

Definition of mechanisms that enable the exploitation of governed content

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Abstract

Digital Rights Management (DRM) systems control the use of governed multimedia content through the complete digital value chain. They enable business models in which the creation, exploitation and distribution of digital objects can be controlled according to the terms and conditions stated by content owners, aggregators, etc.

In this context, a key issue is the definition of mechanisms to enable the governed use of content thorough the B2B value chain and to specify the rights and constraints required for the rights expressions governing the digital objects.

This paper presents relevant use cases where governed digital objects are manipulated and determine the rights and conditions that can be used in the licenses that will be issued to enable the manipulation of this governed digital objects.

1 Introduction

A key issue in DRM is to control the use of multimedia content through the complete value chain, from creation to distribution.

This paper presents mechanisms to enable exploitation of governed content through the B2B content value chain. DRM systems will use these mechanisms to enable business models where the composition, transformation, aggregation, etc., of multimedia content is controlled according to the constraints imposed by content owners.

This paper is organised as follows. First, we present DRM systems and their components; essentially we focus in the creation of rights expressions. Then, we present relevant use cases regarding the composition, aggregation, deletion, etc., of digital objects. For each use case, we present mechanisms to enable the

governed derivation and use of digital objects through the complete digital value chain. Finally, some conclusions are drawn and some future work are presented.

2 Digital Rights Management

Digital Rights Management (DRM) systems manage the use of governed digital objects in a controlled way. These systems enable the creation, adaptation, distribution and consumption of multimedia content according to the permissions and constraints specified by content creators or rights issuers.

DRM systems provide mechanisms to create rights expressions that will govern the use of multimedia content through the complete digital value chain. For example, when an aggregator buys content, he/she agrees to certain permissions and constraints, as gathering digital content to be reused or redistributed.

Then, DRM systems enable business models where the use of governed multimedia content is controlled according to the restrictions stated by content creators, aggregators, distributors, etc. These systems are made up a set of elements that has been specified by different standards as MPEG-21 [1] or OMA DRM [2]. However, we only present the creation and enforcement of rights expressions since they are the most relevant aspects that will be addressed in this paper.

2.1 Rights Expressions

Rights expressions are defined to be the terms that govern the usage of digital content. These permissions and constraints are usually presented to the different actors of the value chain as an XML file, usually referred to as license, that is expressed according to a Rights Expression Language (REL). Licenses comprise the digital content usage rules and are associated with

entities and digital assets specified within them. Licenses can be interpreted and enforced by DRM systems. The semantics for the rights specified within the licenses are defined in rights data dictionaries. These dictionaries provide the ability to grant specific rights to users with a specific semantics to license generation services.

In some cases, licenses also contains information related to the protection of digital content, for example, information related to the protection tools or to the key needed to decipher digital objects or assets.

Typically, licenses are signed to provide integrity and authenticity to the terms that govern digital objects.

3 MPEG-21

MPEG aim is to define a multimedia framework to ensure that systems that distribute and use digital content are interoperable.

MPEG-21 has identified and defined the different elements needed to support the multimedia delivery chain and the relations among them. The MPEG-21 multimedia framework has two essential concepts: Digital Items that represent fundamental units of distribution and users interacting with them.

Different parts of MPEG-21 standard normatively specify different pieces and formats needed by a complete DRM system. These parts are MPEG-21 Digital Item Declaration (DID, Part 2) [3], Rights Expression Language (REL, Part 5) [4], Rights Data Dictionary (RDD, Part 6) [5], Intellectual Property Management and Protection Components (IPMP, Part 4) [6] and Event Reporting (ER, Part 15) [7]. Part 2 specifies the model for a DI that is constituted by the digital content, referenced or embedded, plus related metadata that describes additional information regarding the content, i.e., protection, governance and processing information. MPEG-21 REL defines a machine-readable language to declare rights and permissions using the terms as defined in the Rights Data Dictionary. MPEG-21 RDD comprises a set of clear, consistent, structured, integrated and uniquely identified terms. The structure of the RDD is designed to provide a set of well-defined terms for use in rights expressions. MPEG-21 IPMP Components deals with the standardisation of a general solution for the management and protection of Intellectual Property. Digital Items can be protected in order to ensure that the access to the contents is done according to the license terms. The solution lies in the use of digital signatures and encryption techniques over the digital content, which makes it possible to deploy a business model that ensures the accomplishment of the license

terms in a controlled way. MPEG-21 ER provides a standardised means for sharing information about Events amongst Peers and Users. Such Events are related to Digital Items and/or Peers that interact with them.

