

Chapter 39

Agent-Based Infrastructure for Dynamic Composition of Grid Services

Matthew Adigun

University of Zululand, South Africa

Johnson Iyilade

University of Zululand, South Africa

Klaas Kabini

University of Zululand, South Africa

ABSTRACT

The service-oriented computing paradigm is based on the assumption that existing services can be put together in order to obtain new composite services. This chapter focuses on how peer-to-peer architectures based on multi-agent systems can be used to build highly dynamic and reconfigurable infrastructure that support dynamic composition of grid services. The chapter starts by providing an overview of key technologies for SOC. It then introduces dynamic service composition and challenges of composing grid services. The authors further motivate for Multi-agent system approach in SOC and why it becomes important in service composition. They then present our research effort, AIDSEC, an agent-based infrastructure for dynamic service composition, describing its architecture, implementation and comparison with some related work in the literature. In addition, the chapter raises some emerging trends in SOC and the particular challenges they pose to service composition. They conclude by suggesting that a solution based on multi-agent system is required for composing services that possess capabilities of autonomy, reliability, flexibility, and robustness.

INTRODUCTION

The Service Oriented Computing (SOC) paradigm is currently a promising methodology for engineer-

ing applications in both scientific and industrial communities (Bhatia, 2005). It promises a world of distributed services that are loosely coupled to flexibly create dynamic business processes and agile applications that may span many organizations and computing platforms.

DOI: 10.4018/978-1-61520-686-5.ch039

A major assumption of the SOC approach is that services can be combined together in order to obtain new, composite services. The implication of this is that future enterprise and scientific applications do not have to be developed from the scratch but assembled on the fly from an ecosystem of services available on a network such as the grid (NGG Report, 2006). This is already having revolutionary impact on the way software applications are designed, architected, delivered and consumed.

Building scientific or business applications that utilize distributed services is one of the challenges facing the SOC research community today. Traditional software engineering methodologies are often inadequate in addressing the complexity and dynamic nature of large-scale distributed systems. Classical techniques for composing services are procedural and only define how different services ought to be invoked e.g. in terms of ordering and parallelism among them. They are geared for low-level invocation of services, and not specially geared for enabling composition (Singh & Huhns, 2005). Moreover, a number of existing techniques are too rigid and are controlled by a centralized composition engine. They are, therefore, inadequate for service composition, especially, when services require capabilities of autonomy, flexibility and robustness.

Interestingly, there has been an explosion of interest in peer-to-peer (P2P) methodology as a promising approach for engineering large scale distributed systems (Bhatia, 2005). P2P systems generally, offer the advantages of scalability, reliability, and robustness over traditional server-based systems (Verma, 2004). Multi-agent Systems (MAS) have thus, emerged as a P2P methodology that address the issues of organizing large-scale software systems and could, therefore, complement existing methodologies for SOC. Agents are autonomous, computational entities that can be viewed as perceiving their environment through sensors and acting upon them through effectors (Bradshaw, 1997). Many

existing and potential industrial applications of multi-agent systems in engineering large-scale systems are found in many fields such as e-commerce, telecommunications, transportation, sensor network, scheduling, and manufacturing (Weiss, 1999). Multi-agent systems would, therefore, be invaluable in emerging SOC environments especially in developing and analyzing intricate models and theories of interactivity and collaboration among Collaborative Virtual Enterprises (CVEs) and Virtual Organizations (VOs). Moreover, agents provide greater flexibility and robustness in how services are used and created by operating rationally in a variety of environmental circumstances and context that change in a usually unforeseen manner.

We, therefore, present in this chapter an approach that augment current service-based technologies with multi-agent system for dynamic composition of grid services.

The rest of the chapter is organized as follows:

- In the Background section, we present a general introduction to drivers of a new approach to software development that led to the emergence of the SOC paradigm, followed by a short introduction of web services and grid services as two key technologies for implementing services. We further introduce the semantic web and its importance to advancing the vision of SOC;
- Then, in the Dynamic Service Composition section, we introduce the basic concepts of service composition, and then discuss the challenges of dynamic composition of grid services;
- In the section that follows, we present Multi-agent system in SOC by first introducing agents and multi-agent systems; we then present a motivation for MAS in SOC and thereafter, draw abstractions for composition of services;

24 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/agent-based-infrastructure-dynamic-composition/40833

Related Content

Robust and Efficient Custom Routing for Interconnection Networks with Distributed Shortcuts

T. X. Le Nhat, T. Truong Nguyen and Khanh-Van Nguyen (2014). *International Journal of Distributed Systems and Technologies* (pp. 51-74).

www.irma-international.org/article/robust-and-efficient-custom-routing-for-interconnection-networks-with-distributed-shortcuts/119193/

SONATA: Social Network Assisted Trustworthiness Assurance in Smart City Crowdsensing

Burak Kantarci, Kevin G. Carr and Connor D. Pearsall (2016). *International Journal of Distributed Systems and Technologies* (pp. 59-78).

www.irma-international.org/article/sonata/143903/

Collaboration Support for Activity Management in a Personal Cloud Environment

Liliana Ardissono, Gianni Bosio, Anna Goy, Giovanna Petrone, Marino Segnan and Fabrizio Torretta (2011). *International Journal of Distributed Systems and Technologies* (pp. 30-43).

www.irma-international.org/article/collaboration-support-activity-management-personal/58632/

Rough Sets: A Versatile Theory for Approaches to Uncertainty Management in Databases

Theresa Beaubouef and Frederick E. Petry (2008). *Rough Computing: Theories, Technologies and Applications* (pp. 129-151).

www.irma-international.org/chapter/rough-sets-versatile-theory-approaches/28470/

Accelerating Mobile-Cloud Computing: A Survey

Tolga Soyata, He Ba, Wendi Heinzelman, Minseok Kwon and Jiye Shi (2014). *Communication Infrastructures for Cloud Computing* (pp. 175-197).

www.irma-international.org/chapter/accelerating-mobile-cloud-computing/82536/