Licensing Patterns for Linked Data *

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Abstract. Rights expression languages declare the permitted and prohibited actions to be performed on a resource. Along this work, six rights expression languages are compared, abstracting their commonalities and outlining their underlying pattern. Linked Data, which can be object of protection by the intellectual property laws or its access be restricted by an access control system, can be the asset in rights expressions. The requirements for a pattern for licensing Linked Data resources are listed.

Keywords: licensing, Ontology Design Pattern, linked data

1 Introduction

The Linked Data initiative describes how to publish data into a single global data space in the Web [1]. Yet, the mere publication does not entitle the web visitors to use the data for any arbitrary purpose, as data may be protected by intellectual property laws or database laws [2]. In order to use the data, a general license or a private contract must exist, and their terms be respected. **Rights expression languages** (RELs), like MPEG-21 REL [3] or ODRL [4], allow declaring in a machine readable format which rights are given to whom and under which conditions. If these rights expressions are to govern a computer system giving conditional access to the resources, the term **policy** is preferred. Computer access control mechanisms might govern the access to Linked Data resources, based on the context, the user credentials and established access control policies, possibly written in languages like XACML [5].

Both RELs and policy languages represent the same kind of information (which actions a user can do with a certain resource), in a common underlying model that has been manifested in the different existing languages. This abstraction might be made explicit as an *Ontology Design Pattern* (ODP) [6]: ODPs are known modelling structures applied to recurrent problems, regarded as good solutions in ontology design, and having a pattern for rights declaration may be of interest in many different contexts. While [7] proposes such an explicit pattern, this paper revolves about the existing rights declaration languages, abstracting their commonalities and differences, assessing its adequacy for Linked Data, and postulating that rights expressions for RDF should be manifested also in RDF supported by a lightweight ontology and known vocabularies.

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2 Licensing languages

2.1 XML based Rights Expression Languages

Several rights expression languages have been defined since the late nineties, having been applied in different contexts. This section examines the most notable of them (MPEG-21 REL, ODRL), as well as the policy language XACML. Other XML-based languages, similar in nature or form are METSRights[8] as the standard of the Library of the Congress to preserve and transmit digital objects, or TVAnytime RMPI [9] in the audiovisual industry.

The **MPEG-21 REL** (ISO/IEC 21000-5) license is a XML document whose hierarchical nature is reflected in Fig. 1(a). Each box in the figure represents an XML element, enclosed in its parent element. The root element is the *license*, comprising one or more *grants* given by an identified *issuer*. Each of the grants, allows executing one or more *rights* against a *resource* by a *principal*, subject to certain *conditions*. The actual rights (play, print, etc.) are defined in profiles and further catalogued in a Rights Data Dictionary, as well as the conditions, which can specify a price, different payment forms, a territory or a period during which the grant holds, etc. An authorization mechanism is defined to validate if a user request is backed by a proper license whose conditions are met.

The **Open Digital Rights Language** (ODRL) is a rights expression language able to express permissions, prohibitions, obligations and assertions. It was created in 2000 when DRM (Digital Rights Management) systems were burgeoning, and in 2012 the latest specification (version 2.0) has been released. Under different forms, it has been implemented in cell telephones (Open Mobile Alliance DRM), in the eBook publishing industry and in the news rights management. ODRL is defined with an abstract core model plus profiles with the specific vocabulary of particular domains, and it can be serialized as XML. In its version 2.0, *policy* is the root element (Fig. 1(b)) and it can include *permissions* or *prohibitions*. A permission allows a particular *action* to be executed on a related *asset* by a particular *party*, conditioned to some *duties*. The prohibition is expressed in similar terms and it can be limited by *constraints*. These elements can be combined to represent offers, agreements, requests or privacy settings.

Licensing with a XACML policy. XACML (Xtensible Access Control Markup Language) is a general-purpose XML policy language, able to declare attribute based access control policies to resources. The most important element in XACML is also the *policy* (Fig. 1(c)), which is defined with a collection of *rules*, *obligations* and a *target* to determine if the policy applies. Policies can be combined following predefined algorithms. Each rule is composed of a target, a condition and an effect (permit or deny). The target is made up of *subjects* (entities requesting access), *resources* (data, services or system components) and *actions* (the type of access requested on the resource). An environment provides context information. Subjects, resources, actions and context have attributes whose values are compared to the values in policies to decide the authorization.

Comparison of MPEG-21 REL, ODRL and XACML. Beyond the apparent differences between these expression languages, it is possible to abstract

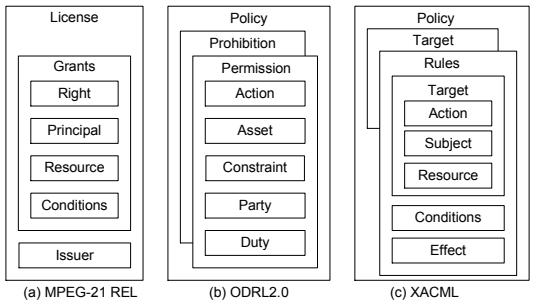

Fig. 1. Main elements in a MPEG-21 REL license, and an ODRL and a XACML policy

some parallel concepts. The main XML element in MPEG-21 REL is *license*, and *policy* in ODRL and XACML. They are equivalent in meaning and they can contain, in any of the three cases, a set of permissions or prohibitions. These are called *permission / prohibition* in ODRL, *rule* in XACML (duly attributed to determine whether they *permit* or *deny*) and *grants* in MPEG-21 REL (which cannot declare bans). This second-level element groups the authorized/prohibited action: who does what over which resource. Actors take different names across the languages (*subject*, *party*, *issuer*, *principal*) as well as actions (*right*, *action*) and *resources* (also termed *assets*). Finally, the *conditions* in MPEG-21 REL or XACML are equivalent to the *duties* and *constraints* in ODRL.

2.2 Ontologies capable of expressing Rights Expressions

There have been other attempts at least from the academia to build RELs at a semantic level enabling reasoning like KAoS, Ponder or Rei [11]. LicenseScript [10] was based in Logic Programming and had a materialization in Prolog, while the CopyrightOntology[1], OntologyX[2] and the Copyright Registry[3] were specified in OWL. Although they propose solid models, none of them has a significative community of users behind. Moreover, their design was done before the Linked Data paradigm had gained spread, and they lack connectivity with other pieces of data in the web. This section describes in more detail the most acknowledged vocabulary (ccREL[4]), the MPEG-21 Media Value Chain Ontology[5] (MVCO) and the Web Access Control[6] vocabulary (WAC).

The **Creative Commons Rights Exprsesion Language** (ccREL) can represent Creative Commons licenses' information using RDF. The main two classes are *Work* and *License*, each of them having possibly attributes. The

[1] http://rhizomik.net/html/ontologies/copyrightonto/
[2] http://www.rightscom.com/Default.aspx?tabid=1067
[3] ttp://semanticcopyright.org
[4] http://wiki.creativecommons.org/CC_REL
[5] http://dmag.ac.upc.edu/ontologies/mvco/
[6] http://www.w3.org/wiki/WebAccessControl

license permits, requires or prohibits actions (these terms being properties relating the license to a set of limited and non-extendable rights, requirements and bans). The actions in ccREL reflect the basic rights reflected in intellectual property law, and common to almost any jurisdiction: *reproduction* (making copies), *distribution* (publication of a copy of the work) and *derivativeWorks* (publication of derived versions of the original work). Permissions can require a notice, an attribution, etc. The prohibitions and the requirements, however, are those particular of the Creative Commons licenses and lack the generality of the permissions.

The **MPEG-21 MVCO** (ISO/IEC 21000-19) represents the intellectual property entities along a value chain, and it defines an abstract model for granting permissions. It is also used by the Media Contract Ontology, in the standardization path to become the formal language to represent contracts handling audiovisual contents and the rights thereof. In MVCO, a *permission* is given by a *user* so that another user can execute an *action* over an *IPEntity* (object of intellectual property including the original work and its transformations). The permission can be conditioned to one or more *facts* to actually hold. Actual users, permissions and intellectual property entities are instances of the respective classes.

The **Web Access Control** (WAC) vocabulary permits expressing who is authorized to access to web resources through the so called *access control lists* (ACL). ACLs declare the *agents* and their access modality (limited to *read*, *write*, *access*, *append* and *control*) to *InformationResources*. WAV is simple (hardly a dozen of classes and properties) yet in use in important services as in data.fm or OpenLink Data Spaces[7].

Comparison of ccREL, MPEG-21 MVCO and WAC. The presented ontologies, capable of representing rights and authorizations, have similar elements. The concepts of *license* (ccREL), *permission* (MVCO) and *authorization* (WAC) are equivalent, and they grant a *permission* (ccREL) an *access* (WAC) or the right to execute an *action* (MVCO) on a given *work*, *informationalResource* or *IPEntity* respectively by an *agent* (WAC) or a *user* (MVCO). Unlike the rest of the mentioned languages, ccREL cannot express a licensee, and instead, each policy applies for the public in general. It cannot declare prohibitions (useful for example to restate a copyright ownership), nor conditions beyond those found in Creative Commons licenses. In particular, this constrains the use of ccREL for offers of non-open content where representing a price is needed.

3 A pattern for licensing Linked Data

The commonalities between the six analyzed rights expression languages, either in XML or RDF, revolve about the n-ary relation that exists among a resource, its rightsholder, another user (or the public in general), the deontic category (permission, obligation, prohibition) and an action conditioned to some requirements. The tree structure of XML languages naturally includes these elements

[7] http://ods.openlinksw.com/wiki/ODS/

under a license node, but the representation as RDF –the natural one for licensing Linked Data resources like RDF datasets or mappings– requires adopting the solution of the *n-ary relation* pattern[8], having a central entity related to the others and qualifying the n-ary relation itself (*qualified relation* pattern[9]).

The new breed of vocabularies for Linked Data rights declaration like LiMO[10], L4LOD[11] or ODRS[12] have paved the way towards an acknowledged set of terms found in existing open licenses. If interlinked, properly extended and articulated as in the model discussed before, the representation of both existing licenses and custom-taylored rights expressions will be possible, not only in open but also in payment-based scenarios. While new tools for creating, evaluating and reasoning on rights expressions are needed, an ecosystem of entities creating, brokering and consuming open and proprietary Linked Data assets would benefit from a clear rights expression model in harmony with the mature rights expression languages which already share their essential features.

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