Abstract. Currently, mobile environments are gaining importance, and new promising paradigms, like Mobile Cloud, are arising. However, these environments pose new challenges and are mainly characterized, among others, by frequent changes in their execution context. This particularly is challenging for software architects in the design and implement this kind of systems. For instance, the Service Oriented Architecture (SOA) paradigm has not been devised to operate in dynamic network environments, where centralized services or static deployments must be avoided, in order to provide a higher availability of services. Therefore, in order to provide a reliable SOA implementation in mobile environments, it must be complemented with techniques and methods of Autonomic Computing. In this work, a self-adaptive SOA approach is proposed. This architecture will provide support to the dynamic replication and deployment of services in mobile environments. The approach is based on the context information modelling and management as key aspect to achieve the required architecture adaptation.

Keywords: Context-awareness, context modelling, software architecture, mobile environments, Service Oriented Architecture (SOA).

1 Introduction

The Service Oriented Architecture (SOA) paradigm proposes a modular distribution of the functionalities of a system through services [10]. It provides the foundations to build an interoperable and scalable system thanks to the use of standard protocols (e.g., SOAP) and service composition (i.e., service orchestration and choreography). However, SOA paradigm has not been designed to operate in dynamic network environments [2], such as mobile environments. Thanks to the increase of the capabilities of mobile devices, mobile systems are gaining importance and new concepts and paradigms are arising, like, for instance Mobile Cloud [5]. These environments pose new challenges and are characterized, among others, by frequent changes in their execution context (e.g., changes
in network topology or in the availability of the devices). Because of this, centralized services or static deployments must be avoided, in order to provide a higher availability of services. Thus, in these environments it is not feasible to implement a system strictly based on SOA.

For instance, in the forensic domain there are different scenarios: natural disasters, accidents, terrorist attacks, murders, etc., where security forces must apply protocols of action intended to support victim identification. Forensic support systems, like the Mobile Forensic Workspace [12], must allow to exchange information with nearby devices, in order to support data sharing between forensic experts. However, in some scenarios common network infrastructures may not be available. Consequently, an ad-hoc network must be created between the users that compose the working group, who may be moving around the scene. This implies unstable connections (disconnections and network partitions), and thus, the availability of the services and information can be compromised.

Therefore, systems deployed in mobile environments should aim to be autonomous sufficiently to adapt themselves to context changes in runtime, without the explicit intervention of the user. In this way, SOA paradigm must be complemented with techniques and methods of Autonomic Computing [9] for architectural software design. Autonomic Computing provides the techniques to extend a system with self-* features (i.e., self-healing, self-configuration, self-optimization and self-protection). This is fundamental in mobile environments, where systems must be proactive, and for that reason, self-adaptive architectures have been gaining importance in the research community [17].

However, current solutions are not effective. This is primarily for two reasons: (1) they are solutions designed for a particular application domain, and hence, they are difficult to apply and reuse in different domains; and (2) they are based in a limited set of context information for the dynamic deployment of services, which leads to solutions with a poor performance.

In this paper the context information that influences the adaptation process in self-adaptive service replication and deployment is identified and modelled. This context model is defined independently of specific application domains, within the mobile collaborative networks, and it takes into consideration the network topology, the computational features of the devices, and how they adjust to the requirements of each specific service. Moreover, a self-adaptive SOA approach is proposed. This architecture is based on the proposed context model and provides support to the dynamic replication and deployment of services in mobile environments.

The rest of this paper is organized as follows. Section 2 provides an overview of the literature in this field. Section 3 defines a context model and introduces a self-adaptive software architecture to support the dynamic replication and deployment of services in mobile environments. In Section 4 the Mobile Forensic Workspace case study is detailed, and it highlight how the proposed system helps to improve the availability and reliability of the services and information deployed in the system. Finally, Section 5 draws some conclusions and outlines the plans for future research.