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Design of a Semantic License Model for supporting Sell and Buy of User Created Content

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Abstract

In these days, the creative user really enjoys creating digital items and sharing their works with other people on the Web. Most users, who create digital contents, want to make secured packages of their works and distribute them with the attachment of valid licenses. To make the user-centric DRM functionality possible, we found that license management should be more intelligent to enable users make appropriate licenses for the secured distribution of their created works. In this paper, we define the semantic-based rights expression and management model for the user generated content. Unlike the previous XML-based rights expression models, our license management model conceptualizes the internal and external knowledge structures of entities like user, content, role, license, right, constraint, device, and domain by adopting ontological engineering.

Keywords: *User Created Content, License, Rights, DRM*

1. Introduction

In these days, the creative user really enjoys creating digital items and sharing their works with other people on the Web. Most users, who create digital contents, want to make secured packages of their works and distribute them with the attachment of valid licenses[1]. Current DRM(Digital Rights Management) systems, however, do not provide the functionality, which supports the requirement of the creative users who are considered as just consumers by the current available DRM systems[2].

DRM systems have functionality for controlling and managing digital rights for use and distribution of digital assets. A DRM system must have a rights control module as a core component, which is implementing a particular rights expression specification[3][4]. A rights expression language is designed for digital rights management. The Moving Pictures Expert

Group(MPEG) proposes specifications of a REL and RDD(Rights Data Dictionary) as the fifth part of the MPEG-21 standard that formalizes multimedia framework[5]. Many existing DRM systems employ MPEG-21 REL/RDD or OMA DRM specifications to implement their rights management components[6].

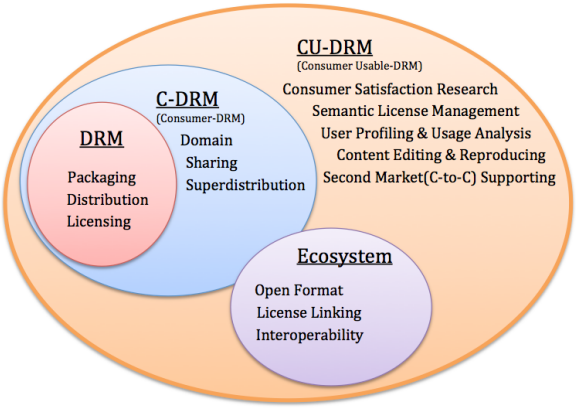

Fig. 1. The direction of the DRM system's evolution

As shown in Fig. 1, however, the objective of developing DRM systems is changing from the strict restriction of use and distribution of digital assets to the consumer-centric use, share, and distribute. As rapid evolving of authoring applications like apple iMovie, users(consumers) can make high quality multimedia contents easily. Further, they distribute and share their own contents by using social networks, YouTube, or etc. To make the user-centric DRM functionality possible, we found that license management should be more intelligent to enable users make appropriate licenses for the secured distribution of their created works.

In this paper, we define the semantic-based rights expression and management model for the user generated content. Unlike the previous XML-based rights expression models, our license management model conceptualizes the internal and external knowledge structures of entities like user, content, role, license, right, constraint, device, and domain by adopting ontological engineering. After creating a digital item, a user can make an instance of the UGC class by defining property values about the his own content, and then he creates a new license for the content by composing the required rights and constraints. Each user created content can have one or more licenses with different types, reproduction, distribution, and usage. Based on our semantic license model, we can support a new business model in which users can sell and buy their created digital items in a secure environment.

The structure of this paper is as follows. First, we introduce drawbacks of the standard XML-based RELs and previous ontological transformations in section 2. Section 3 represents our approach extends the MPEG-21 REL and defines a semantic rights expression model, including new constructs for supporting the formal specification of use, share, and distribution of user generated content(shortly UGC).

2. Rights Expression Languages

The MPEG-21 REL is an XML-based formal language that defines the syntax and semantics to specify rights and conditions for users to use digital assert under the controlled ways. In the MPEG-21 REL data model, the license is the one important element, which contains one or more grants and an issuer. The license is a collection of grants, which allow principals to have rights over resources, issued by one or more issuers. The principal denotes the identification of an entity holding rights to execute digital works under some conditions. The rights granted to the principal specify acts to be performable on resources, such as print, play, move, delete, and so on[5].

