

Semantic Expression and Execution of B2B Contracts on Multimedia Content

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Abstract. Business to business commerce of audiovisual material can be governed by electronic contracts, in the same way as digital licenses govern business to consumer transactions. 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, these languages fail to replace the rest of the contracts agreed along the complete Intellectual Property value chain. To represent their corresponding electronic counterpart licenses, a schema based on the standard eContracts and 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.

Keywords: Contract, license, DRM, Intellectual Property, Ontology, MPEG-21.

1 Introduction

Perhaps audio and video distribution never received so much public attention as in these days. From the legal changes around the intellectual property (IP) to the newest gadget with new wondrous capabilities to appear in the market, mass consumption of media is nowadays in the spotlight of everybody. Less socially interesting but of no fewer economical importance are the transactions of multimedia material within the business to business (B2B) limits.

Technologies to serve media to the consumer have developed very fast, in a controlled manner through web portals and Digital Rights Management (DRM) systems and in non controlled manners through parallel channels like P2P networks, fast download servers, etc.

In the business to consumer (B2C) sector, economical transactions have been kept relatively simple –the consumer pays and in exchange can download a file or gain access to a football match streaming, for example. Digital licenses, expressed in one of the existing *Rights Expression Languages* (REL) allow some degree of complexity, where the transaction can be conditioned to the satisfaction of some conditions (e.g., of temporal or territorial nature), and can define more precisely the action the user can

make (perhaps render but not store nor print). In the B2B sector of audiovisual content, transactions happen in a similar way: there is flow of money and a flow of content in opposite directions, both of which can take place in the digital space. The quintessence remains the same as in the B2C case, but complexities arise in the conditions and the nature of the agreements, and a pre-filled license does not suffice. Written contracts regulate the economical transactions instead of digital licenses, and technology is not relied as it is in the retail segment.

The authors of this paper believe that part of this lack of acceptance of digital systems to create, manage, and execute the agreements is due to the lack of maturity in the technology, which has failed to express satisfactorily the terms of real contracts in a digital language and manage and execute them accordingly.

This paper recalls the previous attempts of expressing contracts in a digital language and their role as enforcement agents in information systems. It then particularizes to the case of the audiovisual B2B sector, which presents some recurrent patterns in the contract structure, and a very well defined candidate environment for their use: the DRM systems. The paper finally evaluates more complex contracts in the context of its execution and its role as steering documents.

2 Contract Representation

2.1 Contract Representation Overview

B2B transactions in the audiovisual market have been regulated with narrative contracts. 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.

Efforts to represent contracts electronically are not new –they are as old as computers, and even making them part of digital systems is not new. Along with the development of computer sciences and network communications, the electronic representation of contracts played each time a more active role. Thus, in the earliest Electronic Data Interchange (EDI) standards, about forty years ago, only bills and invoices were exchanged, but slowly the exchanged messages became richer in their expressivity and their role in an integrated information system was each time more important.

Besides proprietary systems where information acquired an ad-hoc structure there have been some remarkable attempts to structure electronically the information in contracts. COSMOS [1] 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. DocLog [2] 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 (Document Type Definition). An effort to achieve a common XML contract representation was the Contract Expression Language (CEL) [3],

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 [4], 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 ([5][6][7]) being developed domain ontologies in the KIF (Knowledge Interchange Format) or OWL (Ontology Web Language) languages. Still climbing levels in the Semantic Web layered model, RuleML first and SWRL (Semantic Web Rules Language) after were enacted as the new model container for electronic contracts, given that a contract declares a set of rules [8]. 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 (Resource Description Framework), thus providing a seamless integration with OWL ontologies. Some of these contract models have also been aimed at governing Information Technology systems [9][10].

2.2 Contract Representation with eContracts

Currently, the most widely acknowledged standard is the *eContracts*, promoted by the OASIS consortium. Their electronic contract representation banks on XML again, but it has gained rapid acceptance. This is the culmination of the LegalXML eContracts Technical Committee, which started in 2002 to evaluate a possible eContracts Schema, and which achieved its final form in 2007 [11]. The model proposed in this chapter uses this eContract standard as a framework for the execution of contracts in the audiovisual B2B sector. Being eContracts the container, contents are expressed with the help of some existing ontologies in the field, like the Media Value Chain Ontology [21] and the principles of deontic logic for contracts execution in other formalizations.

