Use of Mobile Agents for IPR Management and Negotiation

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Abstract. The paper describes a model and an implementation of a system to negotiate and manage Intellectual Property Rights (IPR) for the electronic commerce of multimedia products such as video sequences, photos, images, music, documents, etc. This could also be used in the context of electronic publishing services like electronic production of books or multimedia CD-ROMs. The system considers issues from the IPR negotiation phase when a copyrighted material is sold, till the control of later payments derived by rights use. The rights use defines the capabilities that an entity has in relation to authorised operations with copyrighted products. In order to represent the IPR information, metadata are used. In particular, our implementation adapts existing models for a broker based architecture. Finally, the mobile agents are used to allow brokers to collaborate in the analysis and detection of illegal use of copyrighted material.[1]

1 IPR General Model

The starting point, from an IPR's point of view, is the selection of the model in which to base IPR representation and management. The IMPRIMATUR Business Model [1], the one we have selected, identifies a series of entities that may take different roles, such as Creator, Provider, Rights Holder, Distributor, IPR DataBase, or Watermarking & Fingerprint marking.

Figure 1 illustrates the different entities participating in the general model for IPR handling. It must be noted that one user may take more than one different role.

A more simplified and specific model, the one we are producing, consist on the use of a Broker (with the role of Distributor) in charge of being an intermediary between providers of multimedia material (content providers) and the customers interested in buying that material and the corresponding rights for use and/or commercial exploitation. From a functional point of view, these copyrighted multimedia material providers may also assume the roles of Creator and Rights Holders in the same entity.

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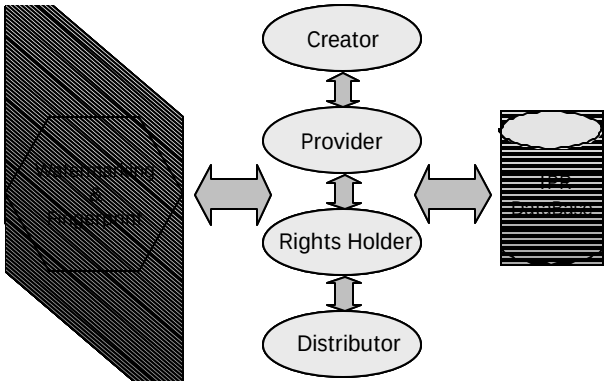

Fig. 1. Different entities in an IPR General Model

Furthermore, the broker stores and keeps up to date (with the help of content providers) the information about the multimedia material for sale in the system (from all content providers associated to the broker), and about the terms and conditions in which commercial electronic transactions are done, with the help of the IPR DataBase. Figure 2 illustrates this Broker Based IPR General Model.

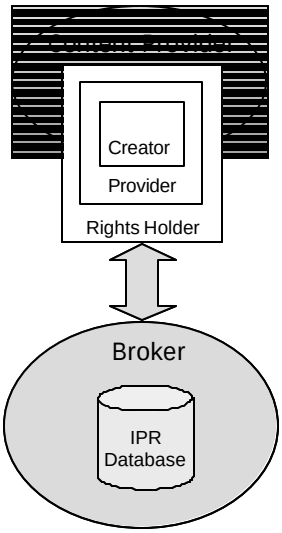

Fig. 2. Broker Based IPR General Model

2 Metadata for multimedia content

The model presented in section 1 has been implemented with RDF [2] schemas, extending the fundamental modelling concepts provided by the “RDF model and

syntax" [3] and the "RDF schema" [4]. The schema utilisation policy of this framework allows the creation of a very flexible representation, untied to any concrete initiative of metadata creation.

As said before, our system is based on a broker agent that is trusted by the content providers and the buyers, normally business users. It includes a database with references to the audiovisual material to sell. Since our implementation is focussing on video material, the multimedia metadata (information about the content to sell) stored in the broker can be divided in two types according to its use. First, there are video descriptive attributes (descriptive metadata) used to facilitate that the user locates the audiovisual material he's interested in. The second type encloses the part of the model concerned with intellectual property rights representation (IPR metadata). This information is structured following a metadata model that we have developed based on existing ones, such as those developed by INDECS [5], MPEG-7 [6], CEN/ISSS [7], Dublin Core [8], etc.

