

Electronic Rights Enforcement for Learning Media

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Abstract

In this paper we present a possible approach to the application of digital rights languages in the field of learning media, and indicate how it facilitates the establishment of new learning media services (specifically rights enforcement). Digital rights languages are used to specify usage rights to learning resources (LR) in electronic contracts. Important issues for rights enforcement are to identify those parts of contracts which can reliably be enforced electronically, as well as suitable means of translating the enforceable parts into concrete access control information. We addressed these two problems by identifying criteria for the enforceability of electronic contracts, and by designing a flexible strategy for translating the expression of rights into access control information.

1. Introduction

The E-Learning community applies metadata standards such as Learning Object Metadata (LOM) [8] or Dublin Core [4] to enrich the description of digital learning resources, and to provide sophisticated support services for learning resources, such as searching, processing or evaluation.

One crucial factor in the success of learning media is the protection of intellectual property rights (IPR). LOM defines a vocabulary for IPR issues that, at least in our experience, provides an inadequate basis on which to formulate rights expressions for learning resources. Instead, the exchange of such resources should be managed by digital contracts established between LR provider and LR consumer. Metadata standards known as *digital rights languages* (examples are Open Digital Rights Language (ODRL) [9] and Extensible rights Markup Language (XrML) [2]) already exist in the field of contract management. The language concept and vocabulary provided by these digital rights languages enable the expression of usage rights for learning resources, as well as other terms and conditions for the use of digital goods in general.

2. Digital rights languages and learning media

Contracts formulated in a digital rights language may enclose (or reference) descriptions in other metadata standards (see Figure 1). An electronic learning resource contract comprises three main components:

- *Parties*: LR provider and LR consumer (described, for example, using vCard).
- *Usage Rights*: specified LR usage rights, described using e.g. ODRL or XrML.
- *Assets*: learning resources to which the specified rights apply, described with e.g. LOM or Dublin Core.

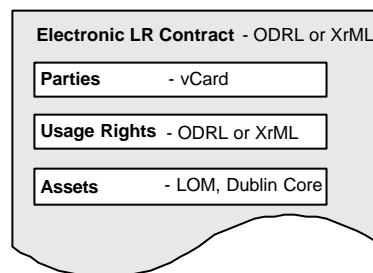


Figure 1: Merging different metadata standards in electronic learning resource contracts

The additional metadata about usage rights to learning resources is designed to facilitate the offering of new learning media services [3]. The most important new services are:

- supporting electronic rights enforcement,
- supporting intellectual property rights (IPR) protection,
- providing sophisticated accounting and sales figures,
- providing information about legal relationships to learning resources,
- automated license phrasing.

In the remaining sections we will focus specifically on the service of "electronic rights enforcement".

3. Enforceability of digital contracts

Electronic rights enforcement aims to verify specified usage rights in digital contracts and ensure their observation – both by electronic means. Not all usage rights that can be expressed using digital rights languages can be electronically enforced. We have divided usage

rights into three categories, based on their level of *enforceability* in electronic contracts:

- *Non-enforceable rights*: those parts of electronic contracts specifying usage rights for learning resources, observation of which cannot be monitored by computer technology.
- *Potentially enforceable rights*: those parts of electronic contracts specifying usage rights for learning resources with a high potential for enforcement by computer technology, under certain circumstances.
- *Enforceable rights*: those parts of electronic contracts specifying usage rights for learning resources, observation of which can be monitored by existing computer technology.

We aim to identify and comment on enforceable usage rights in digital contracts. In order to identify such rights we need clear criteria for determining the level of enforceability of a given set of rights. Below we accordingly outline the main criteria for each level of enforceability.

I. Availability of required information

The first criterion for an enforcement system to be successful is that all required information can be recorded, and is available to the system.

Example: As the extensibility of digital rights languages is limitless, there are no boundaries to the formulation of rights expressions. The following right might not be a common one, but it represents a possible clause in an electronic contract.

“The consumer may have access to my entire learning material, after he has invited my department for a discussion round.”

The precondition “after he has invited my department for a discussion round” is not enforceable, since the necessary information (receive invitation) on fulfillment of the precondition cannot be recorded by the system.

II. Availability of appropriate technology

A second criterion is the availability of an appropriate technology that permits monitoring of specified usage rights for the learning resource format concerned.

Example: A specified usage right for a learning resource could be (in words):

“The LR consumer may show the digital teaching video to a class once per semester.”

We now have all relevant information required to enforce this right. However, in order to prevent the video from being shown more than once per semester, we need a reliable enforcement technology capable of monitoring the

usage rights of video formats. The music industry is currently promoting the development of such technology.

III. Implementation of a trusted environment?

The third main criterion is the implementation of a trusted environment. Rights enforcement in a “trusted” environment is more likely to be successful than in an “untrusted” one.

Example: Rights enforcement is easier to implement if the learning resources concerned are not delivered to the LR consumer, but remain with the LR provider. In that case, the system administrator of the learning media retains responsibility for system-based access control of the resources. Conversely, rights enforcement is hard to implement if the execution of usage rights is managed by software on the client PC, as management of access rights is not the responsibility of the delivery system anymore. We classify the environment of the LR provider as relatively “trusted”, and that of the LR consumer as relatively “untrusted”. As yet no 100-per cent “trusted environment” exists [5]. The principal problems result from the digital format. Once a digital learning resource has been rendered, it is technologically easy to make unprotected copies of it.

The relation between these three criteria and the three levels of enforceability can be represented in matrix form (see Figure 2).

Enforceability Criterion	Enforceable	Potentially Enforceable	Not Enforceable
Information	available	available	not available
Technology	available	available	*
Environment	trusted	untrusted	*

* The fact that not all information is available makes this factor irrelevant

Figure 2: The enforceability matrix

4. Processing an electronically enforceable learning resources contract

Now that we have identified criteria for establishing which parts of contracts are electronically enforceable, we want to demonstrate how electronic rights enforcement can be implemented for learning media. In doing so, we will use Universal, a pan-European brokerage platform for learning resources, as a reference project. Universal aims at developing an infrastructure for the exchange of learning resources among higher education institutions in

Europe [6]. By providing an inter-organizational information system, called the UNIVERSAL Brokerage Platform (UBP), the project facilitates the secure exchange of educational material (e.g. PowerPoint slides, case studies), as well as the organization of collaborative, IT-mediated teaching.

4.1. Learning resource delivery on the Universal Brokerage Platform

The Universal brokerage platform operates by separating the descriptions (or metadata) of LRs from the actual LR content [1]. The metadata is held on the UBP, while the content is held by the LR provider and can be delivered by his delivery system. Once a learning resource has been purchased, the UBP's delivery management engine has to initiate the LR delivery. The delivery management engine and the delivery server communicate using a set of interfaces. These interfaces allow the UBP to check, for example, the availability of LRs and the supported bandwidth of the delivery server, as well as to transmit security information (access rights) for the LRs. The purchase of a learning resource by an LR consumer causes the UBP to grant access rights to this consumer for the learning resource concerned, the learning resource itself remaining within the "trusted environment" of the delivery server.

The process of an LR purchase over the Universal brokerage platform is divided into three main steps (see Figure 3). These are: *conclusion of the contract*; *granting of access rights to the learning resource*; and *accessing of the learning resource by the LR consumer*. Currently, a Universal contract is stored as an entry in the Universal booking log. This log information is translated into a method call, which is then sent to the delivery server. In the following we introduce an enhanced approach to learning resource delivery that uses electronic contracts instead of a booking log entry, and represents a first step towards processing digital contracts that enable rights enforcement.

1. *Conclusion of LR Contract*: We assume that a certain learning resource is offered and available on the Universal brokerage platform. An LR consumer decides to purchase this learning resource at the predefined conditions. The resulting contract is stored in digital form, formulated in a digital rights language (e.g. ODRL or XrML) based on XML. The contract is parsed and all information relevant for the LR delivery (LR ID, user ID, etc.) is filtered.
2. *Granting of access to learning resource*: The delivery management engine generates an interface method call conforming to the Universal interface specification. The delivery system receives and executes the method

call. This, in turn, triggers an access right to be implemented on the delivery server, granting the LR consumer access to the specified learning resource.