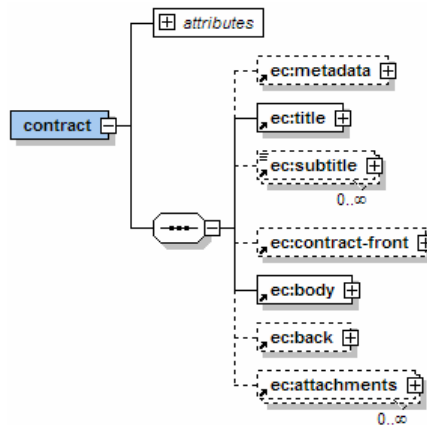


Fig. 1. Top elements in the eContracts XML contract

eContracts is a standard aimed at representing general contracts, having no particular field in scope. eContracts documents are composed of general paragraphs and clauses, being the main XML elements the *ec:item*, the *ec:title*, the *ec:block* and the *ec:text* with the item element used recursively. Figure 1 shows the XML schema for the root and the main elements (the root element is, of course, the *ec:contract*). *ec-metadata* elements in the contracts allow the specification of contract date, creator or title (using the Dublin Core metadata elements). Contract parties are declared in the *ec:contract-front* part, being the clauses under the *ec:body* element.

2.3 Representation of Audiovisual Contracts

The most common clauses found in the body of multimedia contents contracts have been studied [12] by analyzing some paper contracts in the sector. Besides the metadata and header clauses, the main kinds of clauses are listed here:

- *Rights*. Actions that the licensee can execute.
- *Resource*. Object of the actions to be executed.
- *Report and Auditing*. Obligation to report on sales or action executions.
- *Fee*. Fee to be payed in exchange to a transfer of IP or content delivery.
- *Territory*. Spatial condition imposed on the execution of an action.
- *Term*. Temporal condition imposed on the execution of an action.
- *Confidentiality*. Prohibition to release information around the agreement.
- *Disclaimer*. Denial of responsibilities on certain issues.
- *Jurisdiction*. Agreed legal frame and court on case of dispute.
- *Breach and termination*. End of the contract extinction conditions.

These kinds of clauses may constitute refinements of the existing eContracts elements like *ec:item* or *ec:block*. But a better refinement of the structure could be given, specifying the nature of the clause. Clauses can be classified according to one of the standard deontic logics notions of ‘prohibition’, ‘obligation’ and ‘permission’. Some other clauses are auxiliar of the former, only describing facts agreed by both parties (assertions). Each of the clauses in the contract can be classified as one of them (prohibition, obligation, permission or assertion) (see Table 1). Contract metadata and contract front constitute also assertions. The namespace *aec* stands for *audiovisual electronic contracts* schema.

Table 1. Kind of clauses and their meaning

Kind of clause	Meaning	Example clause
1. <i>aec:permission</i>	What the licensee can do	Licensee rights
2. <i>aec:prohibition</i>	What the licensee cannot do	Confidentiality
3. <i>aec:obligation</i>	What the licensee must do	Fee, territory, term
4. <i>aec:assertion</i>	What both parties agree it is	Jurisdiction
<i>ec:metadata</i>	Data on the contract itself	Contract date
<i>ec:contract-front</i>	Contract heading	Contract parties

3 Contract Representation with Rights Expression Languages and the Media Value Chain Ontology

A parallel and practical effort in automating the trade of multimedia assets has been made with the Digital Right Management (DRM) systems and the electronic licenses as the contract-like elements governing the transactions.

These licenses are expressed in a Rights Expression Language (REL) and they can be seen as effective electronic contracts that are being enforced. Examples of RELs are the MPEG-21 REL [13] and the Open Digital Rights Language (ODRL) [14]. This joint analysis of RELs as electronic contracts is not new [12] but so far it has not received enough attention.

In both MPEG-21 REL and OMA DRM, an XML file contains a license which expresses the rights one of the parties has and the conditions that have to hold. And in both cases, these licenses can represent both in-force contracts or license offers. Comparing with Section 2.3, contract clauses representable in a REL license are only those directly needed for a rights enforcement: the parties clause, the rights clause, and some of their enforceable conditions (fee, territory, grant etc.).

3.1 Parties in REL Licenses

Licenses refer always to two parties, likewise most of real contracts. 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, the concept of 'user' include "individuals, consumers, communities, organizations, corporations, consortia, governments and other standards bodies and initiatives around the world" [15]. 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. This is enough for most of DRM platforms, but a contract model should consider all the user roles appearing in the complete media value chain.

3.2 Rights and Conditions in REL Licenses

Rights and conditions are declared together in REL licenses, and they are declared in only one direction: *rights* mean rights of the licensee, and *conditions* mean conditions that have to be met for the licensee to execute his rights. In practice, contracts in the audiovisual sector include clauses in both directions: each of the parties may have rights, obligations and prohibitions.

The rights defined in MPEG-21 REL and ODRL (Table 2) are only focused in one of the directions, and they are not enough to describe all the actions that are permitted in contracts. The list of actions and rights needed to express the contract information is given in Table III, which was elaborated after a systematic analysis of existing contracts in the audiovisual market [12].