To start developing from a solid basis, the model has been constructed over INDECS basic model. This provides the general concepts that allow non-traumatic extensibility and a great adaptability to concrete and changing environments.

Figure 3 shows a hierarchical view of the basic metadata model.

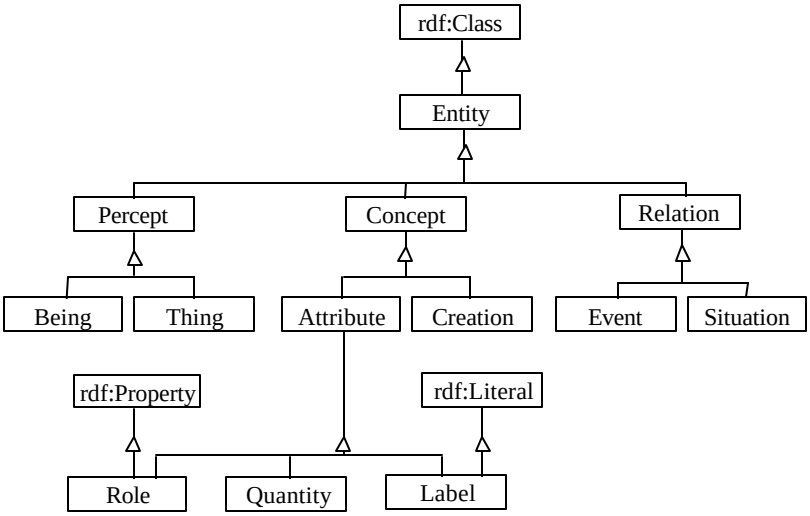

Fig. 3. Basic Metadata Model

It is worth noting that the class "Creation" encloses all the instances of the managed audiovisual material. All these instances could be more strictly classified by defining more specific subclasses, by instance "Video", "Audio", "Picture", …

The descriptive metadata subset includes all those audiovisual material properties that permit the easy and rapid localisation of the audiovisual material needed. These properties can be included according to punctual necessities packaged inside RDF schemes.

Examples of available or definable schemes are the following:

– Dublin Core [8], for general categorisation facilities,

– MPEG-7 [6], for video specific properties, definable with RDF, and
– HYPERMEDIA [9], that uses some video attributes portable to a RDF schema.

All these attributes can be easily included and used to describe the stored audiovisual material. Depending on the semantic applicability of these attributes, they can be associated to the more general representation by the class “Creation” or can only be available to more specific subclasses, like “Video”.

The metadata for IPR representation will be detailed in section 4, together with the metadata for IPR negotiation.

3 IPR Negotiation

Based on the IPR attributes set, when a buyer requests, to the broker, a purchase of audiovisual material subject to copyright, the broker extracts IPR information from its database and presents an offer to the buyer. This information allows the buyer to take a decision on how to buy IPR, i.e., to know what are the copyright rules associated to the asset, to decide if he wants to re-sell it, etc. To facilitate this process, a negotiation mechanism is being developed based on a simple negotiation protocol using XML [10]. At first, we have only considered three phases in this simple negotiation protocol: Offer, Agreement and Payment. XML is also used as interface to the IPR information in the broker’s database. Since all metadata attributes are specified using XML, the implementation could be easily ported from one system to another. If the negotiation process finishes with agreement, it is complemented by the production of an electronic contract, that is signed by buyer and rights owner and stored in the broker agent.

In an electronic contract, it is necessary to store information about identification of the concerned parties, description of the product, fees, terms of payment, royalties to the author, rights expiry, use rights (re-selling, sub-licensing), etc. Security mechanisms, like digital signature, can be used if we may expect a conflictive situation to appear between the entities who subscribe the contract. The broker agent has, in this sense, a notary role.

If we want to add a signature to the electronic contract, we need to make sure that the electronic contract representation is, when obtained from the information stored in the database, unique. This is necessary to verify the signature and be sure that is a valid one. This problem has not obvious solution depending on how we store the information coming from the RDF representation of the metadata. More details are given in the next section.

4 Metadata for IPR Representation and Negotiation

To represent all the information needed for IPR representation and negotiation, the intellectual property section of the INDECS initiative has been adopted and adapted. This has been constructed over the previous basic metadata model and also takes profit of the RDF facilities.

Figure 4 shows a specific refinement for IPR of part of the hierarchical view already shown in figure 3.