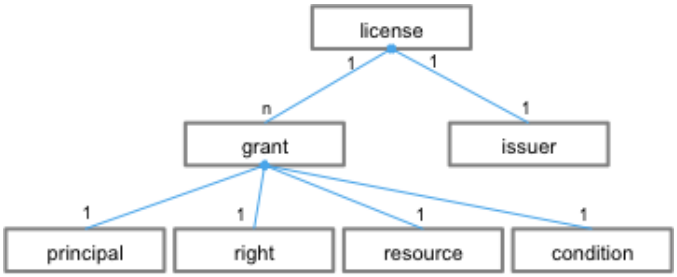

Fig. 2. The data structure of the MPEG-21 REL

MPEG-21 REL can be extended for supporting new business models by defining extensions. However, the new business model of UGC has to support the more functions of consuming, share, distribute, sell, and adaptation performable by original authors as well as second authors. There are some approaches to define the ontology-based models for rights expression through transferring XML-based syntaxes to OWL syntaxes[7]. They create mapping rules between XML and OWL constructs and propose OWL documents corresponding to RELs of MPEG-21 REL, ODRL REL, and Creative Commons REL[8].

However, these ontology models are not appropriate for rights expression and management of UGC because they don't consider the semantic relationships identifiable in creating, editing, selling, sharing, distributing, and consuming UGCs.

3. Design of Semantic License Model

3.1 System Architecture

In this section, we describe the system architecture of our proposed semantic license system to support the sell and buy business model of the user created content. Our system can be used as a semantic-based license management module of the existing DRM systems. As you can see in Fig. 3, our system has a client - server architecture and is composed of four components, Content Server, License Server, Semantic Map Server, and Consumer Manager.

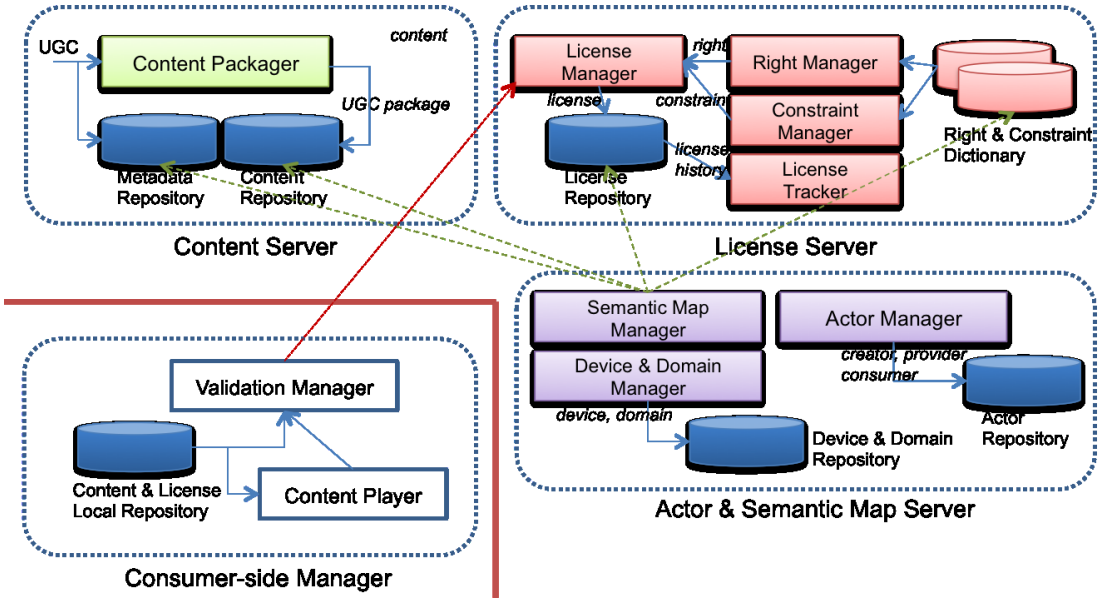

Fig. 3. The system architecture for supporting the user-centric license model

Content Server performs two different functions, which are annotating and packaging user generated content. Given the new content, the user adds metadata for describing characteristics of the content and request secure packaging of the content of the content packaging module. Annotated and packaged contents should be stored into the content repository. The creator has authority for creating different types of licenses to allow the user to access packaged contents. License Server supports the functionality of managing licenses, rights, and constraints.

