Multi-step Media Adaptation with Semantic Web Services

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Abstract

An increase in diversity of devices that access the Internet, each with its own specifications, has generated the need for adapted presentations for each specific platform. However, to dynamically adapt these presentations, information from three parties needs to be matched: a description of the target platform's capabilities and preferences, the structure of the presentation and the media items it contains, and a survey of the available adaptation processes. We propose in this paper a solution that applies semantic annotation to describe these three parties. We use OWL-S to describe and chain the adaptation processes and CC/PP for communicating the capabilities of the target platforms. This semantical annotation is based on a single ontology in OWL that specifies the concepts of the media adaptation domain. The domain ontology also serves as a basis for specifying adaptation strategies by defining a set of rules and constraints on the concepts involved.

1 Introduction

With the growing popularity and diversity of devices like Personal Digital Assistants or Mobile phones to access the Internet, adaptation of media for these devices is getting increasingly difficult and time-consuming. As the leading broadcaster of Belgium, the VRT offers a wide range of television and radio channels. With the introduction of the *VRT-nieuws.net* project, a platform that offers news and video-footage on the Internet, the VRT now reaches a whole new audience and set of devices. This project, in combination with the introduction of a digital television platform, demands for a new approach to the problem of adapting traditional television content to the needs of these devices. It is no longer possible to manually create and host different versions of each publication, tailored for each specific device. Available information about the target devices is also virtually non-existent, as we speak this information is limited to a choice for the customer between two video formats. We propose in this document a new approach to dynamic media adaptation that offers better performance and better adaptation results by integrating various Semantic Web technologies.

2 Technologies for Media Adaptation

Many approaches for the multimedia adaptation problem propose new document models or combine existing ones to support text, interactivity and media items such as audio, images and video. The Cuypers system [van Ossenbruggen *et al.*, 2002] has a somewhat different approach: rather than adapting existing presentations, the adaptations with the Cuypers engine are based on an abstract semantical model of the presentation which is more detailed throughout the adaptation process. According to Boll [Boll, 2003], this system would demand additional programming when complex presentation generation tasks are needed. She proposes a programming framework that provides interfaces to develop personalized applications which can integrate existing approaches like CC/PP [W3C, 2004], a mechanism for describing platform capabilities and user preferences. A programming framework however, will not provide the flexibility we need in a constantly changing environment like the Internet. Web Services offer in this context greater independence from programming language or network topology and the emerging description language OWL-S allows for rich annotations with ontology concepts. Moreover, Semantic Web Services can be composed dynamically based on domain knowledge. In most of the relevant research on this topic [Kim and Gil, 2004] [Gómez-Pérez and González-Cabero, 2004] [Sirin *et al.*, 2004], a technique is used which couples the description of a service with a description of a planning or task-methodology. This allows for standard planning or state-space algorithms to be used on the problem of chaining the adaptation processes.

3 Media Adaptation with Semantics

Our approach is based on the combination of OWL-S, CC/PP and an ontology in OWL. When one wants to take adaptation decisions, a description and mapping is required that relates all the concepts about the platforms, adaptation services and source material. This enables us to reason about this domain and write down rules and constraints for adaptation. Of course, one can always agree on a certain set of tags [Jannach *et al.*, 2004] but this offers very limited reasoning possibilities, so some adaptation options may never be explored with this technique. We propose the creation of a shared vocabulary, through an ontology, which allows us to define adapta-

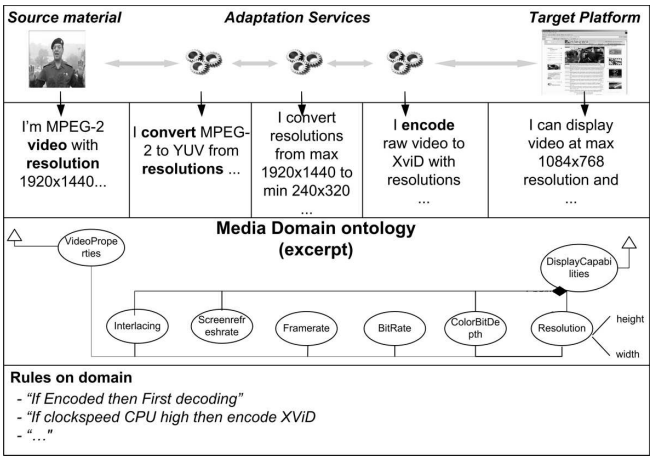

Figure 1: Describing platforms, services and source material using domain knowledge.

tion strategies without the use of proprietary formats or programming languages. Fig. 1 gives a schematic overview of our approach. The media ontology is specified with OWL and can be used to describe services' input and output parameters, preconditions and effects through the use of OWL-S service profiles. New services can easily be described and integrated in an adaptation strategy. Composition of services can be done based on the available domain knowledge instead of simple matching of input and output parameters. Since CC/PP is based on the RDF-standard, concepts from the domain ontology in OWL can be used for the description of target platforms. And finally, source material containing media items may be annotated using the same descriptions in OWL.

Our work in the VRTnieuws.net-project context currently focuses on the adaptation of video material based on the demands of the target platform. We have created an ontology that can describe platforms (PDA, PC and TV with set-topbox), adaptation services (scale, decode, encode, deinterlace,. . .) and video streams (framerate, resolution, encoding,. . .). On this domain ontology, we formulate several rules on how to chain the available services : decoding first, then deinterlace, framerate adaptation, cropping & scaling and finally encoding to the desired format for the target platform. Rules allow for a dynamic composition of the adaptation chain, in the correct order. A simple match based on only input and output-format information could result in a wrong order : e.g. scaling before decoding and encoding the video.

Currently, we are working on an alignment of the domain ontology with concepts from a Problem-Solving Method (PSM) ontology. We are looking towards specifications like UPML [Fensel *et al.*, 1999] that will allow composition of the adaptation services using a PSM-based approach. We are also extending the ontology with the notion of text and subtitles to prove that our approach works with more complex media documents.

4 Conclusion

Many approaches to media adaptation try to define a standardized set of XML-tags or a programming framework. These approaches however, lack the flexibility to describe new adaptation processes and constraints that may exist in the future. We argue in this paper that for efficient media adaptation, semantics are necessary. Defining a domain ontology that can describe target platforms, adaptation services and multimedia presentations is the first (necessary) step towards automatic multi-step media adaptation. Adaptation strategies can then be defined by specifying a set of rules and constraints on this ontology. Whilst full-blown adaptation of documents containing video, text, pictures and interaction may be for the far future, some necessary steps can be taken today.

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