Chapter 8

A Knowledge-Based Multimedia Adaptation Management Framework for Ubiquitous Services

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ABSTRACT

The range of multimedia contents and services on the Internet, the diversity of terminals, and the heterogeneity of network technologies make it less and less feasible and rather costly for providers to prepare contents and services in advance in all conceivable formats. There is a need to incorporate dynamic adaptation management into existing multimedia content/service delivery networks. We propose an Adaptation Management Framework (AMF) that provides architectural and functional support allowing dynamic and autonomous content/service adaptation without introducing additional complexities to the actual content/service provider or the user. The AMF provides functionalities needed in such an automated adaptation process, including context representation, adaptation decision making and adaptation operations selection across heterogeneous entities and platforms. It alleviates the complexity of those tasks using ontology representation formalism and knowledge-based processing techniques. It deploys itself as well as associated third-party applications, such as adaptation tools, as Web Services to enhance the interoperability among different entities. The AMF can be plugged into content/service delivery networks as an adaptation engine and serves as an invisible service enabler for ubiquitous content/service delivery.

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INTRODUCTION

The concept of ubiquitous services has been attractive to service providers, telecommunication operators and technology manufacturers alike because of the increased revenue prospects. As the name implies, ubiquitous services represent communication scenarios where services can be accessed anytime, anywhere and anyhow without explicit involvement from any players in the service delivery process. Today’s network access technologies, such as WiFi, WiMAX, seem to bring the vision of ubiquitous services closer to reality, another major barrier to ubiquitous services provision remains still as a challenge, that is, to deliver a mix of contents and services via a multitude of heterogeneous access networks and technologies to a wide range of access devices users may have as well as user’s different preferences and likings. Delivery of a content and service mix, such as multimedia, in comparison with uni-modal web contents, in such heterogeneous environment is technically more challenging because multimedia formats themselves can be heterogeneous, for example in terms of their encoding. Even for the same coding format, it still can vary in encoder settings such as spatial and temporal resolution, colour depth etc. Due to this heterogeneity, today’s end users are in general not able to access multimedia ubiquitously. Some kind of adaptation and delivery management is necessary (Jannach et al., 2006; Li & Moessner, 2007). Previous approaches to this problem, such as multi-authoring (Hanrahan & Merrick, 2004), are static in that they require providers to prepare multiple versions of the same content for a number of possible devices which may render the content, or simply differentiate their contents for mobile devices from PCs typically for web contents by starting the content URL with mobile or ending with .mobi etc. This is neither a cost-effective approach from providers’ point of view, nor does it provide the flexibility to incorporate new devices that may reach the market after content has been generated. Different from those approaches, the adaptation management system we aim to develop should have the capability to manage adaptation dynamically and autonomously without explicit involvement from either users nor content/service providers, the extensibility to incorporate new media types and support new devices, the inter-operability with standardisation efforts in relevant domains.

To facilitate a seamless and ubiquitous user experience and enable persistent service access when user moves across networks and changes devices without user’s explicit involvement in configuration, it requires not only constant sensing of user’s surrounding context, such as available devices and their capacities, but also linking the context to the requested multimedia content. Effective context description scheme and representation formalism play a key role. Apart from user’s context, an adaptation management process also needs to be aware of the context of multimedia contents as well as that of any available multimedia adaptation operations. Basically, all those contexts form a knowledge base and need to be described in a way that is amenable for processing those knowledge as well as their instances. Ontology, particularly with its technological development in Semantic Web field, has become popular in recent years as the means for knowledge representation due to its added layer of semantic that provides a common and formal understanding of domain concepts on top of the syntax modelling provided by existing schema languages, typically XML.

There have been a number of efforts that introduced ontology and its technologies into multimedia adaptation and delivery domain, such as the work in (Jannach et al., 2006; Soetens et al., 2004; Yu et al., 2006). However, they either, as in (Jannach et al., 2006; Soetens et al., 2004), focus only specifically on issues of how to semantically describe adaptation operations in order to facilitate the autonomous composition of a multi-step adaptation operations with planning
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