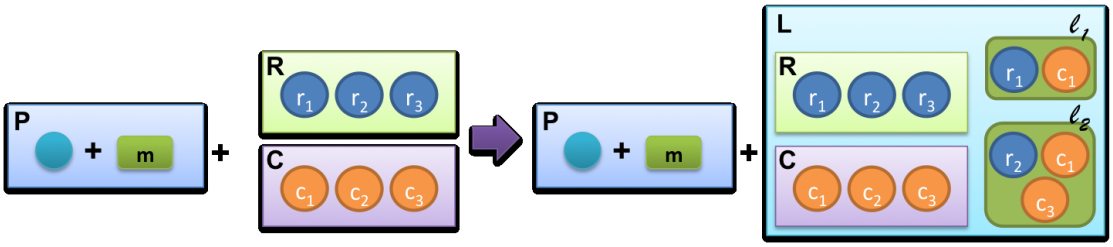

Fig. 4. Interlinking between packaged content and licenses

For a packaged content, the creator creates one or more rights and constraints. For example, a print right is granted to users with three time constraint for a new fashion webzine. After that,

one or more licenses can be created through the combination of selected rights and constraints. Fig. 4 shows the interlinking between a packaged content and licenses, which are composed of rights and constraints.

3.2 Semantic License Model

As described in section 2, the existing RELs have the nested entity structure and defined with XML-based syntaxes. In XML-based REL model, a license is key entity, which contains an issuer and one or more grant entities. A grant entity includes resources, principal, right, and condition entities. A license has one or more resources in the hierarchical path of which a route is the license itself. There is no semantic information between entities in this model. As you can see in Fig. 5, we have a different concept to organize entities for supporting authorized usage of the content. Our semantic license model consists of four types of sub models, which are actor model, resource model, license model, and trace model.

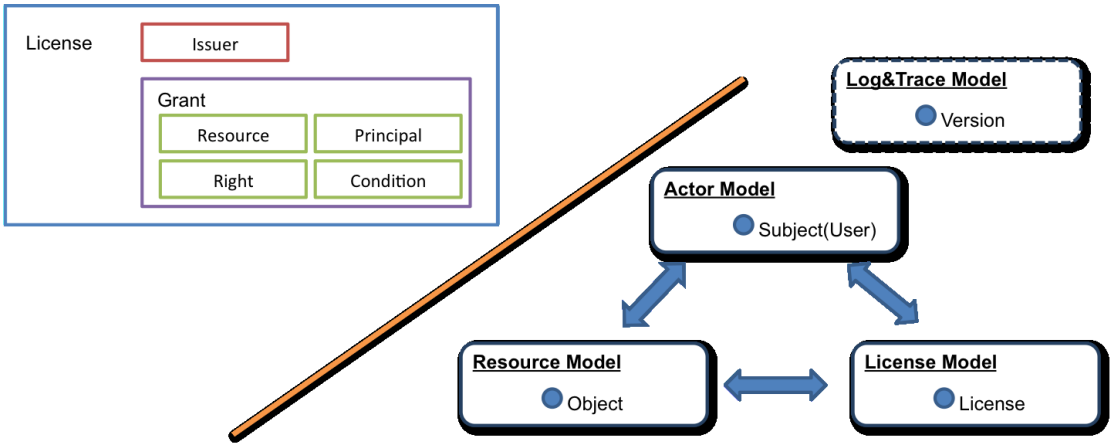

Fig. 5. Difference between XML-based nested entity model and concept-based semantic model

Actor model is composed of classes to conceptualize different actors doing creation, modification, usage, and distribution of the content and license. Resource model is composed of classes to represent multimedia items to be created and consumed by users. License model consists of classes to define licenses, rights and constraints. Trace model has classes, which define modification history, version, and logging of contents and licenses. These classes belong to different models have semantic relationships. Thus a user-generated content has links to multiple licenses with *hasLicense* relationship.

Fig. 6 shows an example of the semantic map consisting of concepts and relationships for representing share and distribution of UGC-related digital works. In this figure, Alice is a consumer of certain multimedia content. She has a valid license to download and play the

content as well as distribute it to her friends who are granted to get the content. There are semantic relationships between entities, such as hasLicense, hasRight, hasRestriction, and so on.

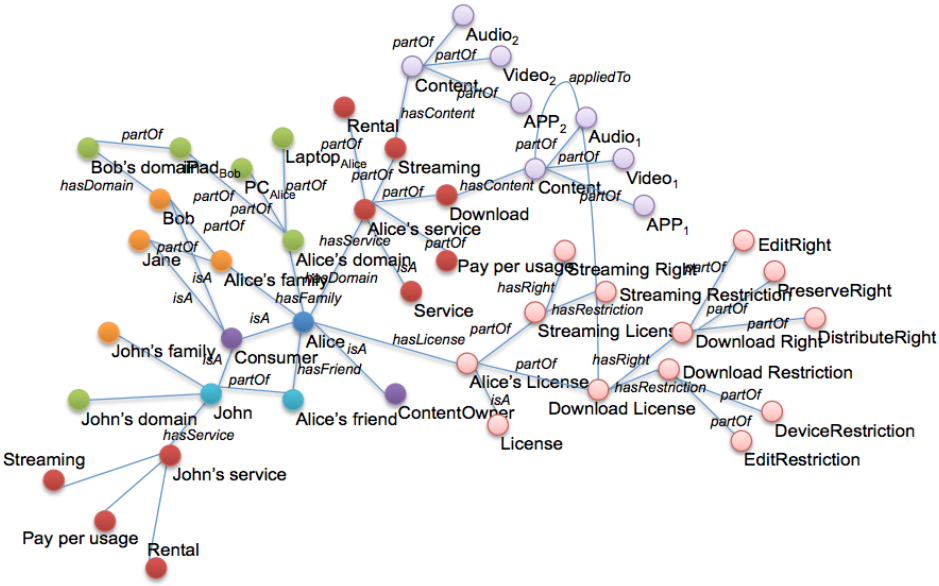

Fig. 6. Semantic map representing concepts and relationships of our proposed semantic model

We have referenced FRBR (Functional Requirements for Bibliographic Records) specification to define user created content semantically and formally. Borrowing a few concepts, which representing work, person, organization, subject, from FRBR, we define digital asserts authored and reproduced by users with the following keywords: physical work, format, analogue, electronic, books, paper, film, textual, music, video, and so on. Fig. 7 shows the partial structure of our proposed semantic model.

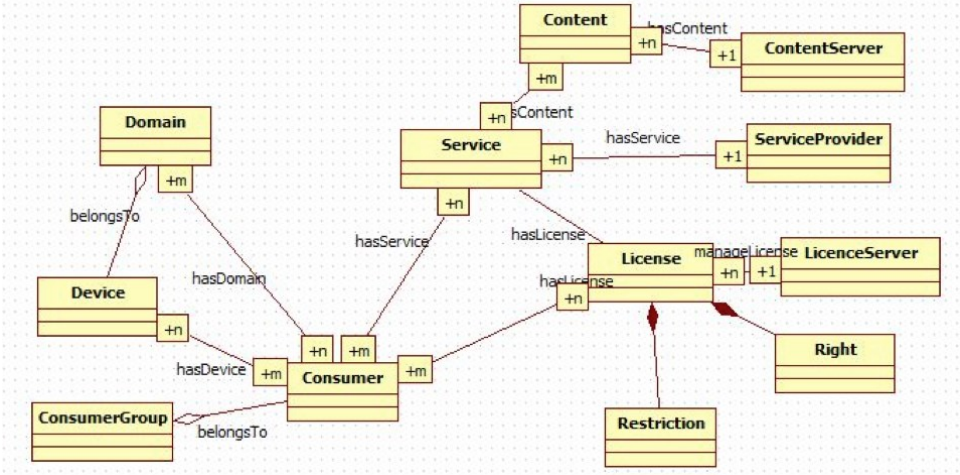

Fig. 7. Data model of our proposed semantic model

4. Design of License Ontology

4.1 Class definition

We design the license ontology for supporting semantic-based rights management for user created content. Table 1 shows the list of classes defined in the license ontology.

