Chapter 3.2
Knowledge Representation in Semantic Mobile Applications

Panjak Kamthan
Concordia University, Canada

INTRODUCTION

Mobile applications today face the challenges of increasing information, diversity of users and user contexts, and ever-increasing variations in mobile computing platforms. They need to continue being a successful business model for service providers and useful to their user community in the light of these challenges.

An appropriate representation of information is crucial for the agility, sustainability, and maintainability of the information architecture of mobile applications. This article discusses the potential of the Semantic Web (Hendler, Lassila, & Berners-Lee, 2001) framework to that regard.

The organization of the article is as follows. We first outline the background necessary for the discussion that follows and state our position. This is followed by the introduction of a knowledge representation framework for integrating Semantic Web and mobile applications, and we deal with both social prospects and technical concerns. Next, challenges and directions for future research are outlined. Finally, concluding remarks are given.

BACKGROUND

In recent years, there has been a proliferation of affordable information devices such as a cellular phone, a personal digital assistant (PDA), or a pager that provide access to mobile applications. In a similar timeframe, the Semantic Web has recently emerged as an extension of the current Web that adds technological infrastructure for better knowledge representation, interpretation, and reasoning.

The goal of the mobile Web is to be able to mimic the desktop Web as closely as possible, and an appropriate representation of information is central to its realization. This requires a

transition from the traditional approach of merely presentation to *representation* of information. The Semantic Webprovides one avenue towards that.

Indeed, the integration of Semantic Webtechnologies in mobile applications is suggested in Alesso and Smith (2002) and Lassila (2005). There are also proof-of-concept semantic mobile applications such as MyCampus (Gandon & Sadeh, 2004) and mSpace Mobile (Wilson, Russell, Smith, Owens, & Schraefel, 2005) serving a specific community. However, these initiatives are limited by one or more of the following factors: the discussion of knowledge representation is one-sided and focuses on specific technology(ies) or is not systematic, or the treatment is restricted to specific use cases. One of the purposes of this article is to address this gap.

UNDERSTANDING KNOWLEDGE REPRESENTATION IN SEMANTIC MOBILE APPLICATIONS

In this section, our discussion of semantic mobile applications is based on the knowledge representation framework given in Table 1.

The first column addresses semiotic levels. Semiotics (Stamper, 1992) is concerned with the use of symbols to convey knowledge. From a semiotics perspective, a representation can be viewed on six interrelated levels: physical, empirical, syntactic, semantic, pragmatic, and social, each depending on the previous one in that order. The physical level is concerned with the representation of signs in hardware and is not directly relevant here.

The second column corresponds to the Semantic Web"tower" that consists of a stack of technologies that vary across the technical to social spectrum as we move from bottom to top, respectively. The definition of each layer in this technology stack depends upon the layers beneath it.

Table 1. Knowledge representation tiers in a semantic mobile application

Semiotic Level	Semantic Mobile Web Concern and Technology Tier	Decision Support
Social	Trust	Feasibility
Pragmatic	Inferences	
Semantic	Metadata, Ontology, Rules	
Syntactic	Markup	
Empirical	Characters, Addressing, Transport	
Physical	Not Directly Applicable	

Finally, in the third column, we acknowledge that there are time, effort, and budgetary constraints on producing a representation and include feasibility as an all-encompassing factor on the layers to make the framework practical. For example, an organization may choose not to adopt a technically superior technology as it cannot afford training or processing tools available that meet the organization's quality expectations. For that, analytical hierarchy process (AHP) and quality function deployment (QFD) are commonly used techniques. Further discussion of this aspect is beyond the scope of the article.

The architecture of a semantic mobile application extends that of a traditional mobile application on the server-side by: (a) expressing information in a manner that focuses on *description* rather than presentation or processing of information, and (b) associating with it a knowledge management system (KMS) consisting of one or more domain-specific ontologies and a reasoner.

We now turn our attention to each of the levels in our framework for knowledge representation in semantic mobile applications.

Empirical Level of a Semantic Mobile Application

This layer is responsible for the communication properties of signs. Among the given choices, the