3. *Accessing of learning resource by LR consumer*: The LR consumer may now access the purchased LR on the conditions stipulated. The access rights could be limited, for example, by specifying a time period or a maximum number of accesses. Enforcement of such access limitations is possible, since the administration of access rights continues to be controlled by the "trusted environment" of the delivery server.

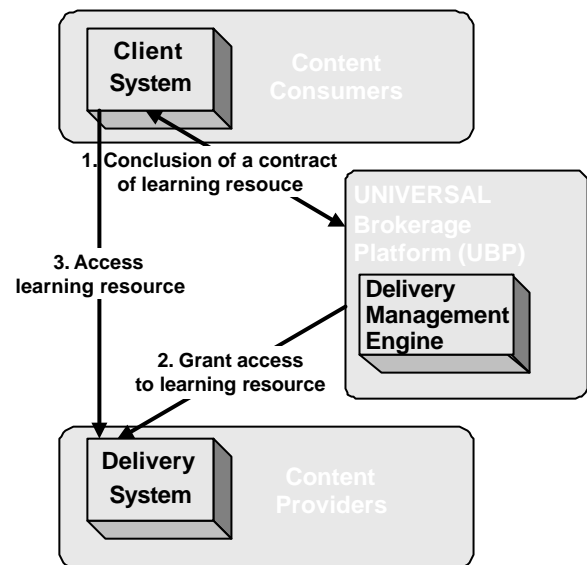


Figure 3: Delivery management and rights enforcement on UNIVERSAL

4.2. Enforcing a digital contract: a simple example

A simple Universal contract, formulated in ODRL and specifying learning resource ID (URL), user ID and specified access right, might have the following format.

```
<rights>
  <asset><context>
    <uid>http://lr.wu-wien.ac.at/lr.pdf</uid>
  </context>
</asset>
<party><context><uid>sguth</uid></context></party>
<permission><read></permission>
</rights>
```

The delivery management engine parses and translates this information into a method call (`grantUserAccessToLR`) which conforms to the Universal interface specification, and which can be interpreted by the interface of the delivery server. The resulting method call will have the following format:

```
grantUserAccessToLR (
    URLString http://lr.wu-wien.ac.at/lr.pdf;
    User sguth;
    Right read;
);
```

Execution of this method call on the Universal delivery server causes the access rights “read” for the user “sguth” to the learning resource “http://lr.wu-wien.ac.at/lr.pdf” to be implemented. On the Universal platform this is achieved currently by means of the “realm” access control mechanism of the Hypertext Transfer Protocol (HTTP).

4.3. Conceptual design of a flexible rights enforcement system

In the previous section we gave an example of rights enforcement for a simple learning resource contract on Universal. Rights enforcement may function in that way if the electronic contracts do not leave the Universal platform, or are not intended to be processed on other brokerage platforms. Interpretation of the electronic contract is tied to Universal’s functional specification and its interface definitions. This approach has two major drawbacks:

1. Interpretation of electronic contracts is predetermined. Universal contracts cannot be processed on other brokerage platforms, and vice versa.
2. The access control mechanism on the delivery server is predetermined.

We foresee a need for usage rights specified in electronic contracts to be processed flexibly. Electronic contracts written in different rights languages should be processable and interpretable on various brokerage platforms. A platform-independent service would require LR providers to specify usage rights to their learning resource only once, while enabling them to offer the same resources on various platforms.

Additionally, rights enforcement should be independent of the access control mechanisms of the delivery system, in order to support flexibility for the delivery servers of brokerage platforms. A delivery server could then implement the access control mechanism of its choice. Below we outline the conceptual design of a four-step rights enforcement system for digital contracts (see Figure 4).