Table 2. MPEG-21 REL rights and ODRL permissions

MPEG-21 REL rights			ODRL permissions			
			Usage	Reuse	Asset Management	Transfer
End user	End user	Distributor	End-user			Distributor
Enlarge	Play	Issue	Display	Modify	Move	Sell
Reduce	Print	Revoke	Print	Excerpt	Duplicate	Lend
Move	execute	Obtain	Play	Annotate	Delete	Give
Adapt	Install	modify	Execute	Aggregate	Verify	Lease
Extract	Uninstall				Backup/Restore	
Embed	delete				Install/Uninstall	

Table 3. Main actions and rights to be considered in a contract representation

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

The comparison shows that MPEG-21 rights and ODRL permissions do not completely represent the information expressed in B2B contracts, and although RELs foresee mechanisms for the extension of the rights list, the main unaddressed issue is that they were not B2B conceived.

3.3 Parties and Rights in the Media Value Chain Ontology

Much of the mismatch between RELs expressivity and contracts reality can be shortened with the help of the Media Value Chain Ontology (MVCO) [16]. 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 is a semantic representation of the intellectual property along the Value Chain conceived in the framework of the MPEG-21 standard. The MVCO is based on work by the authors [17] and from an ontology that is part of the Interoperable DRM Platform (IDP), published by the Digital Media Project. 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. The 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.

Although the MVCO was not intended to describe specifically contracts, their vocabulary is useful given that contracts on audiovisual material are contracts essentially on its intellectual property.

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 2 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).

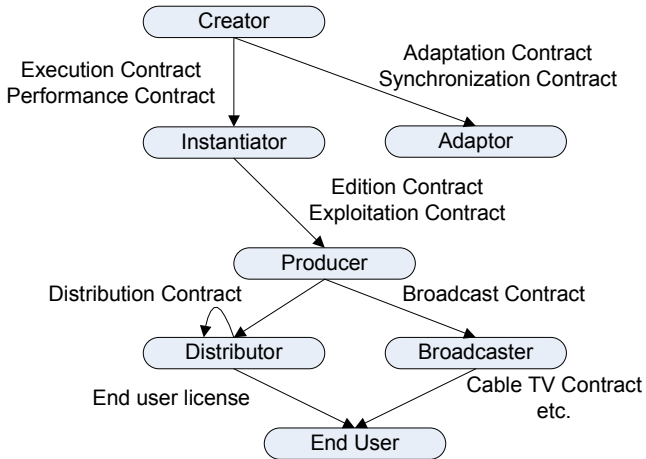


Fig. 2. Kinds of contracts in the media value chain

An example of eContracts fragment declaring the parties using the MVCO is given in Figure 3.

```

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

Fig. 3. eContracts parties declaration using the MVCO expressions

The IP value chain considers the different kinds of IP entities linked from the original work to the final product, as can be seen in Figure 4. There is a parallel between the chain of IP and the chain of contracts.

Figure 4 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.

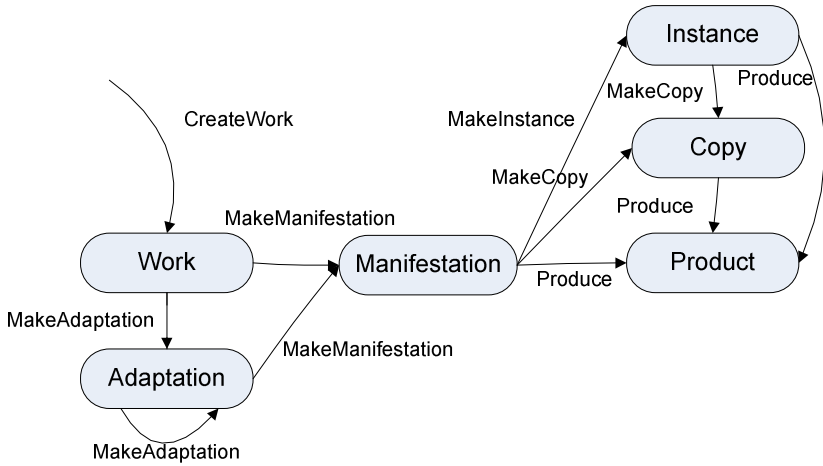


Fig. 4. The IP Value Chain

The MVCO can add much of its vocabulary to the semantics on contract representation. For example, three of its main classes are “Action” (comparable to the rights analyzed in the previous section) “User” (comparable to the parties in the contracts) and “IP Entity” (a classification of the objects of the contract from a IP point of view). Table 4 lists these classes and their immediate subclasses.

Table 4. 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)

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. Contract parties, if expressed in the terms of the MVCO, belong to one of the following classes: Creators, Adaptors, Instantiators, Producers, Distributors and EndUsers. Being broader in scope, the MVCO provides a good starting point for deriving new actions and parties to be used in a contract vocabulary.

3.4 RDF Representation of Deontic Clauses with MVCO

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 unknown (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 [22].

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 can be deduced from the first, but for readability, usually both are kept. In these expressions, P is no more than an alethic proposition.

The MVCO defines a class “Fact” with a definite truth value (overcoming the open world assumption which enabled an unknown 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 Assertions, and we can represent them with the symbol P) or deontic expressions, the latter being either Permission ($\neg \Diamond P$), Prohibition ($\Diamond \neg P$) or Obligation ($\Diamond P$). Similar approaches in the treatment of contracts can also be found in the literature [20]. Clauses which are liable to be enforced are enclosed in the *aec:enforceable* element.

3.5 Semantic Contract Representation

We have now all the ingredients to describe a semantic representation of the audiovisual contracts. First we have a good structure given by the eContracts standard, which is naturally extendable. A general purpose standard like eContracts, with only 51 XML elements, cannot cover the details of any particular domain, but it can be refined. Then, we have a rich vocabulary of specific terms from the DRM world (and specified formally in the RELs), which is complemented by the elements in the semantic model of the complete value chain given in the Media Value Chain Ontology. Note that even though MVCO is an OWL-DL ontology, the declaration of its individuals is given in RDF and as such, easily integrable in the eContracts structure. Note that the multimedia objects, if properly annotated with Multimedia Semantics, can bear information about its intellectual property nature making the integration easier. A real eContract clause carrying RDF triples of the MVCO can take the form shown in Figure 5.