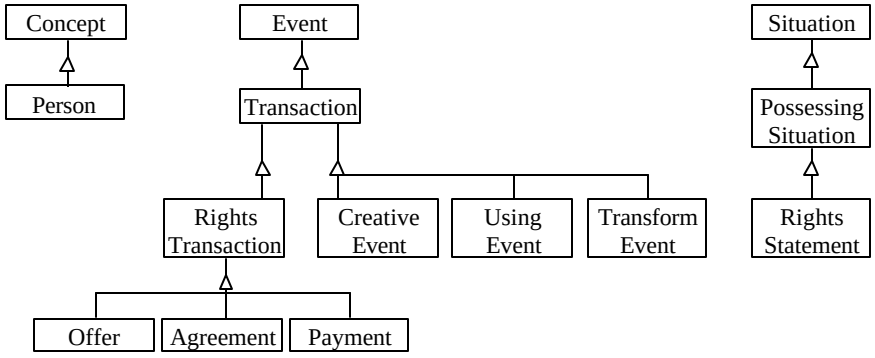

Fig. 4. Metadata for IPR Representation and Negotiation

Two main branches can be observed in the figure, that below the class “Event” model the dynamic aspects treated in IPR negotiation, while the other, enclosed by “Situation”, represents the static aspects.

In the dynamic part, IPR commerce is realised by “Rights Transactions”, that reference actions over the intellectual property managed, classified in three types of events. These actions and transactions produce determined rights states modelled by “Rights Statements”.

Finally, a class has been included to represent all the legal persons concerned in IPR negotiation and management. Under “Person”, the entities introduced in the IPR General Model can be included as new subclasses: “Creator”, “Provider”, “Rights Holder” and “Distributor”.

The example of figure 5 represents an agreement between a Rights Holder (content provider) and a Distributor (broker). The notation is based on that used in the INDECS project [5].

As previously introduced, agreements are used as input to the production of electronic contracts. To accomplish this, they should be extracted from the IPR database in a restricted way that allows a unique representation. A first restriction step imposes a depth first search of the agreement graph of figure 5, starting at the “Agreement” class instance, following property edges in alphabetical order. This step will produce a unique sequence of triplets (Subject, Property, Object), the basic conceptual representation of a RDF model.

Now, this sequence is serialised to a XML stream that is lastly signed to produce the required electronic contract. Then, a second restriction step is needed because RDF provides several ways of serialisation of its conceptual model to XML. To avoid ambiguities, the basic abbreviated syntax as specified in RDFMS [3] is imposed as the valid method to produce the XML serialisation of an agreement.

So, starting with the same modelled agreement, these two restriction steps allow the production of unambiguous serialisations that can be digitally signed to produce electronic contracts.

