with a 'XML like' structure, which anticipated the next generation of XML-based contract representations. When XML was mature enough it was seen as a good container of contract clauses, and thus the new format specifications came under the form of a XML Schema or a DTD. An effort to achieve a common XML contract representation was the Contract Expression Language (CEL) (CRF, 2002), developed by the Content Reference Forum. It formalized a language that enabled machine-readable representation of typical terms found in content distribution contracts and was compliant with the Business Collaboration Framework (Hofreiter, 2004), but it was not finally standardized.

In the following years, the advent of the Semantic Web reached the contract expression formats, and new representations evolved from the syntactic representation level to the semantic one (Kabilan, 2003; Llorente, 2005; Yan, 2006) being developed domain ontologies in the KIF or OWL languages.

Still climbing levels in the Semantic Web layered model, RuleML first and SWRL after were enacted as the new model container for electronic contracts, given that a contract declares a set of rules (Paschke, 2005). SWRL provides a Web-oriented abstract syntax and declarative knowledge

representation semantics for rules; but the concrete syntax can have the form of a RDF schema, thus providing a seamless integration with OWL ontologies. Some of these contract models have been aimed also at governing Information Technology systems (Morciniec, 2001; Krishna 2005).

However, the ultimate technology on contract representation has given a step backwards in this evolution line and banks on XML again. We are referring to "eContracts", the new OASIS standard. In 2002 OASIS established the LegalXML eContracts Technical Committee to evaluate a possible eContracts Schema, and its first version of the standard has been approved during 2007 (Leff, 2007). This seems to be the most promising of all the aforementioned and the current reference format.

The model proposed in this chapter does not rely either on a SWRL-based schema, but still adheres to the ontology representation. It considers that the Intellectual Property model lacks a simple model representing the universal know-how on the field, and this model has to be established first before the rules are described. Also, the models reviewed in this section are general oriented, excepting CEL, while this work is only interested on specific contracts in the multimedia content sector.

The work presented in this chapter aims at representing the B2B contracts in the multimedia market, and at using this representation as the governing steer of the DRM system.

3. Analysis of real contracts in the market of multimedia material

Among the different parties and interests in the value chain, we may find creators, adaptors, performers, producers, distributors or broadcasters, all of them adding value to the product, and all of them tied by agreements in which Intellectual Property rights are handed over in exchange of economic compensations.

If every contract represents an agreement between two parties who belong to the value chain, contracts can be classified according to the signing parties. Figure 1 shows the typical name of the contract types and relates them with the parties, including the contract between End User and Distributor (usually an oral contract).

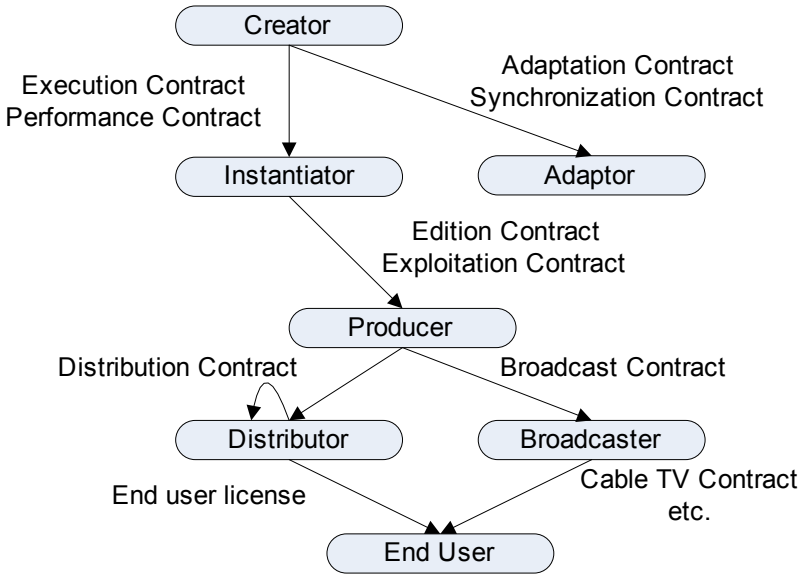

Figure 1. Most common contracts along the value chain

These kinds of contracts follow common patterns, which have been thoroughly analyzed for this study. Narrative paper contracts vary in extension and contents for each particular case, but usually account for a dozen or two of clauses, comprising less than ten pages (Rodríguez, 2007a, Rodríguez, 2008). Although clauses are representative as units of information, a single clause sometimes represented several complex ideas, and conversely, sometimes just one idea is spanned in several clauses. In the simplest case, clauses are sentences, and each of them can be classified according to the deontic logic, in terms of what can be done, must be done and is forbidden.