1. The electronic contracts can be parsed and interpreted by the delivery management engine of any brokerage platform.
2. Every brokerage platform supports a rights enforcement interface (REI) that provides rights enforcement information to delivery servers. The REI

represents a Meta DRM level that holds usage rights information independent of any syntax or protocol.

3. The rights enforcement interface communicates with the rights enforcement module (REM) at the delivery server, and transmits the rights enforcement information.
4. The rights enforcement module interprets the access control information and transmits it to the access control mechanism of the delivery server. Each delivery server may use a different access control mechanism, and may implement access rights optionally using role based access control (RBAC), access control list (ACL), capability list, HTTP access control mechanisms, etc.

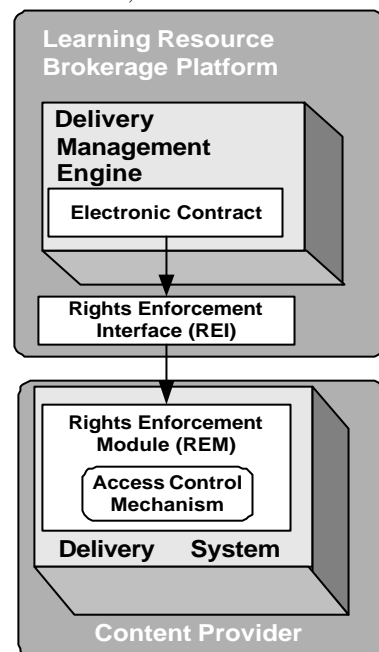


Figure 4: Conceptual design of a flexible rights enforcement system

Such a rights enforcement interface would become an integral part of every learning resource brokerage platform, serving several different rights enforcement modules (see Figure 5).

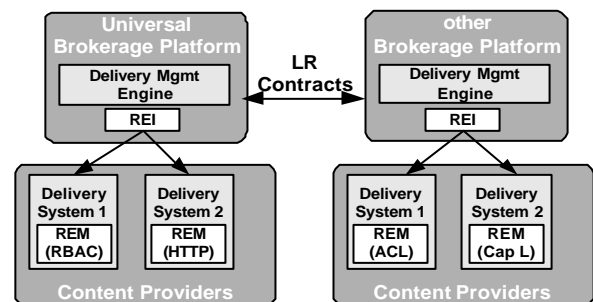


Figure 5: Rights enforcement system

5. Related work

A similar rights enforcement mechanism is introduced in a Nokia white paper [10]. Nokia uses the enforcement of electronic contracts for the superdistribution of mobile content, for example ring tones. Its rights enforcement concept lacks an intermediate level, like the rights enforcement interface, to enable flexibility of, and independence from, the rights enforcement module.

An implementation of a complete digital rights management system is IBM's Electronic Media Management System (EMMS) [7]. It consists of a set of servers (Clearinghouse, Contenthost, Web Store) and a client-side player and SDK. The enforcement of usage rights is mostly achieved in the player application, with some checks performed on the server side. The usage rights specification covers most of the usual applications associated with multimedia content, such as eBooks, music or videos.

6. Conclusion and future work

In this paper we have presented a possible approach to the application of digital rights languages in the field of learning media, and indicated how this facilitates the establishment of new learning media services. First, we showed how digital rights languages are related with other metadata standards that apply to learning resources. We identified the potential new learning media services that are opened up by the application of digital rights languages. In the third section we investigated the enforceability of electronic contracts. We identified three levels of enforceability, and introduced criteria for each of the three levels. In the fourth section we gave a simple example of rights enforcement for a learning resource contract, formulated in the digital rights language ODRL. The process of rights enforcement was illustrated with reference to an existing learning resource brokerage platform. We showed the drawbacks and limits of this simple approach, and developed a conceptual design for a rights enforcement system independent of both the platform and the access control mechanism of the delivery server.

Further work is called for in the following fields:

- detailed specification of the rights enforcement interface and rights enforcement module
- implementation of an interpreter for various digital rights languages
- application of the conceptual design to systems with different architectural styles and approaches to rights enforcement
- design and implementation of the additional services that have been identified

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