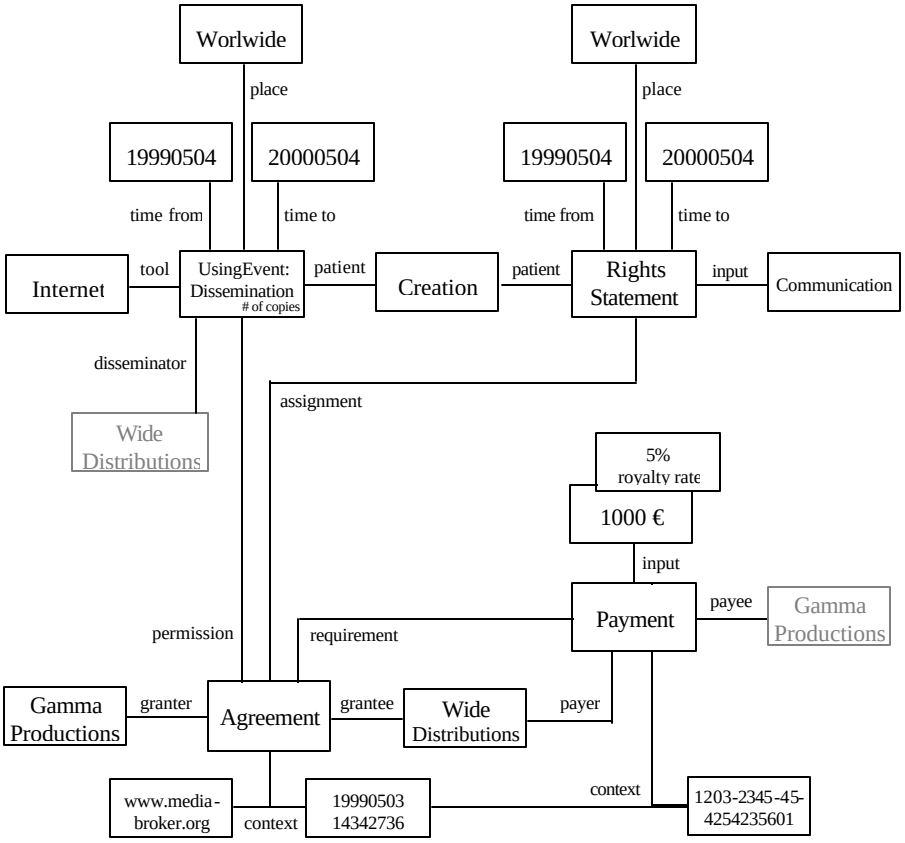

Fig. 5. Schematic example of an Agreement

5 IPR Distributed Management

5.1 Problem and approach

Different models exist to characterise and formalise electronic commerce. They are based on different points of view, such as the functional, the operational and the architectural one [11]. The operational one specifies the steps followed by a purchase process. The steps are grouped (from a service point of view) in the following four phases: Service Identification, Service Request, Agreement and Post-Agreement. The IPR negotiation process described above finalises in the Agreement phase. However,

in this kind of application it is very important to verify the fulfilment of the contract clauses, normally in a Post-Agreement phase.

There are several issues associated to this phase in relation to IPR management. First, getting payments for the use or re-selling of a copyrighted material. This could be controlled in a "voluntary" basis. Furthermore, if the original buyer informs the broker about the new buyers of the material, then this payment could be easily managed. In this case the broker would have the role of IPR payments collector.

The situation is more complex if the system has the responsibility to follow the fulfilment of the rights associated to products sold without acknowledge information by buyers. In this case, mobile agents can help to control what is happening with the copyrighted material sold by the system. For this, different strategies could be followed. First, checking the WWW to see if audiovisual material without the proper IPR control is circulating. For this purpose, ad-hoc agents might be instructed on how to look for material to check, and how to contact the broker to decide if the situation of that material is legal, i.e., all necessary payments have been done.

A second strategy could be to check if some specific material (a video clip, a video movie, a book, etc.) is in the network without all the requisites. The job for these agents would be to look for material initially bought by a specific user, or look for specific content independently of to whom it has been sold.

5.2 An implementation with brokers

For our first implementation, we are assuming an architecture in which the intellectual property rights owners (content providers) are associated to a broker, that is in charge of exploiting (selling) their content rights, and, once those are sold, of controlling that the IPR are respected; i.e., no illegal copies are circulating on the Internet. Figure 6 summarises the architecture.

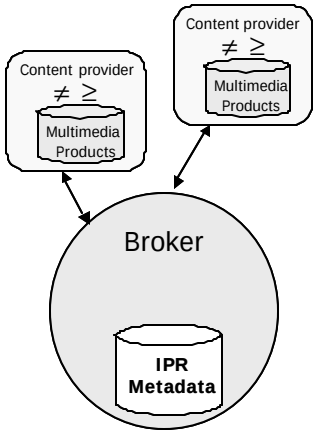

Fig. 6. Broker and Content Providers Architecture

To satisfy the previous requirements, an specific broker includes an specialised service for the distributed management of the IPR of a sold material (what we call IPR Distributed Management Service, or IPR-DMS). This is basically done by searching in the Internet for illegal copies of copyrighted audiovisual material, that is owned by content providers associated to brokers that make use of this IPR-DMS.

As introduced in previous sections, every broker has a database with information (including the IPR related one) about the multimedia material of its associated content providers. This is, for security reasons, private information that should not be transmitted. For this reason, mobile agents are used to facilitate the collaboration between the broker providing the IPR-DMS and the brokers that are making use of this service to protect the IPR of their content providers.

The IPR Distributed Management Service basically offers two different services:

– Continuous search in the Internet.
– Looking for evidences when an illegal situation is detected.

