

A Semantic Model for the Authorisation of Context-Aware Content Adaptation

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ABSTRACT

This paper considers the authorisation of context-aware content adaptation in a generic multimedia scenario based on a semantic model. The Context Aware Ontology (CAO) models the Universal Environment Descriptor (UED) tool contained in the MPEG-21 DIA standard, and his context representation feeds an Adaptation Authorisation based on the RRDOnto (Represent Rights Data) ontology, which grants that Intellectual Property rights will be respected along the Value Chain while supporting the MPEG-21 license model. The integration of both is described, providing a joint model that allows the adaptation to be controlled by Content Creators and Content Distributors.

Keywords

MPEG-21, Digital Item Adaptation, Rights Expression Language, Context Aware Ontology, RRDOnto

1. INTRODUCTION

Content adaptation is an essential element in Universal Multimedia Access scenarios to enable users to access any type of content anywhere and anytime. Context information is required to decide how and when to adapt content, so as to meet users' expectations and satisfy usage environment constraints. However, content is often considered an artistic work and therefore subject to the Intellectual Property (IP) enacted legislation. If an adaptation is performed without the consent of the rights holder, copyright laws are infringed. Both Content Creators and Content Distributors have to express digitally their authorisation in the framework of a Digital Rights Management (DRM) system.

The MPEG-21 standard (ISO/IEC 21000) proposes a framework for multimedia applications where a generic Digital Item (DI) is the unit of content. Digital Item Adaptation (DIA, part 7 of MPEG-21) identifies and represents context to assist operations to adapt the DI. Rights Expression Language (REL, part 5 of MPEG-21) defines XML Schemata to specify licenses authorising users to execute specified rights over the DI. A joint use of REL and DIA can be found in [2], but their focus was on syntactic integration rather than covering a complete DRM scenario.

2. A VIRTUAL COLLABORATION SYSTEM

The semantic bridge between MPEG-21 REL and DIA presented here is given in the context of the project VISNET-

II¹, where a Virtual Collaboration System has been proposed with a strong semantic orientation [1]. The scenario consists of the following four major modules: Adaptation Decision Engine (ADE), Adaptation Authorizer (AA), Context Providers (CxPs) and Adaptation Engine Stacks (AESs), the latter comprising a suite of Adaptation Engines (AEs).

CxPs are software or hardware entities that provide explicit contextual information, while ADE is the module that collects that information, inferring higher-level concepts. The DIA's Usage Environment Descriptors (UEDs) are XML-based tools that allow to describe the context in 4 different axes: user characteristics, terminal capabilities, network characteristics and natural environment. These context profiles provide essential information to optimize the adaptation decision, but is not enough when dealing with protected contents. The ADE needs to interact with the authoriser (AA) to find out whether an adaptation is permitted or not. Thus, the ADE will first send an authorisation request, indicating the right the user wants to execute, among other information. The AA will then issue the approval or rejection of the authorisation. The AA implements a semantic engine where the authorisation decision is taken based on the application of a set of SWRL rules. These rules check the deontic logic behind the permit: to authorise a petition, obliged propositions must hold (likewise conditions in REL), prohibited propositions must be false, and the IP value chain of authorisations will have had to be respected.

3. SEMANTIC REPRESENTATIONS

The expressiveness in the MPEG-21 DIA is given by a set of XML schemata. Whilst providing a structured representation of the context, they are not sufficiently rich to describe more complex real world situations and relations and are not the most suitable to enable computer reasoning. Thus, the CAO ontology describes semantically the UED tools. Additionally it includes the description of a media profile derived from the MPEG-7 Multimedia Description Schemes (MDSs). The main classes in CAO ontology are based on these standards, but not literally translated. The domain knowledge, here conceived, can be used to model domain rules and heuristics that help to improve the quality and effectiveness of adaptation decision [3].

The RRDOnto ontology is an OWL ontology aimed at repre-

¹VISNET II Network of Excellence, IST-2005.2.41.5

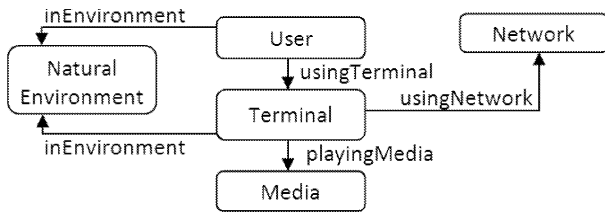


Figure 1: Context Aware Ontology Model

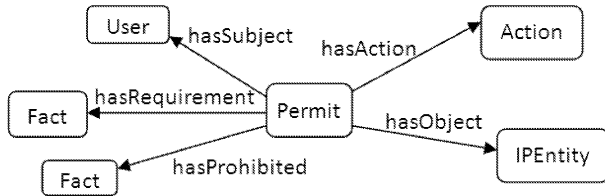


Figure 2: The Permit class in RRDonto

senting the Intellectual Property Value Chain [4]. RRDonto is a part of the Interoperable DRM Platform, a proposal of the Digital Media Project to make DRM systems to become truly interoperable and to extend its benefits to all involved parts. The RRDonto has applicability in any information system and is based in the sole idea that IP rights do exist and they are transferred along a provenance chain which starts in the Content Creator and finishes in the End User. The RRDonto, coded as an OWL DL ontology, represents the elements and the roles involved in this Value Chain, and their relations. The *IPEntity* class represents anything subject to the Intellectual Property laws, over which some *Actions* can be performed by users playing certain *Roles*. Through the use of *Permits*, users can authorise the execution of these actions; this *Permit* class the binding point to the CAO.

4. THE ADAPTATION AUTHORISATION

Content Creators retain moral rights enabling them to veto changes over their works (distortion, multilation etc.). In addition, Content Distributors, who presumably perform the adaptation, hold the distribution rights over the work and may be interested in modifying the features of the distributed content. Both the original author and the distribution rights holder are in conditions of issuing licenses over content.

This licensing procedure has been done through paper contracts or by issuing MPEG-21 REL licenses including one of the defined rights -*m3:adapt*, *m3:modify*, *m3:governedAdapt*- but the AA proposed here can manage instances of the *Permit* class of the RRDonto ontology, and context information expressed semantically with the CAO ontology descriptors. Thus, a matching of concepts can be done between these ontologies and DIA. The MPEG-21 User is an abstract agent (person or machine) who executes functions over digital items ("Media" in the CAO Ontology, "IPEntities" in RRDonto) and matches the RRDonto incarnation of one or more roles definition of User. Context state (terminal, network etc.) represents positive facts that can be combined in a *Permit* as deontic statements: *Requirements* or

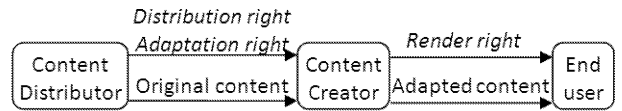


Figure 3: Rights transfer

Prohibitions, through relations in the ontology.

The ADE creates instances of the CAO ontology based on the simple XML CxPs information, together with the Media information and the desired operation and characteristics. These CAO class individuals are sent to the AA, which in turn looks up in its license store (a collection of *Permit* instances) and matches for a suitable one to authorise the requested operation. The authorisation itself is described as a mere result of a rule validation, where the context information will have been processed as assertions to be matched against the conditions and bans in the collection of *Permits*.

5. CONCLUSIONS

Content adaptation can be based on more expressive descriptors defined on the CAO ontology, and its authorisation is a mere inference which takes into account complex permits conditioned by these descriptors. The presented model represents a novelty and enthusiastic application on how to formulate an adaptation based on authorisation, although this potential flexibility has still to be put into practice in the framework of a Virtual Collaboration project.

6. ACKNOWLEDGMENTS

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