# Chapter IV
# Ontologies for Location-Based Services

**Matthias Brantner**
*University of Manheim, Germany*

**Sven Helmer**
*University of London, Birkbeck College, UK*

**Carl-Christian Kanne**
*University of Manheim, Germany*

**Guido Moerkotte**
*University of Manheim, Germany*

## ABSTRACT

*A user of a mobile business application is usually not interested in technical data, but its meaning (which may also vary from user to user). We discuss how ontologies can help in translating this technical, location-based data (e.g. geographical coordinates) into semantic information. Taking a practical point of view, we first define typical requirements of location-based services, develop an ontology for locations, and show how this ontology can be integrated into existing technologies.*

## INTRODUCTION

One of the key advantages of mobile computing is the potential to personalize the services offered to a user based on his or her location. While the software industry has moved towards service-oriented architectures (SOAs) in the last few years, this has mostly been done for non-mobile enterprise systems. In order to implement SOAs in a mobile context, we have to be able to handle location-based information effectively. Integrating different services on a syntactical level—that is, exchanging geographical coordinates (e.g., GPS coordinates)—will not be enough. For users as well as applications, this form of location-based information is of little practical value. We need to attach meaning to the coordinates. However, this meaning also depends heavily on the user, as for example a tourist might be interested in the history of a building, a businessman in the companies located there, while someone delivering a package wants to know the address (street name and number). Additionally, the services themselves also need location-based information.

Here we discuss how ontologies can help solve these problems. When writing this chapter we chose to adopt a practical view. This is reflected by the different parts of the chapter: First, we give a brief introduction to ontologies and services (readers who are familiar with these topics can skip this). In the section on use cases, we define typical requirements of m-commerce applications with the help of concrete use cases. Based on these requirements we present an ontology for locations in the section on ontology. We explain the different elements of the ontology (written in OWL) and show how the previously defined requirements are met. We also demonstrate how this ontology can be integrated into existing technologies, taking as examples OWL-S and UDDI. Finally, a short summary concludes the chapter.

## PRELIMINARIES

In this section we briefly define the terminology that is used in the following parts of the chapter. This mainly involves definitions for the terms ontologies and services.

For ontologies we include a rough overview of the Web Ontology Language (OWL) (World Wide Web Consortium, 2004b), while for services we will talk about service descriptors and the interaction between service requesters and service providers.

### Ontologies and OWL

An *ontology* is an explicit specification of a conceptualization (Gruber, 1995). It specifies for a special domain the objects and relationships between the objects. In our context we use ontologies to describe services. Within these descriptions we have specialized ontologies that provide information on locations and regional availability of services.

OWL is a language to describe ontologies. The World Wide Web Consortium (W3C) developed OWL by revising the DAML-OIL Web Ontology Language. It defines semantic markup for Web resources and builds up on RDF (Resource Description Framework) (World Wide Web Consortium, 2004a). RDF is a general-purpose language for representing information on the Web, based on an XML syntax. OWL adds language primitives to support a richer expressiveness like cardinality restrictions, restrictions on the scope of properties, or on characteristics of properties (e.g., transitivity or uniqueness).

Different categories of requirements for OWL lead W3C to define three sublanguages of OWL (descending in power of expressiveness): OWL Full, OWL DL, and OWL Lite. For the purpose of describing our location ontology, OWL Lite suffices. In addition to being easier to understand, OWL Lite also has another advantage important in the context of large-scale mobile services. Due to its limited expressiveness, reasoning and searching can be implemented very efficiently.

An OWL document (describing an ontology) consists of an optional header plus any number of elements. The most important building blocks are classes, individuals, and properties: