OREL: An Ontology-based Rights Expression Language

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ABSTRACT

This paper proposes an Ontology-based Rights Expression Language, called OREL. Based on OWL Web Ontology Language, OREL allows not only users but also machines to handle digital rights at semantics level. The ontology-based rights model of OREL is also presented. The usage of OREL and its advantages against existing RELs are discussed.

Categories and Subject Descriptors

K.4.1 [**Public Policy Issues**]: Intellectual property rights; I.2.4 [**Knowledge Representation Formalisms and Methods**]: *Representation languages*.

General Terms

Languages, Security, Standardization.

Keywords

Rights Expression Language, XrML, OWL, OREL.

1. INTRODUCTION

Masses of digital contents are delivered nowadays via web. The problem of how to protect intellectual property therefore becomes urgent. DRM (Digital Rights Management)[1] systems are designed to protect the interest of content creators and disable illegal distribution of digital contents. A right specifies an action (or activity) or a class of actions that a principal is permitted to perform on or using the associated resource. The DRM system is not only doing the job of access control but also involving usage control, finance exchange, digital content delivery security and so on. One of the key technologies for the DRM system is REL (Rights Expression Language).

Creators or dealers of digital contents use REL to create a license that grants the rights to end-users. Most of the popular RELs in current use are based on XML, such as MPEG REL[2], XrML [3].

The top-level construct in XrML 2.0 is a “License”, which is a container of “Grant”. XrML 2.0 data model comprises four elements and their relationships shown as figure 1. The four elements respectively represent the principal to whom the grant is issued, the right that the grant specifies, the resource that is the direct object of the “right” verb (or act) and the condition that must be met for the right to be exercised. “Grant” conveys to a particular principal the sanction to exercise an identified right against an identified resource, possibly subject to first fulfilling some conditions.

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The XML-based RELs support the interoperability at the syntax level benefiting from XML. But the meaning of the entities and the relationship between these entities are informal, and the application developers are assumed to take the responsibility to deal with the semantics of “Licenses”. In other words, these RELs are hard to be automatically handled by machines at the semantic level. It also leads to the problem of interoperability at semantic level when the data of licenses are exchanged. Considering two applications using different RELs, if they both issue a license granting “Play” to end users, it’s difficult to infer automatically that the two “Play” are the same or tell what the difference is.

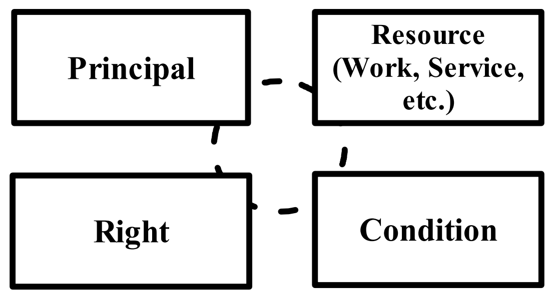

Figure1: XrML data model

Further, existing RELs will be infeasible in the future of the Web-Semantic Web because they are hard to deal with automatic reasoning or semantic query. Web ontology languages play a crucial role to the emerging Semantic Web, as they allow the explicit representation of term vocabularies and the relationships between entities in these vocabularies. OWL (Web Ontology Language) is designed by the W3C as a language for defining and instantiating web ontologies. Based on Description Logic, OWL provides more expressive power than RDF Schema. All of these motivate us to design an Ontology-based Rights Expression Language (OREL), a new REL based on OWL.

2. ONTOLOGY-BASED RIGHTS MODEL

The ontology-based rights model, shown as figure 2, is the heart of the OREL language. We use the terms “Act”, “Agent”, “Resource”, “Time” and “Place” from MPEG RDD (Rights Data Dictionary)[4] as well as their hierarchy and relationships to build our ontology. RDD is a dictionary of key terms that aims to unambiguously describe rights of all users, including intellectual property rights.

As figure 2 shown, there are some similarities between our model and XrML data model in that “Act” corresponds to “Right”, “Agent” to “Principal”, and “Grant” and “Condition” to the corresponding elements in XrML. But there exists some essential differences. First, our model is much clearer than XrML model in describing the context of “Act” by separating “Time” and “Place” from “Condition”. Second, our model is more powerful especially when describing multi-users have multi-rights under multi-conditions. Third, the very difference is that our model is based on the ontology rather than just XML format.

