Chapter 73
Workflow Management and Mobile Agents:
How to Get the Best of Both Approaches

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ABSTRACT

Service composition is an extremely powerful and versatile way to aggregate and reuse distributed services and software components into richer and complex scenarios. Workflow Management Systems have emerged as one of the leading technologies to execute service compositions but typically fail to support distributed scenarios, where distributed services should be invoked in a scalable and effective way. Mobile Agent platforms propose a suitable framework to distribute the execution of complex service compositions, and therefore to enable scalability and improve performance. However, current proposals for MA-based WFMSs still target rather static and poorly distributed scenarios and exploit agent migration benefits only in a partial and insufficient way. The authors' model proposes to overcome these problems via a richer and more effective agent delegation strategy that can also cope with dynamic scenarios where services can move and replicate, in order to achieve a better integration by taking advantage of both technologies.

INTRODUCTION

Ubiquitous environments have proven to be extremely effective to overcome heterogeneity and to face dynamicity, with novel devices, services, and also wired and wireless connectivity networks becoming available at any time. However that motivates and asks for ubiquitous support platforms able to dynamically and flexibly extend to support novel features and user requirements.

A Service-oriented vision has recently emerged as the key approach to break down and elegantly modularize complex ubiquitous scenarios into more manageable off-the-shelf components that

can be easily aggregated and orchestrated. Service orchestration and aggregation represent research fields deeply debated and with a long experience, with many models and tools to support these non trivial tasks: in that area, workflow-based approaches provide a flexible and extensible abstraction to shape complex aggregates of services in flows organized in basic building blocks that can be either services (pieces of concrete business logic) or control blocks (conditional branches, forks, loops, joins). Recently, service oriented approaches and workflow-based coordination platforms have been proposed together as the way to deal with increasingly complex and dynamic ubiquitous ecosystems: the service-oriented approach allows to shape each piece of business logic (e.g., content delivery, media adaptation and transcoding) into reusable modules (services) that can then be easily and flexibly recombined into larger and possibly complex workflows of business logic.

Even though that model can be extremely flexible and powerful, open issues still remain unsolved, especially with respect to the efficiency and Quality of Service of these infrastructures in complex real-world deployment scenarios with a great number of users, services, and workflows involved. Typical workflow management systems, in fact, adopt centralized approaches (a central execution unit manages, coordinates, and invokes remote services) that provide poor scalability and Quality of Service features (e.g., dependability, availability, response time) when the system complexity grows, for instance with hundreds/thousands users, services, and workflows involved and contemporarily operating.

The key proposal of this chapter is to overcome scalability and efficiency issues by merging traditional service-oriented and composition-based architectural approaches with highly distributed and scalable Mobile Agent technologies, with the goal of obtaining the best of both. Specifically, we investigated the adoption of Mobile Agent technologies to distribute service workflow execution in extremely dynamic ubiquitous scenarios with services and contents dynamically becoming continuously available (and also unavailable), migrating, and replicating. The main idea is to realize a distributed workflow execution model, where agents can migrate workflow execution towards available services current locations, by also taming complex scenarios where services can move and be replicated to achieve better load balancing. The proposed model and implementation provides an extremely scalable, flexible, and efficient infrastructure for service and content provisioning in dynamic ubiquitous environment.

The rest of this chapter is organized as follows: Background section provides an overview of Ubiquitous Computing and main approaches to Service-oriented Computing and service composition; next section provides some insights about related work in the domain of Mobile Agent platforms for distributed workflow execution. Next two sections present our architectural model, together with implementation details and relevant performance evaluations. Finally, last section reports concluding remarks our work has led to.

BACKGROUND

In ubiquitous computing scenarios, users require to access services and contents from anywhere, at anytime, and with any device at hand. This forces service provisioning support platforms to address several challenging and debated research areas, such as mobility management, multimodality, and context-awareness support. Service-oriented middleware architectures have recently emerged (Boari, 06) and propose to solve the inherent complexity and heterogeneity of such scenarios by exploiting a modular and composition-based approach. This section describes the most relevant fields of ubiquitous computing and provides an insight into the most relevant middleware support proposals for each one of them. Then, we deepen the description of service-oriented architectural

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