3.1 MPEG-21 REL

Part 5 of the MPEG-21 standard specifies a Rights Expression Language (REL) that defines the syntax and semantics of the language for issuing rights for users to act on digital items and their components.

MPEG chose XrML [8] as the basis for the development of the MPEG-21 REL [4].

The most important concept in REL is the license that conceptually is a container of grants, each one of which conveys to a principal the sanction to exercise a right against a resource. A license is formed by the elements title, inventory, grant or grantGroup, issuer and otherInfo. The title element provides descriptive information about the license. The inventory element is used for defining variables within a license. The grants and grantGroups are the means by which authorization policies are conveyed in the REL architecture. The issuer element contains information related to the identification of the issuer and to the circumstances under which the license was issued, this element usually also contains a digital signature for the license.

Finally, the other information element may place additional information relevant for the license. Fig. 1 shows the structure of an MPEG-21 REL License.

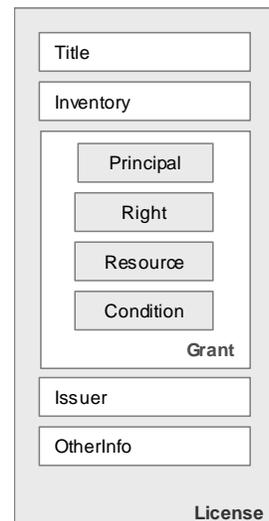


Fig. 1. MPEG-21 REL License structure

A grant is formed by four elements, the principal that represents the unique identification of the entity or

entities to which rights are granted. The right element specifies the action the principal may perform. The resource element represents the object against which the principal of can exercise the granted rights. And the condition element that specifies the requirements and constraints that must be satisfied before the principal can perform the requested action.

3.2 MPEG-21 RDD

The MPEG-21 Rights Data Dictionary [5] comprises a set of clear consistent, structured, integrated and uniquely identified Terms to support the MPEG-21 REL. The RDD Dictionary has the characteristics of an ontology that represents a structured catalogue of well defined terms in which meaning is inherited. The terms defined in the RDD can be used in licenses governing the use of digital content. The methodology used in the RDD to create the standardized terms may be used also to create new terms under the governance of a Registration Authority.

MPEG-21 RDD defines the RDD system that is comprised of three elements, the specifications contained in the RDD Standard, a dictionary where the terms are defined and a database that is the tool containing the RDD Dictionary and supporting its maintenance.

The use of this system will facilitate the exchange and processing of information between parties that create or enforce rights.

4 Composition of governed digital objects

Since MPEG-21 has already standardized multimedia extension of basic rights, by mainly taking into account end-user consumption, AXMEDIS license model could introduce further extension of those rights. This extension should allow producing licenses for content exploitation along the B2B content value-chain.

Next sections present a relevant selection of content manipulation examples. The scenario based approach has been chosen, for it has provoked the reasoning among action semantics, thus determining the corresponding set of rights to be owned.

For each examples, the following will be specified: all the needed rights, which is the asset each right refers to, how to identify the involved assets and under which condition each right can be exploited.

For this purpose, we will study the MPEG-21 REL and RDD standards and determine if they specify the permissions and constraints needed to enable governed

manipulation of content specified in the different presented scenarios.

First, we will determine if the rights required for the different proposed scenarios are defined in the MPEG-21 RDD and if their semantics is appropriate. Then, we will propose an extension or profile for MPEG-21 REL that enables the creation of licenses supporting these rights. Moreover, we will also propose conditions regarding content exploitation that will form part of the proposed extension or profile for MPEG-21 REL.

5 Addition of resources to governed digital objects

This section presents some relevant examples of addition of digital resources to governed digital objects. For each of the presented scenarios, we will specify the elements needed to create the right expressions that will grant to the user the permissions to add governed content.

The main elements of an MPEG-21 REL license are the grant and the issuer, within the grant the principal, right, resource and condition elements are specified. In this section we will only define the rights and conditions required in each use case, as the types defined in MPEG-21 REL for the other elements of a license fulfil the requirements for the different use cases presented in this paper.

5.1 Adding to root level

This section presents the process of adding elements to the root level of a governed digital object. Then, the user must have the appropriate permissions to embed digital objects and/or assets to a governed digital object.

In order to determine the rights expressions needed in this process, we will consider the use case sketched in Fig. 2, in which a user tries to aggregate two objects, AX01 and AX02, to the digital object AX04. In this scenario, the licenses governing these objects shall grant the user the right to modify or adapt the digital object (AX04) embedding within it AX01 and AX02.



