

# Chapter 23

## Ontology Driven E–Government

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### ABSTRACT

*Expectations of citizens concerning the quality of electronically available public services are steadily increasing. Thus more and more of these services are fully transactional (Layne und Lee, 2001) and offer tight integration of electronic access and underlying processes. Whereas this leads to better results in the terms of time, convenience and correctness, software systems become more complex and development effort rises as well. On the other hand, in the field of software engineering there exist several recommendations and approaches to reduce development time and increase the degree of software re-use. Some of these recommendations are known for decades (McIlroy, 1968). One approach that tries to tackle this problem at the very beginning of the development circle is Model Driven Architecture (MDA) (Miller et al, 2001). The core idea behind MDA is the creation of a comprehensive system model that is based on several abstraction levels (OMG, 2002). These different modeling layers as well as a set of transformations between them allow for the automatic generation of most of the code needed. Whereas typically UML 2, which is also based on the same multi-layer modeling approach, is used to create the required abstract descriptions, there already exist some efforts to extend MDA to semantic web technologies as well (OMG, 2006). This chapter describes an approach to apply an MDA-like methodology, which is entirely based on a semantic model to the e-Government domain. The goals are to ease access to e-Government services, provide a new level of user experience and of course to reduce the implementation and maintenance effort while significantly improving the overall quality of service.*

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## WHAT IS AN ONTOLOGY?

Ontologies are the basic elements of semantic systems since they describe the semantic aspects of any given domain. There are numerous definitions of the term ontology available. One that is very frequently cited, is the one by Thomas Gruber:

*“An **ontology** is an explicit specification of a conceptualization” (Gruber, 1995, p. 908)*

By citing (Genesereth and Nilson 1987) he also explains, that any approach of representing knowledge has to be based on conceptualisation, which in turn is a collection of “objects, concepts, and other entities that are assumed to exist in some area of interest and the relationships that hold among them”. This makes a conceptualisation a simplified and abstract representation of the part of the world that should be modelled. All needed elements are explicitly specified by means of a representational vocabulary, thus leading to the more precise definition:

*“In such an ontology, definitions associate the names of entities in the universe of discourse (e.g., classes, relations, functions, or other objects) with human-readable text describing what the names mean, and formal axioms that constrain the interpretation and well-formed use of these terms. Formally, an ontology is the statement of a logical theory.” (Gruber, 1995, p. 909)*

In a more recent article Gruber refines this definition and provides slightly different explanations depending on the context in which an ontology is used. For the context of computer and information sciences his definition is:

*“...an ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class*

*members). The definitions of the representational primitives include information about their meaning and constraints on their logically consistent application.” (Gruber, 2007)*

In this article Gruber also argues, that the most important reason why ontologies are considered to be at the “semantic” level rather than at the “logical” level is their expressive power when it comes to logical constraints. This expressiveness comes close to first-order logic.

A similar but rather pragmatic definition can be found in (Hendler, 2001, p. 30):

*“I define ontology as a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic”*

A more formal definition, however, can be found in (Ehrig, Haase, Stojanovic, 2004):

Definition: An *ontology with datatypes* is a structure

$O := (C, T, \leq_C, R, A, \sigma_R, \sigma_A, \leq_R, \leq_A, I, V, \iota_C, \iota_T, \iota_R, \iota_A)$  consisting of

- six disjoint sets  $C, T, R, A, I$  and  $V$  called concepts, datatypes, relations, attributes, instances and data values,
- partial orders  $\leq_C$  on  $C$  called concept hierarchy or taxonomy and  $\leq_T$  on  $T$  called type hierarchy,
- functions  $\sigma_R: R \rightarrow C^2$  called relation signature and  $\sigma_A: A \rightarrow C \times T$  called attribute signature,
- partial orders  $\leq_R$  on  $R$  called relation hierarchy and  $\leq_A$  on  $A$  called attribute hierarchy, respectively,
- a function  $\iota_C: C \rightarrow 2^I$  called concept instantiation,
- a function  $\iota_T: T \rightarrow 2^V$  called datatype instantiation,
- a function  $\iota_R: R \rightarrow 2^{I \times I}$  called relation instantiation,

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