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Metadata interoperability for e-commerce of multimedia publishing material

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Abstract. Using metadata for referencing multimedia material is becoming more and more usual. This allows better ways of discovering and locating this material published on the Internet.

Several initiatives for establishing standards for metadata models are being carried out at the moment, but everyone focuses on their own requirements when defining metadata attributes, their possible values and the relation between them. From the point of view of someone who wants to seek and buy information (multimedia content in general) in different environments, this is a real problem, because he has to face different metadata sets, and so, must have different tools in order to deal with them.

In this paper, we present a model for the interoperability of different metadata communities, where neither the publishers nor the customers have to be aware that they all may be working with different metadata models. We are mapping the semantics of different metadata models with the objective of not loosing information when the user and the content provider use different metadata schemas. A "metadata agent" is used to carry out the interoperability information.

1 Metadata for multimedia initiatives

There are currently several international initiatives for the development of metadata schemes. Some of them are of general purpose and others have a very specific focus, many of them around multimedia information.

For our work, we are initially considering three of these initiatives, which are widely used and have a different focus. Since we want to develop metadata interoperability, there are good reasons to select these three metadata schemes. Although they have been initiated in very different environments, these initiatives have the objective of being as general as possible. However, interoperability is currently not possible. These initiatives are known as Dublin Core [1], MPEG-7 [2] and IEEE LOM [3].

1.1 Dublin Core

Dublin Core is a standard that represents a metadata element set intended to facilitate the discovery of electronic resources. Although it was born in the bibliographic domain, it has turned out to be a de facto standard for metadata on the web.

The metadata element set is formed by these 15 elements: Title, Creator, Subject, Description, Publisher, Contributor, Date, Type, Format, Identifier, Source, Language,

Relation, Coverage and Rights. The simplicity and conciseness of the set is one of the keys that explain its success.

Besides the metadata element set, a list of qualifiers is formally recommended, intended to sharpen the semantics of the 15 original elements, and thus, to adjust to specific domains and local implementations.

1.2 MPEG-7

The Moving Picture Experts Group (MPEG) is a working group of ISO/IEC in charge of the development of standards for coded representation. Among many others, it is now working on the MPEG-7 standard, formally named "Multimedia Content Description Interface", whose aim is to create a standard for describing multimedia data, and to offer tools to create and manage their descriptors. Its natural scope is the description of audiovisual information, be it analogue or digital, and be it broadcasted in real time from some source or recorded in media such as film, magnetic tape, CD, etc.

The MPEG-7 tools will allow users to create descriptors of content that may include information describing the creation and production processes of the content, information related to the usage of the content, information of the storage features of the content, structural information on spatial or temporal components of the content, conceptual information of the reality captured by the content, etc.

A description generated using MPEG-7 description tools will be associated with the content itself, to allow fast and efficient searching for, and filtering of material that is of interest to the user. MPEG-7 data may be physically located with the associated audiovisual (AV) material, in the same data stream, or in the same storage system, but the descriptions could also live somewhere else on the globe. When the content and its descriptions are not co-located, mechanisms that link AV material and their MPEG-7 descriptions are needed; these links will have to work in both directions.

The main tools used to implement MPEG-7 descriptions are the Description Definition Language (DDL), Description Schemes (DSs), and Descriptors (Ds). Descriptors bind a feature to a set of values. Description Schemes are models of the multimedia objects and of the universes that they represent; e.g. the data model of the description. They specify the types of the descriptors that can be used in a given description, and the relationships between these descriptors or between other Description Schemes.

1.3 IEEE LOM

The IEEE, through its Learning Technology Standards Committee, is working in a standard that aims to facilitate search, evaluation, acquisition, and use of learning objects, for instance by learners or instructors. Currently, this standard, called Learning Objects Metadata (LOM), is in the status of working draft.

The standard specifies a conceptual data scheme, formed by data elements that describe a learning object. Also, a Base Scheme is specified, which for each data element defines a name, an explanation, the size, the order, the value space, the data type and an illustrative example.

The data elements can be grouped into categories. The Base Scheme consists of nine categories: General, Lifecycle, Meta-metadata, Technical, Educational, Rights, Relation, Annotation and Classification.

2 The problem of metadata interoperability

The proliferation of different metadata schemes for published resources' description, like those just described, are making accessing this information difficult, since it is not always possible to view data in the same way from different applications. This situation requires applications to know all the schemes that may be found in different information providers guides to content. Furthermore, it is also usual to find storage systems containing objects referred to using different metadata schemes at the same time. There is yet another extra problem: we have to be aware of new metadata schemes that might appear, this will require applications to also adapt to these new schemes.

For these reasons, there is a need to develop interoperability systems between metadata domains, with the purpose of simplifying the discovery and access to this information, and to allow a high level of automation to this access.