The most common clauses found in the multimedia contents contracts are the following:

- *Metadata clauses.* Title, declaration of the involved parties, date and place, signature.
- *Rights*. The licensee can exercise certain rights. This is usually the first and main clause.
- *Resource*. The referenced resource is either mentioned in the first clause as well, or detailed as an appendix when it is a list of items.
- *Report*. and Auditing In distribution contracts where benefits have to be distributed according to the sales, these sales have to be reported.
- *Fee*. The licensee must pay a fee with the described conditions
- *Territory*. The licensee must exercise the right (if he/she does) in the given location.

- *Term*. The licensee must exercise the right (if he/she does) in the given time
- *Confidentiality*. In B2B relations there is usually a clause banning the public issue of information.
- *Disclaimer*. To deny responsibilities on certain issues etc.
- *Jurisdiction*. In case of dispute, the agreed jurisdiction and court is agreed.
- *Breach and termination*. These clauses provision the end of the contract in normal or abnormal conditions.

4. Assessment of current RELs to express narrative contracts

Considering the role that REL licenses play on DRM systems, they can be seen as effective electronic contracts that are being enforced. As such, this section analyzes how well they perform this task, and for this, the two most important RELs have been considered, namely the MPEG-21 REL (ISO/IEC 2004) and the Open Digital Rights Language (ODRL) (Ianella, 2002). The later has additional importance considering that the Open Mobile Alliance (OMA) has developed its OMA DRM Rights Expression Language based on ODRL.

Both RELs were developed in the late 1990s, but none can be considered fully deployed up to this date. On July 2003, parts 5 and 6 of MPEG-21 were approved as Final Draft International Standards; they described the Rights Expression Language and the Rights Data Dictionary (ISO/IEC, 2004b) respectively. Previously, in 2000, the first version of the ODRL had been proposed as an open standard language for expressing rights information over content (it largely matches the objectives of the MPEG RDD too). In both cases, the incarnation of a REL expression is a XML file called *license*. This license is what we pretend to see and evaluate as an electronic contract.

In ODRL, the license pretends to express not only agreements, but also offers, what can be seen as simply potential contracts.

4.1 CONTRACT PARTIES IN THE LICENSE

Licenses refer always to two parties (actually an MPEG-21 license may content several grants each of them with a different party, but then we can consider the grant as the basic license unit). In MPEG-21 language, parties are called *issuer* and *principal*, while in ODRL they are directly referred as *parties*, classified as *end users* and *right holders*.

No more information is given about who might be these parties, excepting that they are uniquely identified, and that one of them (the rights

issuer) electronically signs the document. In the framework of MPEG-21, users include "*individuals, consumers, communities, organizations, corporations, consortia, governments and other standards bodies and initiatives around the world*" (Bormans, 2002). In ODRL, "*parties can be humans, organizations, and defined roles*". According to the standards, users are only defined by the actions they perform, but if we attend to the expressivity of both RELs, in the licenses there can be only end users and distributors (see Table I and Table II).

Table I. Rights defined by MPEG-21 REL in its core and multimedia extension

Right	**Party**	**Right**	**Party**
Issue	distributor	Extract	end-user
Revoke	distributor	embed	end-user
possessproperty	end-user	play	end-user
Obtain	distributor	print	end-user
Modify	end-user	execute	end-user
Enlarge	end-user	install	end-user
Reduce	end-user	uninstall	end-user
Move	end-user	delete	end-user
Adapt	end-user		

Table II Permissions defined by ODRL. Transfer actions belong to distributors

Usage	**Reuse**	**Asset Management**	**Transfer**
End-user			Distributor
Display	Modify	Move	Sell
Print	Excerpt	Duplicate	Lend
Play	Annotate	Delete	Give
Execute	Aggregate	Verify	Lease
		Backup/Restore	
		Install/Uninstall	

Both MPEG-21 and REL do not characterize in depth more kind of users than End Users and Distributor but a contract model should consider all the user roles appearing in Figure 1.

4.2 RIGHTS EXPRESSED IN THE LICENSE

The rights defined by MPEG-21 REL and ODRL are those shown in Table I and Table II. They have to be compared with the real necessities detected in the analysis of the contracts performed in the previous section, and they have to be compared with the basic action defined along the IP Value Chain. The new list of actions and rights needed to express the contract information are listed in Table III.