3. USAGE OF OREL

OREL is defined as an OWL ontology consisting a set of related classes and properties. OREL users can import this ontology and write their own license by using instantiation or inheritance to fulfill their application-specific requirements. When a user of OREL writes a license, the user should obey not only XML but also OWL specification. It is obvious that more complexity will be added. However, we will illustrate that it is worth trying. The user will benefit from the power of Semantic Web in virtue of description logic. We present three use cases with increasing complexity step by step at our website and give the corresponding licenses to illustrate the usage of OREL.

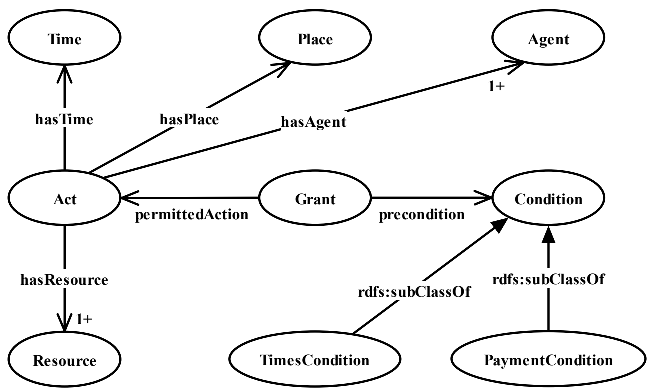

Figure2: OREL Ontology Model

4. ADVANTAGES OF OREL

OREL users will find it easy to define their own ontology by inheritance of class using OWL. User can use the ontology to make specific expression by adding new properties or changing existing property value. For example, a dealer can define its own specific environment as a subclass of "Place" to limit end users using a resource within this specific environment, e.g. specific hardware, software or even software with specific version.

OREL inherits the expressiveness and flexibility of OWL. Seemingly irrelevant terms or entities may describe the same thing or correlative things. When digital rights are expressed by OREL, there is an additional ability to express the relationship between those related entities. This will help when applications interoperate with each other with digital rights exchanged.

Semantic query is another important advantage of OREL. When rights data becomes huge from various sources, OREL will be efficient in virtue of many mature semantic query language such as RDQL or RQL and so on.

Reasoning within OREL is based on the one within description logic [5], while existing RELs have no ability of reasoning. The most obvious advantage brought by reasoning is preventing some redundant information from occurring in the license and gives more convenience to language users. Besides this, reasoning in OREL may infer some implicit but useful information. For example, a dealer only grants permission to faculties of a department and their relatives to access a resource. When an unknown user named "Alice" request the resource, reasoning system of OREL can help us infer that whether she/he is a faculty or faculty relative of the department by reasoning with the Personal Information of "Alice". Of course, the reasoning needs the support of Semantic Web environment.

Reasoning ability of OREL makes it possible to partly resolve the problem of "Fair Use" [6]- a big problem challenging DRM. XML Syntax cannot provide a flexible mechanism to explicitly describe the implicit domain that who has right to fair use the resources and how to fair use them. Ontology language such as OWL do not need to express who or how explicitly. We may create a class, and restrict each of its instances to a certain property value. So when semantics is added to licenses, the problem of making such expression sometimes gets simpler. We can express that some kind of "Agent" are fair users, and they can do some kind of "Act" for some kind of "Purpose" ("Purpose" may be added to core OREL ontology). Then in virtue of Semantic Web, OREL reasoning engine will search and query the Personal Information System and maybe infer that everything is suitable or not. Now OREL is just a starting attempt and can only resolve very limited fair use problem. But we do believe that with a collaboration of multi-systems such as Semantic Web, knowledge repository, Tracking System and so on, it is possible to resolve fair use to some acceptable extent.

5. CONCLUSION

We represent OREL, a new Rights Expression Language based on ontology. OREL is powered by the Semantic Web technologies. Its expressiveness and flexibility make it worth trying. Moreover, the ability to support semantic query and reasoning with digital rights makes it worth expecting. With the advance of Semantic Web, OREL would reveal its great advantages.

We have released the OREL version 0.5. A Java-based OREL engine and an OREL-powered player are achieved at prototype stage. More information about OREL was posted on http://xobjects.seu.edu.cn/resource/drm/orel/home.htm.

6. ACKNOWLEDGMENTS

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