Fig. 2. Adding resources to the root level

Then, the user shall obtain a license that grants him permissions to embed AX01 and AX02 and to adapt or modify AX04 by adding to it. These licenses will be restricted to certain constraints usually referred to the aggregation process and to the resultant digital object.

Fig. 3 shows the license issued by the owner or distributor of Res A and Res B to the aggregator. This license is formed by the following elements: the identification of the aggregator that is the principal of the license, the embed right, the resources Res A and Res B that will be used for aggregation and the conditions that must be fulfilled to perform such aggregation. Finally, the issuer element identifies the manufacturer of both resources.

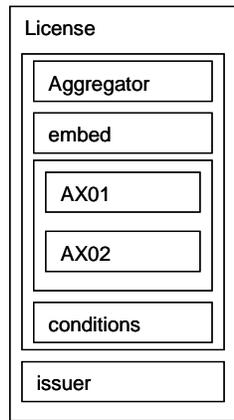


Fig. 3. Embedding license

This license uses the *embed* right specified in MPEG-21 RDD and defined as the right to put a Resource into another Resource.

Note that this right does not form part of any of the MPEG-21 REL extensions or profiles defined yet.

On the other hand, the user also must have permissions of modification or adaptation over the digital object AX04.

If the user chooses the adaptation option two different digital objects will exist as result of the addition process, the original one in unchanged form and the newly made. MPEG-21 RDD defines the term *enhance* as the right “to derive a new resource which is larger than its source”. This right permits the licensee to change the original digital object by adding to it, for example embedding other resources. These changes are made temporarily to the original object, but they are not saved in the original object at the end of the process. Then, at the end of the process a new object is generated with such changes.

Fig. 4. presents the MPEG-21 REL license that will grant to the aggregator permissions to enhance the

digital object identified as AX04 with some restrictions specified within the conditions element of this license.

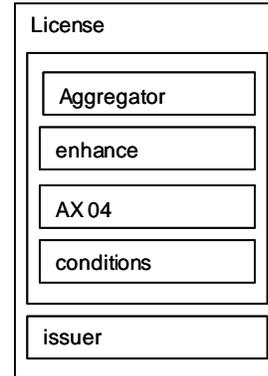


Fig. 4. Adaptation choice - AX04 enhancing license

If the user chooses the modification option, only the modified object will be preserved. For this purpose, MPEG-21 RDD defines the term *enlarge* as the right “to Modify a Resource by adding to it”.

Fig. 5 presents the MPEG-21 REL license that will grant to the aggregator permissions to enlarge the digital object identified as AX04 with some restrictions specified within the conditions element of this license. Then, he can add new material, including the embedding of other resources or elements, for example AX01, but not the changing or removal of existing elements of the original digital object.

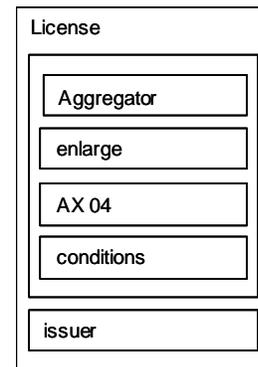


Fig. 5. Modification choice – AX04 enlarging license

MPEG-21 REL specifies some conditions related to the consumption or distribution of digital content, nor to the process of deriving or aggregating new content. Then, in order to provide content owners the ability to impose some restrictions in the creation and use of derived content, conditions related to the governance of derivative works may be specified in an extension of profile of MPEG-21 REL.

When defining conditions it is also important to take into account if the semantics defined for the rights used is so restrictive as desired for the licensee. Then, in this use case may be also necessary the definition of conditions that act as restrictions in the addition process. Once specified, these conditions should also be added to the proposed REL extension or profile.

5.2 Adding to nested level

This section presents the process of adding elements to nested levels of a governed digital object.

Fig. 6 presents an addition use case in which a user wants to add a digital object, AX05, to the AX03 element of the AX04 digital object. In order to perform the addition process in a controlled way, the user must have the appropriate permissions to embed some digital resources to a governed digital object.

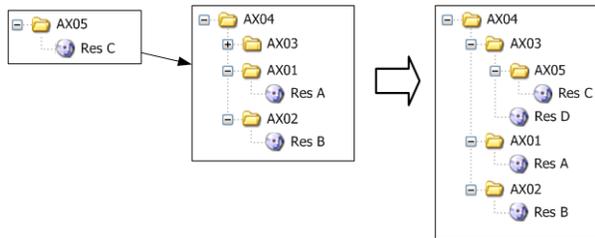


Fig. 6. Adding resources to nested levels

In this use case the permissions that must be granted to the licensee are the same as in the “Add to root level” use case presented in section 5.1. Then, the aggregator in order to modify the governed objects must have two licenses: one that grants him the right to embed AX05 object and the second one that allows him to enhance or enlarge the digital object AX04 and its component AX03.

6 Governed transformation of digital objects

This section presents the mechanisms that Rights Expression Languages must provide in order to enable the creation of rights expressions governing the transformation of digital objects.

Then, content owners could state the terms and conditions that will govern the transformation of their objects and that will be enforced by DRM systems through the complete digital value chain. These terms and conditions are presented to other actors of the value chain as licenses expressed according to a REL.

6.1 Transformation of basic objects

The first use case presented is the simplest one. This use case addresses the process of transforming governed objects and is shown in Fig. 7.

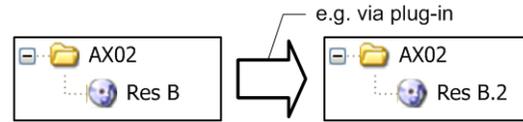


Fig. 7. Basic transformation

In this scenario, the licensee shall issue a license to the user that grants him the right to transform the asset Res B. MPEG-21 RDD defines the term *modify* as the right “to change a resource preserving the alterations made”.

Then, the MPEG-21 license results as follows: the principal contains the identification of the user that can modify (right element) the AX02 (resource element) if certain conditions are previously fulfilled. Fig. 8. shows the structure of the basic transformation license.

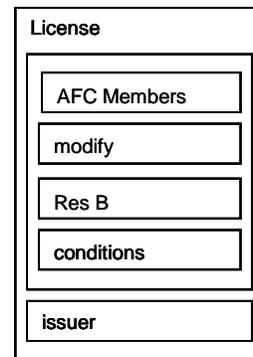


Fig. 8. Basic transformation license example

In use cases where content is transformed, it is important to determine the restrictions that the licensee will determine regarding to the transformation of its digital content. On the other hand, it is also important to take into account that if the original object will be preserved then the MPEG-21 RDD term used as right in the transformation license shall be the adapt right.

MPEG-21 RDD defines the term *adapt* as the right “To ChangeTransiently an existing Resource to Derive a new Resource”.

Adapt and modify rights forms part of the MPEG-21 REL multimedia extension.

A key issue when specifying this kind of licenses is to determine over which resource permissions are granted. Then, if the resource element of the transformation license is a digital asset, for example Res B the modifications only can be done over this

asset. However, if the resource element of the transformation license is AX02, then the modifications could be done over the different elements of this digital object for example for other assets that form these digital object or over the metadata describing this object.

6.2 Transformation of objects in a composition

The use case presented in this section is more complex than in previous one, since the object that will be transformed forms part of a composition. Fig. 9 presents an example in which the digital asset Res B will be transformed and forms part of a composition.

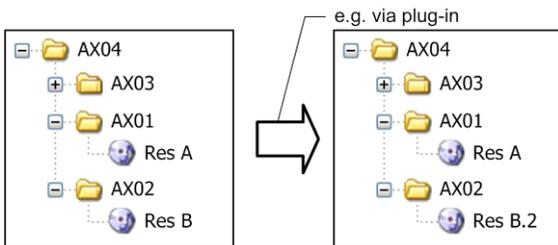


Fig. 9. Transformation of objects in a composition

The license for this use case will be the same as for previous one presented in section 6.1. Then, the license that will allow a user to perform the transformation of Res B within the composition will be the same as presented in Fig. 8. With this license the user only can modify the digital asset. However, if he wants to modify other elements within the composition he has to obtain a license granting him to modify the AX04 digital object or other specific elements within it as AX01 or the metadata associated to any of the elements.

7 Deletion of objects from a composition (from root level or nested)

This section presents the elements that Rights Expression Languages must provide in order to enable DRM systems to control the deletion of objects from a governed composition.

Example of Fig. 10 shows how different elements are deleted from a governed digital object.

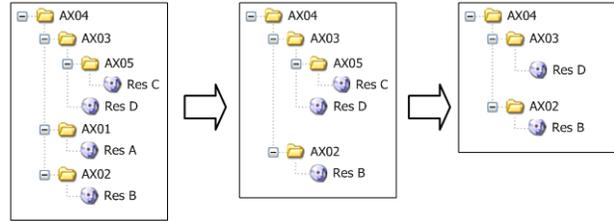


Fig. 10. Deletion of objects from a composition

In this use case the user shall obtain a license (see Fig. 11) that grants him permissions to delete digital objects from a composition.