Table III Main actions and rights to be considered in a contract representation

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

Actions and rights in Table II do not take into account the REL rights, and the latter can be evaluated about how well they match the contract-extracted rights. The comparison shows that MPEG-21 rights and ODRL permissions do not completely represent the information expressed in the contracts, and although RELs foresee mechanisms for the extension of the rights list, the main unaddressed issue is that they were not B2B conceived.

5. The Media Value Chain Ontology

XML representation of contracts, under the form of REL licenses is of limited expressivity compared to the ontology-based contracts presented in Section 2. However none of the domain ontologies in Section 2 has been applied in the context of a content distribution system or a DRM system.

The Media Value Chain Ontology (MPEG-21, 2008) is a semantic representation of the Intellectual Property along the Value Chain conceived in the framework of the MPEG-21 standard. This model defines the minimal set of kinds of Intellectual Property, the roles of the users interacting with them, and the relevant actions regarding the Intellectual Property law. Besides this, a basis for authorizations along the chain is been laid out, and the model is ready for managing class instances representing real objects and users. The MVCO is based on work by the authors (Rodríguez, 2007b) and from an ontology that is part of the Interoperable DRM Platform (IDP), published by the Digital Media Project (Gauvin, 2007).

The Media Value Chain Ontology also provides a Java reference API in order to build practical applications whose management is based on

handling ontology individuals. An example of such an application has been implemented in the context of the AXMEDIS[1] project (AXMEDIS, 2007).

The Media Value Chain Ontology is represented using the expressivity of OWL-DL, and thus each class is well defined and related to a set of attributes and to other classes in a very precise way. In practice, applications can be deployed where the particular users, IP entities, actions etc. are instances of the ontology.

Three of the main classes in MVCO are "Action", "User" and "IP Entity", whose class relationship is shown in Figure 2. Users act Actions over IP entities, over which they have the IP rights. The execution of these actions may create in turn new derived IP entities.

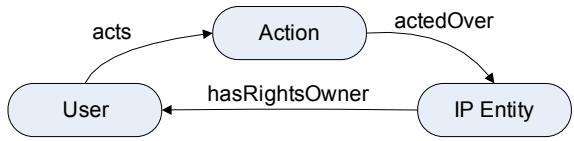

Figure 2 Three main classes and their relationships of the ontology

Table IV lists some of the derived classes, consisting of the main IP entities (Work, Product etc.), the main roles (Creator, Producer etc.) and the main actions, subdivided between transforming actions (creating new IP Entities) and end user actions focused to the end user.

Table IV. Main classes of the ontology

Root classes	**Subclasses**
IP Entities	Work, Adaptation, Manifestation, Instance, Copy, Product
Roles	Creator, Adaptor, Instantiator, Producer, Distributor, EndUser
Actions	TransformingActions (adapt, perform, etc.), EndUserActions (play etc)

Figure 3 shows the IP entities along the value chain, starting from *work* as the original abstract conception of an artist and finishing in the *product* as the most elaborate IP entity ready to be enjoyed by the end user.

[1] AXMEDIS Automating Production of Cross Media Content for Multi-channel Distribution, EU 6th Framework Program, IST-2-511299, available at http://www.axmedis.org

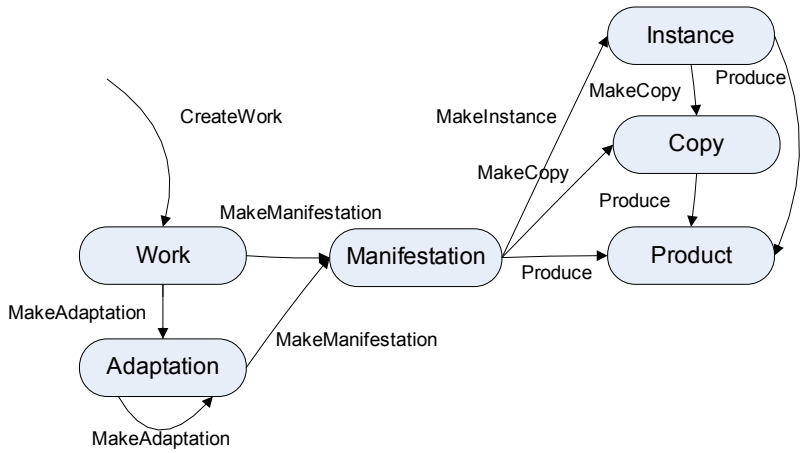

Figure 3. The IP Value Chain

Rights can be handed over users by means of permissions. The Permission class is related to the user who issues it and to the action that is permitted: "who acts which over what" (see Figure 4). The actions that are permitted allow the transformation of the object in other IP entities or its final consumtion. Permissions are subject to the satisfaction of requirements expressed as facts with a truth value.

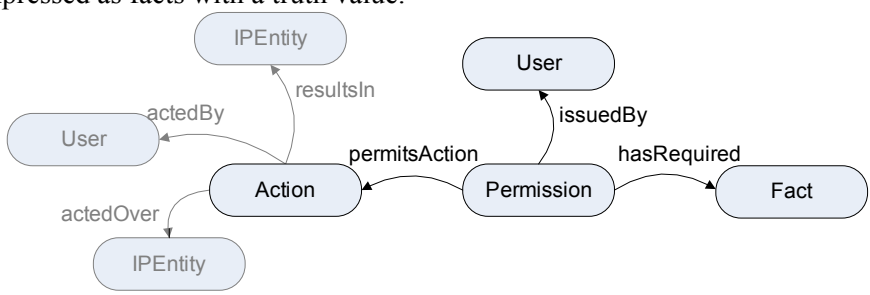

Figure 4. Permission class

The Permission class lays down the entry point for an extension of the MVCO to represent contracts. Thus, if a contract is seen as set of permissions and obligations, etc., instances of this class may represent the term of a contract.

6. Semantic Representation of Contracts

The XML contract represented in the eContracts format has the top elements shown in Figure 5.

The `ec:metadata` element includes elementary metadata information like date, contract author etc. The `ec:contract-front` describes the

parties, lists the terminology to be used along the contract, etc. The `ec:body` element is a sequence of `ec:items`, which can be `ec:chapters`, `ec:parts`, `ec:sections`, `ec:clauses` or `ec:subclauses`.

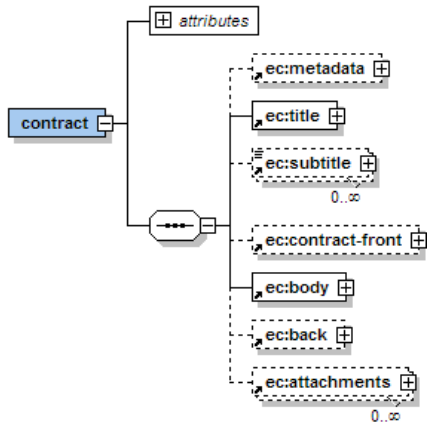

Figure 5. Top elements in the eContracts XML contract

However, the content of these items or clauses is no further refined, and it can be as simple as English text. The structure is good but unable to represent a computer enforceable contract *per se*, therefore the content of these eContracts elements has to be more precise so that computers can interpret it. To do this in the framework of multimedia contracts, the MVCO elements can perform well: MVCO is an OWL ontology and as such it is XML-serializable and its elements easily integrated within an XML eContract.

OWL-DL is a Description Logics knowledge representation language, whose expression can be mapped to a first order predicate logic system. Predicates are verb phrase templates that describe properties of objects, or a relationship among objects represented by the variables (e.g. “Bob is a Creator”). As the given statements representing the domain knowledge constitute a formal deductive system, the ontology can be queried (e.g. “has Bob created any Work?”). For each syntactically correct expression, the OWL-DL ontology is able to assert its truth value: either true, false or unkown (for the latter case, note that that OWL uses the open world assumption).

All the above makes OWL an ideal mean to handle the truthness of propositions. However, not all the propositions in the English language (or human thinking) convey a truth value. Commands, questions or deontic expressions cannot be said to be true or false, and contracts carry its most valuable information in sentences like these (e.g. “Party A must pay party

B in a yearly base"). This kind of expressions lies in the field of deontic logic (Rodríguez, 1978).

Modal logics are concerned with other modalities of existence (usually necessity or possibility), and introduce two new monadic operators related like this:

$$\Diamond P \leftrightarrow \neg\Box\neg P$$

and

$$\Box P \leftrightarrow \neg\Diamond\neg P$$

The deontic logic is a kind of modal logic of the highest interest to represent contracts, and in place of the operators $\Box$, $\Diamond$ we can interpret "Obligation", and "Permission" (in the above expressions, it can be read that "P is obligatory" is equivalent to "it is not permitted not P"). Actually only one of both operators is strictly necessary, as the second one can be deduced from the first, but for readability, usually both are kept. In these expressions, P is no more than an alethic (with a truth value, from the Greek αλήθεια, truth) proposition.

The MVCO defines a class "Fact" with a definite truth value (overcoming the open world assumption which enabled an unkown state), and an object property "hasRequired" which linked to a Permission enables the expression of obligations.

The most important clauses found in multimedia content contracts, as they were defined in Section 3 are either alethic sentences (we call them *Claims*) or deontic expressions, the latter being either *Permisison*, *Prohibition* or *Obligation* (see Table V). Similar approaches in the treatment of contracts can also be found in the literature (Prisacariu, 2007)

Table V. Classification of contract clauses according to their deontic nature

Kind of Clause	**Logic expression**	**Typical clauses**
Claim *Something is*	P	Jurisdiction, Disclaimer, Breach Termination
Permission *The licensee can*	$\neg\Diamond\neg P$	Rights-Resource
Obligation *The licensee must*	$\Diamond P$	Fee, Territory, Term, Report
Prohibition *The licensee must not*	$\Diamond\neg P$	Confidentiality

Some of these clauses may be interesting to be electronically enforced in a content distribution system while others can be discarded. An example of the latter can be seen in Figure 6. While the MVCO defines a Permission class, it does include neither the Prohibition nor the Obligation, but its inclusion as an extension in terms of the former is a trivial task.

```
00<ec:item>
01 <mvco:Prohibition rdf:ID="12">
02  <rdfs:comment> The Program(s) may not be shown at festivals,
03 conventions and markets without Licensor's prior consent.
04  </rdfs:comment>
05 </mvco:Prohibition>
06</ec:item>
```

Figure 6. eContracts clause with a narrative content

Those clauses which are liable to be enforced can have a more precise representation. For example, if the parties declaration take the form shown in Figure 7, individuals are uniquely identified (lines 03 and 04) and can be related to those of a larger Information System.

```
00<ec:contract xmlns="urn:oasis:names:tc:eContracts:1:0">
01 <ec:contract-front>
02  <ec:parties>
03   <ec:party><mvco:User rdf:about="#Alice"/></ec:party>
04   <ec:party><mvco:User rdf:about="#Bob"/></ec:party>
05 </ec:parties>
06</ec:contract-front>
```

Figure 7. eContracts parties declaration using the MVCO expressions

A real eContract clause carrying RDF triples of the MVCO can take the form shown in Figure 8.

```
00<ec:body>
01 <ec:item>
02  <mvco:Permission rdf:about="#Permission000">
03   <mvco:permitsAction rdf:resource="#Action000"/>
04   <mvco:issuedBy rdf:resource="#Alice"/>
05   <mvco:hasRequired rdf:resource="#Germany"/>
06  </mvco:Permission>
07  <mvco:MakeAdaptation rdf:about="#Action000">
08   <mvco:actedBy rdf:resource="#Bob"/>
09   <mvco:actedOver rdf:resource="#Obra1"/>
10  </mvco:MakeAdaptation>
11  <mvco:Territory rdf:about="#Germany">
12   <mvco:hasCountry>DE</mvco:hasCountry>
13  </mvco:Territory>
14  <mvco:Work rdf:about="#Obra1">
15   <mvco:hasRightsOwner rdf:resource="#Alice"/>
16  </mvco:Work>
17 </ec:item>
18</ec:body>
```

Figure 8. eContracts clause integrated with a MVCO Permission

A permission is expressed (lines 02-06 in Figure 8) in which Alice grants a right to make an adaptation (lines 07-10), over the work "obra1" (line 09) to Bob (line 08), once proved that it is executed in Germany (lines 11-13).

7. Conclusions

This work acknowledges REL licenses as the governing element in DRM systems for B2C distribution of multimedia content, and declared licenses as the digital version of end user or distributor contracts. However, after an analysis of real contracts in the IP contents B2B market, it was observed that more flexibility was required to cope with the complexity of those narrative contracts.

On the other hand, other electronic contract representations lack the needed formalism to steer content distribution systems. The MVCO, a recently presented ontology of the IP value chain model, may overcome the limitations of the existing RELs and may merge well into the OASIS eContract structure.

This combination can govern a content distribution system with all the value chain players if some additions are made. In particular, an event description system is needed, and an authorisation mechanism too, capable of processing the dynamic events, the current context and these MVCO-extended eContracts. The execution of SWRL rules can determine this authorisation and make the electronic contracts to be truly semantic containers.

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