Table 1. Classes of the license ontology

Class Name	URI	Definition
Person	http://drm.dlicense.org/principal/person	Abstract person class
Organization	http://drm.dlicense.org/principal/organization	Abstract organization class
Creator	http://drm.dlicense.org/principal/creator	Person or organization creates contents
Owner	http://drm.dlicense.org/principal/owner	Person or organization owns contents
Consumer	http://drm.dlicense.org/principal/consumer	Person or organization uses contents
Provider	http://drm.dlicense.org/principal/provider	Person or organization distribute contents
Issuer	http://drm.dlicense.org/principal/issuer	Person or organization issues licenses
UserCreatedContent	http://drm.dlicense.org/principal/ugcontent	User created content
LicenseType	http://drm.dlicense.org/principal/licenseType	License type
LicenseStatus	http://drm.dlicense.org/principal/licenseStatus	License status
License	http://drm.dlicense.org/principal/license	License
Right	http://drm.dlicense.org/principal/right	Right

The user created content can be created by a person or organization and then it can be owned by another person or organization because the creator can hand the right of the content over to another person or organization. Thus, we define several types of roles, which a person or organization can have in our system, as classes such as *Creator*, *Owner*, *Consumer*, *Provider*, and *Issuer*. In our semantic license model, a license has a specific type, which can be reproduction, usage, and distribution. Each type also has several types of rights, such as adopt, modify, play, copy, print, and so on.

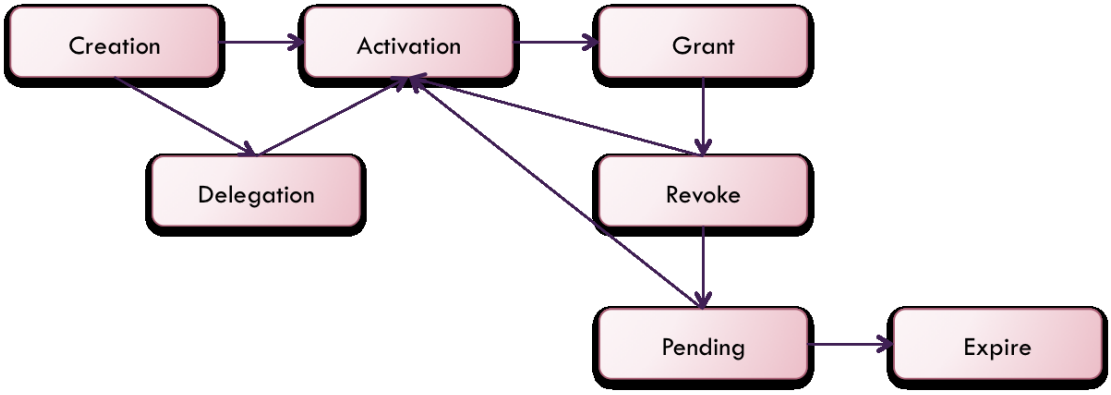

Fig. 8. The life cycle of a license

We define the life cycle of a license using *LicenseStatus* class as depicted in Fig. 8. A license can be created, activated, granted, revoked and expired through performing sell and buy contents by users. License class defines the characteristics of a license, of which rights and constraints are defined by Right and Constraint classes.

4.2 Property definition

In this section, we represent some part of our property design of the license ontology. Table 2, table 3 and table 4 shows properties that can be assigned to Person class, User Created Content class, and License class respectively. The property is defined as data type property, which has a text value, and object type property, which has a Unified Resource Identifier to connect to another object.

