International Journal of Adaptive, Resilient and Autonomic Systems
Volume 7 • Issue 1 • January-June 2016

Towards Automated SLA Management for Service Delivery in SOA-based Environments

Elarbi Badidi, College of Information Technology, United Arab Emirates University, Al-Ain, United Arab Emirates
Mohamed El Koutbi, ENSIAS, Mohamed V University, Rabat, Morocco

ABSTRACT

The services landscape is changing with the growing adoption by businesses of the Service Oriented Architecture (SOA), the migration of business solutions to the cloud, and the proliferation of smartphones and Internet-enabled handheld devices to consume services. To meet their business goals, organizations increasingly demand services, which can satisfy their functional and non-functional requirements. Service Level Agreements (SLAs) are seen as the means to guarantee the continuity in service provisioning and required levels of service. In this paper, we propose a framework for service provisioning, which aims at providing support for automated SLA negotiation and management. The Service Broker component carries out SLA negotiation with selected service-providers on behalf of service-consumers. Multi-rounds of negotiations are very often required to reach an agreement. In each round, the negotiating parties bargain on multiple SLA parameters by trying to maximize their global utility functions. The monitoring infrastructure is in charge of observing SLA compliance monitoring using measurements obtained from independent third party monitoring services.

KEYWORDS

Quality-of-Service, Service Broker, Service Level Agreement, Service Selection, SLA Negotiation

1. INTRODUCTION

As a result of the impressive proliferation of Internet-enabled devices, the growing adoption of SOA for implementing and deploying business applications on the Web and the cloud, organizations increasingly demand services that can meet their functional and quality-of-service (QoS) requirements. Therefore, service-providers need to negotiate Service Level Agreements (SLAs) with their service-consumers and honor them if they want to remain competitive. QoS refers to a set of qualities or characteristics of the service, such as response-time, availability, throughput, latency, security, reliability, and reputation. Several models and were proposed for representing QoS attributes of Web services. The most important ones are:

1. Extension of the WSDL (Web Services Description Language) documents with QoS information (D'Ambrogio, 2006) (Kang, 2007).
2. Extension of the UDDI (Universal Description Discovery and Integration) with QoS information (Lo, Cheng, Lin, & Chao, 2008).
3. Utilization of a Broker (Yeom & Min, 2005) (Tao & Lin, 2005).
4. Utilization of explicit QoS definition languages (Pal et al., 2000).

DOI: 10.4018/IJARAS.2016010102

Service-providers have to adhere to their service level commitments if they want to remain competitive in a very changing and demanding business environment. Also, given the variety in consumers' requirements, providers need to manage an increasing number of SLAs, all with potentially changing quality requirements. The SLA life cycle, as described in the SLA Management Handbook (TeleManagement Forum, 2004), includes six main phases: SLA Development, Negotiation and Sales, Implementation, Execution, Assessment, and Decommissioning. The most significant initiatives in standardizing the use of SLAs are (1) WSLA (Keller & Ludwig, 2003) by IBM, (2) the WS-Agreement specification (Andrieux et al.) by the Open Grid Effort, and (3) the SLAng specification Language (Lamanna, Skene, & Emmerich, 2003). Besides, many efforts have investigated the issue of SLA Negotiation that we discuss in the Related Work section (Dan, Davis, Kearney, & Keller, 2004) (Silaghi, Şerban, & Litan, 2012) (Hasselmeyer, Qu, Schubert, Koller, & Wieder, 2006) (Theilmann et al., 2010). This work shares with these efforts the common goal of providing support for automated SLA negotiation and management. Finding the right service-provider is a daunting task for consumers given the abundance and the variety of service offerings. Besides, collecting information about multiple service-providers is costly and time consuming.

Key aspects of the SLA-driven service provisioning, which are not addressed adequately by most SLA-based service provisioning systems, essentially concern multiple QoS attributes driven service selection, multi-issues SLA negotiation, and SLA-compliance monitoring. We propose in this work a framework that deals with these issues in an integrated way. The main components of the framework are: the Service Broker (SB) and the Monitoring Infrastructure (MI). SB mediates between service-consumers and service-providers, selects suitable service-providers that are capable of delivering required functionality and quality of service, and negotiates SLAs on behalf of service-consumers, and assesses compliance of service delivery with agreed upon SLA. Multiple rounds of negotiations are very often required to reach an agreement. In each round, SB and the selected service-provider bargain on several SLA parameters by trying to maximize their global utility functions. MI is in charge of observing service delivery, during SLA implementation, using measurements obtained from independent third party monitoring services.

The remainder of the paper is organized as follows. Section 2 presents related work on the issue of SLA negotiation. Section 3 describes the typical components of a SLA. Section 4 presents an overview of the proposed framework and describes its components and the interactions among them. Section 5 describes the service provisioning phases and the SLA negotiation process. Section 6 concludes the paper and highlights future work.

2. RELATED WORK

SLA negotiation and specification of machine-readable SLAs have been the subjects of several efforts in the context of SOA-based environments, computational grid environments, and recently cloud-based environments.

Dan et al. (Dan et al., 2004) described a framework for providing differentiated service levels to service-consumers in an SOA environment by means of SLAs and automated management. The framework encompasses WSLA – for the creation and negotiation of SLAs --, a system to dynamic allocation of resources based on SLOs, a workload management system that orders requests consistent with the corresponding SLAs, and a system to monitor compliance with the SLA. Chieng et al. (Chieng, Marshall, & Parr, 2005) described an SLA-driven service provisioning architecture that allows flexible and quantitative SLA negotiation for services. The emphasis is on bandwidth reservation, which is the most important factor to affect connection's QoS. The negotiation high-level service parameters are