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Modelling of Service-Oriented Architectures with UML

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Abstract

Nowadays, service-oriented architectures are becoming gradually more important. The vast diversity of implementation and support platforms for this kind of architectures (such as Web, Grid or even CORBA) increases the complexity of the development process of service-based systems. With the aim of facilitating the development of service oriented solutions, we propose the specification of an architecture centric model driven development method. To achieve this, we study the architectural properties of the SOA paradigm and follow a development approach based on the MDA proposal. MDA proposes a separation of the development process in abstraction levels. This makes MDA suitable to tackle the development of service-oriented systems. This paper describes a UML profile for the PIM-level service-oriented architectural modelling, as well as its corresponding metamodel. PIM (Platform Independent Model) level is chosen because it does not reflect constraints about any specific platform or implementation technology. To exemplify and validate the profile, a case study is presented in which the proposed profile is used.

Keywords: Service-Oriented Architectures, Model-Driven Architecture, PIM-level modelling, UML Profiles

1 Introduction

In the last years the development of systems based on services has grown in importance. The introduction of the service orientation principles into the business field [11], the specification of new technology standards for services [19] or the use of

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services as basis in the construction of middleware systems [8] are among the main motivations. However, several problems have come up along with this evolution. Issues like the migration of execution platform, the design and implementation of intricate lifecycles, the increase in the complexity of the development process and the lack of a precise definition of the concepts involved in SOA (Service Oriented Architecture) solutions are among them. So, different actions should be taken to tackle these problems. We focus in two:

(i) To accomplish a study of the architectural principles governing the SOA designs. The architecture reflects the structure and behaviour of a system and how it evolves as time elapses. Moreover, the architecture of a service-oriented system should include features related to business processes and organizational aspects. The integration of business models, which has lead to its quick evolution and spreading, is one of the main benefits of SOA.

(ii) To follow a methodological approach to reduce the complexity of the SOA development process. One of the current trends that more importance is gaining is the model-driven approach. The ideas behind the MDA (Model-Driven Architecture)[16] proposal can facilitate and improve the development of SOA solutions.

Consequently, to solve the problems stated at the beginning, a SOA development method (SOD-M) based on the MDA principles and architecture-centric could be used. MDA conceives models as first class elements during system design and implementation and establishes a separation of the development process in three abstraction levels, namely CIM, PIM and PSM. Its main feature, however, is the definition of mappings between the models defined in each level and between levels, what makes possible the automation of the development process. In our case, the methodological framework in which we lean on is MIDAS, a methodological framework for the model-driven development of Web Information Systems (WIS) [5].

In previous research works [14], we made an in-deep study of the convenience of extending the MDA proposal to support the specification of the architectural modelling aspect within a MDD (Model Driven Development) process. Following its conclusions, in this article we present a UML profile for the PIM-level service-oriented architectural modelling, together with the correspondent metamodel. To illustrate and validate it we use, as case study, an extension for a Web Information System for medical image management called GESiMED [1].

There are some other works related with the topic of this article. They also deal with the definition of the SOA principles ([2], [13], [17]), with UML profiles for service-based developments ([3], [10], [20]) and even the MDA principles applied to SOA ([21]). They are analyzed in detail in Section 4.

The remainder of the article is structured as follows: Section 2 gives a general overview of the MDA framework in which the research is framed. Section 3 presents, firstly the concepts involved in the UML profile by means of depicting the associated meta-model and, secondly, UML profile for the PIM-level service-oriented