The first service simply consists in accessing WWW servers in the Internet, and verifying the validity of the copies that are publicly available, mainly focussing in material that might be copyrighted by the associated content providers.

The broker providing this service sends a mobile agent to other brokers to verify if the audiovisual material found in an illegal status belongs to them. The mobile agent accesses to their databases and compares their content with the information obtained from the network.

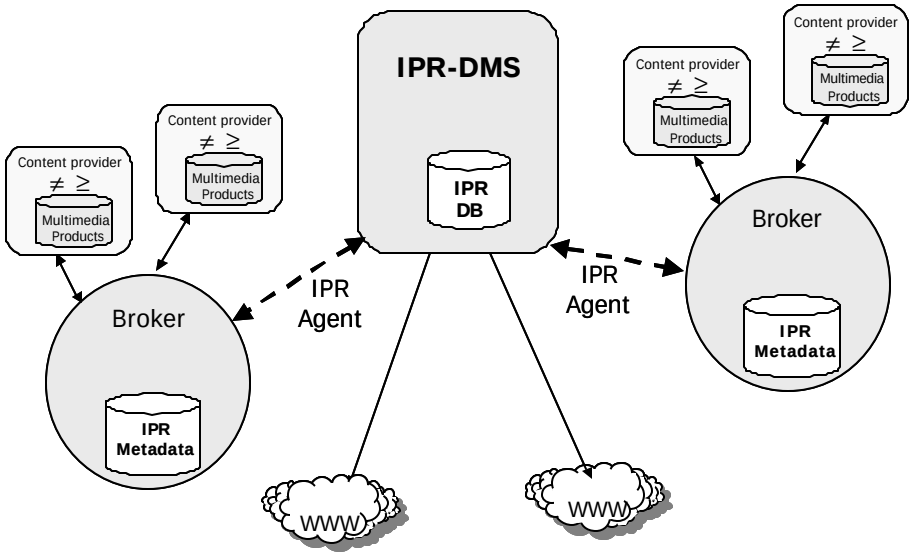

Fig. 7. IPR Distributed Management Architecture

The second service applies when a content provider or a broker suspects that there are illegal copies of its own material on the Internet. In this case, the IPR-DMS

directly looks for the evidences itself, also sending the mobile agent to the relevant broker in order to clarify the evidences.

Figure 7 shows the architecture of the IPR distributed management system, where the different entities are present: IPR-DMS, Brokers and their Content Providers.

6 Conclusions

The paper has shown a specific architecture for management and negotiation of Intellectual Property Rights of audiovisual material in an electronic commerce environment where brokers are used.

These brokers represent content providers and keep metadata about their content, focussing on the IPR related information.

The approach that has been taken with respect to metadata, with a differentiation between descriptive and IPR specific metadata has also been introduced.

The second part of the paper describes the use of mobile agents for distributed management of IPR, focussing on the checking of illegal copies in the Internet.

With mobile agents we facilitate the collaboration between specialised brokers (who provide the IPR Distributed Management Service, IPR-DMS) in order to protect IPR owners.

The representation and negotiation part of our system is already a prototype, while the mobile agents part is still on its specification phase. Further development might show that different approaches could be taken.

References

1. IMPRIMATUR Project, http://www.imprimatur.net
2. RDF (Resource Description Framework), http://www.w3.org/RDF
3. RDFMS (RDF Model and Syntax Specification), http://www.w3.org/TR/REC-rdf-syntax
4. RDFS (RDF Schema Specification), http://www.w3.org/TR/rdf-schema
5. INDECS Project, http://www.indecs.org
6. MPEG-7, http://www.cselt.it/mpeg
7. Metadata for Multimedia Information Workshop, CEN Information Society Standardisation System, http://www.cenorm.be/isss/Workshop/delivered-ws/MMI/Default.htm
8. DUBLIN CORE Home Page, http://purl.oclc.org/metadata/dublin_core
9. HYPERMEDIA Project, http://www.corporacionmultimedia.es/hypermedia
10. XML (eXtensible Markup Language), http://www.w3.org/XML
11. GALLEGO I., DELGADO J. and ACEBRÓN J.J. “Distributed Models for Brokerage on Electronic Commerce”, International IFIP Working Conference Trends in Electronic Commerce (TREC’98), 3-5 June 1998, Hamburg (Germany). Springer, ISBN 3-540-64564-0.