MPEG-21 RDD defines the term *reduce* as the right “to Modify a Resource by taking away from it”. The change that can be performed when exercising reduce right is the removal of existing elements from the original digital object. At the end of the process only the modified resource is preserved.

Reduce right forms part of the MPEG-21 REL multimedia extension.

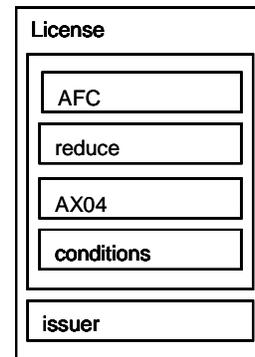


Fig. 11. Deletion license example

When granting *reduce* right, the licensee must consider if he gives permissions to remove all the elements or only a subset of them. If the licensee only grants permissions of deletion of specific elements from the original digital object, these constraints must be specified within the license as conditions.

On the other hand, in some cases the user also wants to destroy the elements taken away from the original digital object. Then, he must possess a license that grants him the right to delete these elements. MPEG-21 RDD defines *delete* term as the right “to Destroy a Digital Resource”. This right forms part of the MPEG-21 REL multimedia extension.

8 Copying of objects from a composition to another

The last use case presents how objects can be copied from one composition to another. Fig. 12 presents two governed compositions, AX04 and AX09 digital objects. The action required by the user is to copy AX02 from the first composition to the second one.

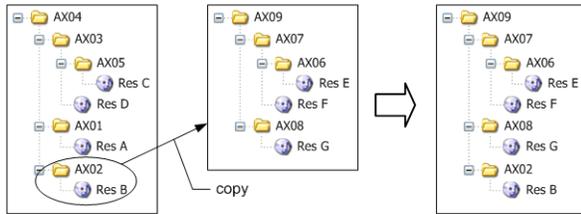


Fig. 12. Copying objects use case

In this scenario, the user shall have a license that grants him to copy AX02 from Composition 1 and to enlarge or enhance Composition2 with AX02.

MPEG-21 RDD does not define the copy right. Then, a new term shall be created under the governance of the RDD Registration Authority. This term will be defined as a specialization of Adapt defined in the RDD as the action “to ChangeTransiently an existing Resource to Derive a new Resource”.

Nevertheless, in the base profile the element *governedCopy* is specified. This element represents the right to copy a resource, in our use case the AX02 element, and at the same time to result in certain rights being associated to the copied resource. The attribute *governanceRule* of this right indicates the name of a governance rule that determines how exactly the copy should be made and what rights should be associated and by whom for the copied resource.

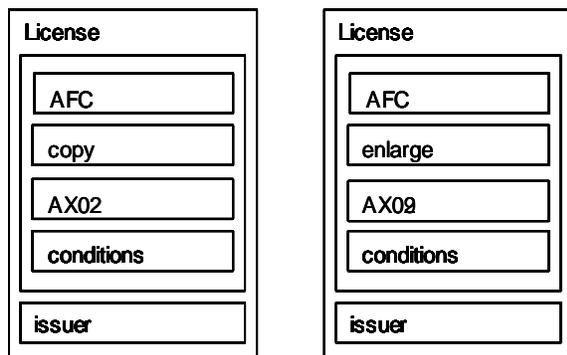


Fig. 13. Licenses for copying use case

If we choose the first option, that is to define the copy right, then the licenses that shall be granted to the user in order to perform the copy from a governed composition to another are the presented in Fig. 13.

9 Conclusions

This paper has presented mechanisms to enable exploitation of governed content in a controlled way through the B2B content value chain.

The required elements for Rights Expression Languages and Rights Data Dictionaries have been defined in order to enable these models. Moreover, we have specified the rights expressions that govern digital content for the different use cases proposed. These elements must form part of a rights expression language to be further used in licenses governing the exploitation of digital content.

In this paper, we have identified the rights needed to enable the derivation of content that does not form part of MPEG-21 REL. Then, we propose to create a new MPEG-21 REL extension that will support these rights.

Further work is needed to determine the conditions that content owners could require when creating rights expressions that will govern their content in order to restrict the permissions granted over their digital objects. These conditions will be related to the governance of the derivative works or to the derivation process itself. This condition may be also specified in the new MPEG-21 REL extension.

Acknowledgements

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