Table 2. Properties of Person class

Property	Type	Cardinality	Domain	Range
personID	Data	-	Person	URI
personName	Data	-	Person	String
description	Data	-	Person	String
creator	Object	1:n	Person	Creator
owner	Object	1:n	Person	Owner
provider	Object	1:n	Person	Provider
issuer	Object	1:n	Person	Issuer
consumer	Object	1:n	Person	Consumer

Table 3. Properties of User Created Content class

Property	Type	Cardinality	Domain	Range
contentID	Data	-	UserCreatedContent	URI
contentTitle	Data	-	UserCreatedContent	String
contentFormat	Data	-	UserCreatedContent	String
conceptTerm	Data	-	UserCreatedContent	String
createdDate	Data	-	UserCreatedContent	Datetime
publicDate	Data	-	UserCreatedContent	Datetime
linkToFile	Data	-	UserCreatedContent	URI
fileSize	Data	-	UserCreatedContent	Numeric
description	Data	-	UserCreatedContent	String

Table 4. Properties of License class

Property	Type	Cardinality	Domain	Range
licenseID	Data	-	License	URI
licenseType	Object	1:n	License	LicenseType
licenseTitle	Data	-	License	String
licenseStatus	Object	1:1	License	LicenseStatus
issuer	Object	1:1	License	Issuer
createdDate	Data	-	License	Datetime
expiredDate	Data	-	License	Datetime
Rights	Object	1:n	License	Right
constraints	Object	1:n	License	Constraint

5. Evaluation

We evaluate the correctness and coverage of our designed license ontology in this section. First, we examined the requirement of users for selling and buying the user created content. Table 5 shows the seller's requirements and the buyer's requirements. After examination of the requirements of users, we know that the both of creators and consumers want to control and access the various types of licenses.

Table 5. The requirements of sellers and buyers of the user created content

Content/License	Seller's requirement	Buyer's requirement
Content	Explicit specification of roles	Consume the content with various manners
	Control of rewriting or reproduction of the content	Reproduction the content under valid grants
	Monitoring the usage	Own or resell the bought content
License	Control of licenses in ease	Buying various types of license
	Control of rights and constraints	Domain – multiple devices
	Tracking history of license usage	Superdistribution – share with family or friends with grants
	Knowing favorite rights types	Hanging licenses over to others

Fig. 9 shows an instance, which can be created in our license ontology, to support buying contents and different types of licenses. From our semantic model, users create their desired types of licenses and trace the status of all created licenses. In addition, consumers can use contents simply, i.e. play, print, copy, perform, etc or they can reproduce their owned contents with valid reproduction licenses. These scenarios can be realized and supported using our designed semantic model.

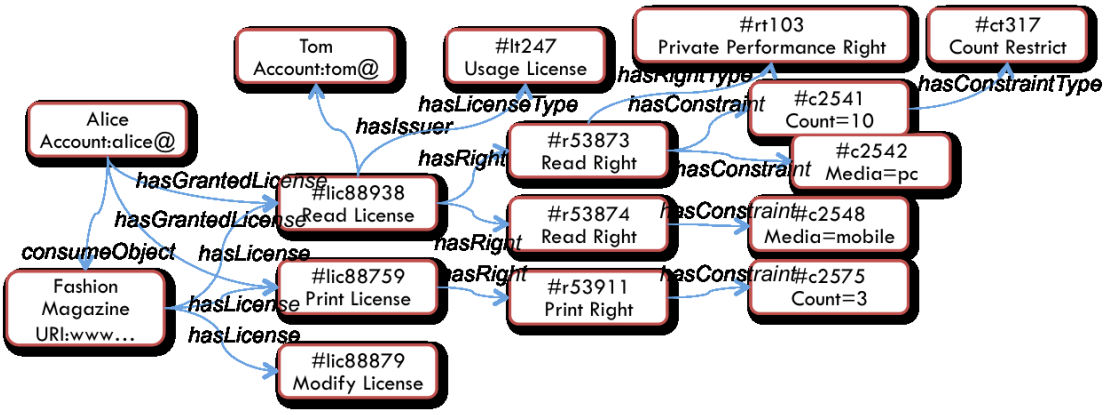

Fig. 9. An instance for representing the buyer's activities of the semantic license model

6. Conclusions

Interoperability of DRM systems as well as support of UGC-based business model is an important issue to be handled in the near future. Our approach represents the meaningful early stage of rights expression and management for creating the semantic map of UGC. In this paper, we described the semantic-based rights expression and management model for the user generated content. The contribution of our proposed model is the invention of a new semantic model, which supports selling and buying user created contents under control of different types of licenses. Further, we concentrate the development of the complete ontology model to support a marketplace for user created content and the related intelligent services.

Acknowledgement

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