

Chapter 2.15

A Methodology for the Design, Development and Validation of Adaptive and Context-Aware Mobile Services

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ABSTRACT

The authors present a holistic approach for the efficient design, implementation, and validation of context-aware mobile services. The according concepts have been developed within the PLASTIC project which devises a methodology based on model-to-model transformations to be applied at different stages of the service lifecycle. Starting from a conceptual model, these models reflect characteristic properties of the mobile service under development such as context information. For the implementation of the service, a middleware suite then is used which comprises a set of constituents which significantly simplify and shorten the mobile services development cycle. The authors focus on demonstrating the

concepts in terms of mobile business-to-business field services as opposed to business-to-consumer services. Here through the methodology and tools the dynamicity can be significantly enhanced. By using the contained adaptation mechanism, service specifications (static by nature) can be qualified to deal with additional information (e.g., context) needed for achieving a better quality of service and usability.

INTRODUCTION

During the last few years, many companies started (or envisioned to start) a slow but radical transformation in the way they conduct businesses. There are two important factors which, among others,

help explaining such trend: the widespread need for *Mobility* and *Service-oriented Computing*.

Mobility of humans and objects has become a characteristic and perhaps, more than that, an essential requirement of daily life. Basic functions like for instance telephony, data exchange, as well as more advanced functions like conducting / tracking / steering businesses, sampling and transmission of critical data etc. are required to be accessed *anywhere, anytime* and *anyhow*.

On the other hand, *Service Computing* is becoming a paradigm more and more popular within enterprises because it proposes an architecture which can promote IT agility through modularity and to align transformation to business priorities. Service Oriented Architectures (SOA) help in fact to cost-efficiently create IT solutions composed by loosely coupled web services which can be reused and seamlessly integrated with others promoting business alignment as well as cross-enterprise collaborations.

In this chapter we recognize and address some of the challenges of combining mobility and service computing. In our work, we focus on *context-aware “mobile web services”* which are going to be offered to users in varying situations, adapting service provisioning to the environment so as to offer the best quality of service in the most cost-effective way. Such quality is assumed to be specified through functional and/or non-functional attributes (like average service response time, availability, ...) which can be observed at the service interface.

Note that while there is a W3C standard definition of web service (“*a software system designed to support interoperable machine to machine interaction over a network*”) there is no widely accepted definition for mobile web service. The notion of mobile web service is less clear since it suggests that (i) either the web service can be consumed from within a mobile setting or (ii) that the service can be deployed on (and made available by) mobile devices. In either case, one of the key problems is handling adaptation for

service consumer or service provider (or both) to a changing environment like the one offered in a B3G (*Beyond 3G*) network setting. The goal of B3G is in fact to exploit the integration of different connectivity standards (WiFi, Bluetooth, GRPS/UMTS, Ethernet, IrDA, etc.) while preserving the heterogeneity of the various networking systems and their qualitative and quantitative characteristic.

The work presented in this chapter is part of an initiative carried out in PLASTIC¹ (*Providing Lightweight & Adaptable Service Technology for pervasive Information & Communication*). PLASTIC is a project funded by the European Union to address several challenges pertaining to the development of adaptable and context-aware mobile services. In order to validate the broad applicability of the approach, the real-world usage in the e-Health, e-Voting, e-Learning and e-Business domains is demonstrated. The project devises a methodology and a platform comprising:

- **A development environment** enabling the thorough design and modeling of context- and resource-aware adaptive services, which may be deployed on the various networked nodes, including mobile terminals and handheld devices.
- **A middleware** enabling B3G networking through the comprehensive integration of multi-radio networks and further context-aware, discovery, and access to networked services.
- **A validation framework** enabling off-line and on-line validation of networked services regarding functional and non-functional properties.

After reviewing the state-of-the art in the area, we will introduce the complete methodology developed within PLASTIC and we explain how it has been applied to a realistic e-Business application from the *Field Service Management* (FSM) domain and how it improves particularly

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