```

00 <ec:body>
01   <ec:item>
02     <aec:enforceable>
03       <aec:permission rdf:about="#Permission000">
04         <mvco:permitsAction rdf:resource="#Action000"/>
05         <mvco:issuedBy rdf:resource="#Alice"/>
06         <mvco:hasRequired rdf:resource="#Germany"/>
07       </aec:permission>
08     <aec:assertion>
09       <mvco:MakeAdaptation rdf:about="#Action000">
10         <mvco:actedBy rdf:resource="#Bob"/>
11         <mvco:actedOver rdf:resource="#mywork1"/>
12       </mvco:MakeAdaptation>
13     <aec:Territory rdf:about="#Germany">
14       <aec:hasCountry>ISO:DE</mvco:hasCountry>
15     </aec:Territory>
16     <mvco:Work rdf:about="#mywork1">
17       <mvco:hasRightsOwner rdf:resource="#Alice"/>
18     </mvco:Work>
19   </aec:assertion>
20 </aec:enforceable>
21 </ec:item>
22 </ec:body>

```

Fig. 5. eContracts clause integrated with a MVCO Permission

The XML snippet in Figure 5 asserts that there is a work called *mywork1* (lines 16-18), that there is a Fact called *Germany* (lines 13-15), and that there is an action that is Bob “making an adaptation over *mywork1*” (lines 09-12). It also declares that there is a permission given by Alice for Bob to make an adaptation provided that it is in Germany (lines 03-07). All this information is enforceable (line 02).

4 Execution of Semantic Audiovisual Contracts

What is called the *execution of contracts* is no more than the authorisation of some media transfers (or the keys to decrypt) and the automatic dispatch of payment orders. Both transfers of bits and money can be ordered as the result of the execution of some rules given in the audiovisual eContract, fired with some events (purchase, consumption etc.).

Figure 6 depicts a general environment of execution of audiovisual contracts, where the “semantic expression of contracts” is the eContracts extension we have described together with the MVCO elements and their extensions, the semantic expression of the context describes also as RDF the environment (spatial, temporal etc.) and the firing events are user request for rights execution or purchases (contract proposal accepts). The detailed syntax of these expressions exceeds the purpose of this paper, but they are a set of SWRL rules which ultimately offer an authorisation result and dispatch event reports.

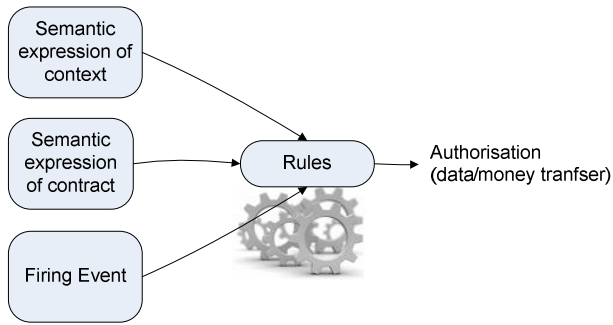


Fig. 6. Execution environment for audiovisual electronic contracts

5 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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