2.1 A first approach to metadata interoperability

Several approaches to interoperability have been tried during the last years, but none of them has yet achieved a relevant result. An example of this, mainly at European level, is the work done by the CEN/ISSS (European Standardisation Committee / Information Society Standardisation System), where a Workshop was formed to deal with these issues, mainly focussing on metadata for multimedia information.

The results from the Workshop, entitled MMI (Metadata for Multimedia Information), were a few CWA (CEN Workshop Agreement) specifying a model for metadata and business requirements [4].

The MMI Model proposes a conceptual model for metadata for multimedia information in terms of classes of metadata, the roles of the different actors involved and the actions performed by each role. At the conceptual level, the same concepts and life cycle model can be applied both to information resources and to metadata.

The nine metadata classes recommended are:

- General: Basic reference to the resource and features independent of its use.
- Life Cycle: Information related to the different phases of the resource.
- Meta-metadata: Characteristics of the description rather than the resource.
- Technical: Technical features of the resource.
- Use dependent: Features that need to be interpreted according to the use of the resource.
- Rights Management: Information related to the control of transactions.
- Relation: Characteristics of the resource in relationship to other resources.
- Annotation: Comments on the use of the resource.
- Security: Metadata concerning security mechanisms.

Three roles are identified in the metadata model: Creator, Service Provider and User.

The actions performed by the Creator (of an information resource or of metadata) include: Author, Create, Capture, Prepare, Edit, Store. The actions performed by the Service Provider (of an information resource or of metadata) include: Maintain, Store, Backup, Integrate, Preserve, Archive, Discard, Validate, Quality Assure, Deliver, Provide Security Functions, Accounting, Advertise and Sell. The actions performed by the User (of an information resource or of metadata) include: Specify information required, Discovery, Selection, Establish right to use, Establish means to access/use, Access/retrieve the information, Verify, Transform and Use.

The MMI requirements do not attempt to produce a complete set of requirements for all uses of metadata, since this would be an endless task. On the contrary, the document is

providing a metadata taxonomy and methodology to help identifying requirements for different sectors and applications.

The general requirements given in the requirements taxonomy are classified in:

- Information that metadata should provide.
- Facilities that should be provided in association with metadata.

The document can be used for different purposes in different ways. First, to have an overview about what are the general requirements for metadata; second, to check if some specific metadata requirements fit with the taxonomy; and, third (the most important use), to derive, from the described taxonomy, new specific requirements for new applications.

Finally, it should be noted that the MMI requirements is a "living" document that may be updated *1)* when new metadata requirements are developed for new applications; *2)* new applications discover their need for metadata; and *3)* if some new requirements are identified for the taxonomy.

As a conclusion, we could say that this work has been a good starting point and has identified the complexity of the problem, also showing that trying to cover all existing metadata schemes or trying to converge is not a feasible task. We should add that this Workshop has been disbanded once the CWAs were published, and has moved to a new Workshop, still running, focussing on Dublin Core.

3 A model for metadata interoperability

The model we are proposing, with a totally different approach to the CEN/ISSS one, is oriented to the search of metadata referenced multimedia material. Hence, how metadata are created or the relationship between attributes is of less importance compared with the issue of the meaning of every metadata element and the set of possible values. Therefore, our model is based, first, on a vocabulary that is common to the different metadata schemes and, second, on the semantic mapping with all of them. These are the key differences to other models.

This common vocabulary starts from the analysis of the most known metadata schemes, such as IEEE LOM, Dublin Core or MPEG-7. From here, the system has to be able to incorporate new elements and the corresponding mapping in case of finding other metadata schemes in which there were elements not already considered in the common vocabulary. To make this inclusion, it is clear that, as a first step, human intervention is needed, since tools to deduce the semantics of these elements are not currently available.

Table 1 illustrates the kernel of the common vocabulary and its mapping to the mentioned metadata schemes.

This mechanism of semantic mapping from a general vocabulary to the different metadata schemes is easily scalable, since we do not need to maintain crossed mapping among all existing schemes. It is clear, as also stated in [5], that the idea of supporting a matrix for crossed mappings between all possible schemes is not a scalable one.

What we propose then in our interoperability model is to only consider the mapping between different schemes and our common vocabulary. Then, for every new scheme that we want to add to our system, we only need to fill a column in the previous table, where the attributes with a semantic relationship with our vocabulary would appear.

Taking into account that the objective of the model we are presenting is the search of content in heterogeneous sources, our approach is that it is not necessary to keep an exhaustive and complete mapping of all the attributes of the metadata schemes. Hence, we can forget about those attributes that only appear in only one scheme but not in the others. In this way, our vocabulary would be a kind of intersection of all available systems we could find.

Table 1: Common vocabulary and its mapping

	Dublin Core	IEEE LOM	MPEG7
Identifier	Identifier	General.CatalogEntry	MediaInformation.MediaIdentification. Identifier
Title	Title	General.Title	CreationMetaInformation.Creation. Title.TitleText
Description	Description	General.Description	CreationMetaInformation.Creation. CreationDescription
Format	Format	Technical.Format	MediaInformation.MediaProfile. MediaFormat.FileFormat
Author	Creator	LifeCycle.Contribute.Entity	CreationMetaInformation.Creation. Creator
Creation_Date	Date	LifeCycle.Contribute.Date	CreationMetaInformation.Creation. CreationDate
Language	Language	General.Language	CreationMetaInformation.Classification. Language.LanguageCode
Rights	Rights	Rights	UsageMetaInformation.Rights.RightsID

Our model is also based on not imposing on information providers our proposed metadata scheme (our common vocabulary), but to use an agent that will be in charge of searching in the different information providers, at the request of the users of the system.

This *metadata agent* is the only element that knows about this common vocabulary and the mappings. In this way, the content providers and users searching for information are able to continue working with their own metadata schemes with the help of the agent.

Figure 1 shows how the different elements of our scenario are related.

We can see that the different elements (or actors) interchange two kinds of information. On one side, the user provides some keywords to the agent, so it can make the search in the provider system. As an example, we assume that users make queries such as "search for films from Director X" or "search for a painting from Artist Y between year Z1 and year Z2". Then, the agent has to map this information to the metadata schemes corresponding to the content providers where it will look for, in order to be able to deal with them, since we assume that they only understand queries following their metadata scheme.

On the other hand, we have the answers given by the content providers, which, in many cases, have the form of a metadata record following their own scheme. The task of the agent is then to provide the user with this information, that could follow their original scheme, the common vocabulary or the scheme requested by the user, if different.

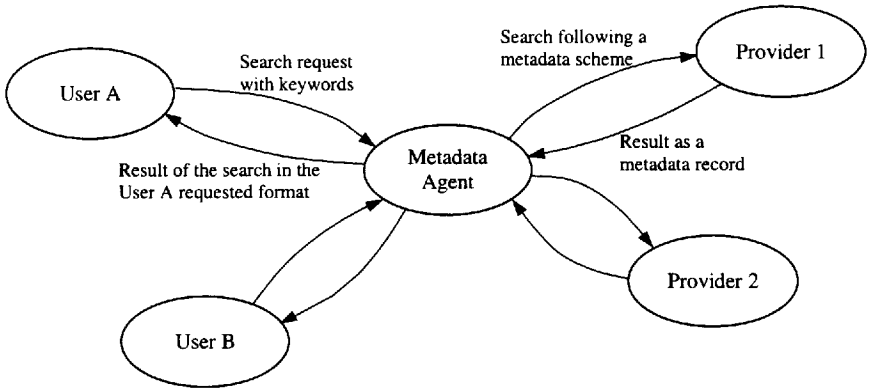

Figure 1: Relationship between elements

With this approach, users are able to make queries to different content providers without the need of knowing their metadata scheme, both at the moment of producing the query and when receiving the answer with the requested information.

4 Application to an e-publishing environment

The interoperability model we have specified, and its implementation with an agent[6], could be applied to very different environments. Apart from a typical application of information discovery and search, e-commerce and e-publishing are very promising areas.

Concerning general e-commerce, metadata is used in some applications for identifying content to be sold. The problem is that customers need to know the metadata scheme used by the multimedia content provider, or providers have to use too simple schemes in order to be accessed in an easier way. With the metadata agent, it is possible to identify content without the need of knowing about the metadata scheme used by content providers, which could be as complex as needed. Of course, this also helps providers in being accessed by more customers through the interoperability agent.

The previous approach could be also applied to an e-publishing environment, similar to the e-commerce one just mentioned. In this new case, the multimedia content to be sold is now multimedia publishing material, to be sold or not.

We have developed an application where users look for multimedia content to buy to be used for further publishing [7]. Both users and providers interact through a broker agent who will include, apart from the common e-commerce facilities and the handling of IPR [8], a metadata agent facility for metadata interoperability handling.

5 Conclusions

We have dealt with the problem derived from the fact that using metadata for referencing multimedia material is becoming more and more usual.

Although this allows for better ways of discovering and locating publishing material, this also leads to new problems. Because the current different initiatives for establishing standards for metadata models focus on their own requirements, a problem of interoperability is arising.

We are developing a model to solve this problem. We have considered the mentioned initiatives, such as Dublin Core, MPEG7, or IEEE LOM, and their different metadata schemes.

Our main objective is that neither the publishers nor the customers have to be aware that they all may be working with different metadata models. We are mapping the semantics of different metadata models with the objective of not loosing information when the user and the content provider use different metadata schemes.

Our model is based, first, on a generic metadata framework, which defines the common semantics between the most used metadata sets, and, second, on a "metadata agent" that will do the mapping between the different metadata models found and this generic model that we propose.

This agent, to be developed, will be integrated in applications that we have already developed in the area of e-commerce of multimedia publishing material.

6 References

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