Towards AiP as a Service: An Agent Based Approach for Outsourcing Business Processes to Cloud Computing Services

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ABSTRACT

The challenges that Cloud computing poses to business processes integration, emphasize the need for addressing two major issues: (i) which integration approach should be used allowing an adequate description of interaction aspects of the composed software components? (ii) how are these interaction descriptions stored and shared to allow other software artifacts to (re)use them? To address these issues, in this paper the authors propose an Agent Interaction Protocols (AiP)-based approach for reusing and aggregating existing Cloud services to create a new desired business application. The proposed approach facilitates rapid development and provisioning of composite Cloud services by specifying what to compose as an AiP. Furthermore, the authors develop an agent-based architecture that supports flexible scaling of business processes in a virtualized Cloud computing environment. The main goal of the proposed architecture is to address and tackle interoperability challenges at the Cloud application level. It solves the interoperability issues between heterogeneous Cloud services environments by offering a harmonized API. Also, it enables the deployment of applications at public, private or hybrid multi-Cloud environments.

Keywords: Agent Interaction Protocols, Business Process Integration, Cloud Computing, Protocols Composition

INTRODUCTION

In modern enterprises, business processes are becoming increasingly complex and integrated both within internal corporate business functions and across the external supply chain (Barjis et al., 2011; Galinec, 2009). Consequently, the software components of the business partners are tightly coupled with each other (Barjis, 2009; Papazoglou et al., 2008). In current practice, there are different issues that require special attention through specialized developments, like scalability, accessibility, resource management, and service orchestration.

To address these issues, Cloud computing has been seen as a promising opportunity to improve enterprise’s revenues. Cloud computing is a rapidly growing IT paradigm, which transforms the Internet into a global market of on-demand resources (Zeginis et al., 2013).
Since 2007, when the term “Cloud computing” started becoming popular, it has managed to evolve into one of the most promising and influential IT trends, occupying the first places in Gartner’s list of top strategic technologies for 2013 (Pettey, 2013). Cloud capabilities are defined and provided as three levels of service offerings: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). This allows users of Cloud-based services to be able to focus on what the service provides them rather than how the services are implemented or hosted. As stated in (Nguyen et al., 2012; Taher et al., 2012), much of the recent work on Cloud computing concentrates on the low-level technological trajectories of the Cloud. For instance Cloud scalability is heavily researched with efforts focusing on service horizontal scaling or vertical scaling and associated issues such as load balancing. However, they do not focus on other aspects of the Cloud, such as Cloud application development.

There is a clear need for placing emphasis on how to develop enhanced composite service offerings at the application level and assign or reassign different virtual and physical resources dynamically and elastically (Nguyen et al., 2012). Hence there is a need for dynamic and automated Cloud service composition capable of satisfying complex consumer requirements as they emerge. Combining different independent Cloud services is the ability to integrate multiple services into higher-level applications. This integration necessitates a uniform description format that facilitates the design, customization, and composition. In this context, Agent Interaction Protocols (AiP) are a useful way for structuring communicative interaction among business partners, by organizing messages into relevant contexts and providing a common guide to the all parts.

It was noted in (Benmerzoug et al., 2007) that AiP are appropriate approaches to define and manage collaborative processes in B2B relationships where the autonomy of participants is preserved. The idea of adopting AiP for managing collaborative processes was first introduced and proposed in our previous work (Benmerzoug et al., 2007). Whereas in (Benmerzoug et al., 2008a, 2008b), we demonstrated the practicability of our approach by embedding it in a Web services language for specifying business protocols, which conducive to reuse, refinement and aggregation of our business protocols. We also elaborated translation rules from interaction protocols notations used in our approach into Colored Petri Nets (CPN). These rules are implemented in AiP2CPN: the tool we developed to automatically generate Petri nets from protocols specifications. Resulting Petri nets can be analyzed by dedicated tools to detect errors as early as possible.

To address the collaboration and interaction issues in modern enterprises, it is normal to turn our attention to Cloud Computing as it aims to provide both the economies of scale of a shared infrastructure and a flexible delivery model. In (Benmerzoug et al., 2013), we presented the idea of Cloud Business Protocol, which is a useful way for structuring interaction among Cloud consumers and service providers. We proposed a set of operators that allows the creation of new value-added protocols using existing ones as building blocks. This research is among the earliest efforts, to the best of the authors’ knowledge, in adopting an AiP-based approach for supporting Cloud services composition.

The challenges that Cloud computing poses to business processes integration, emphasize the need for addressing two major issues: (i) which integration approach should be used allowing an adequate description of interaction aspects of the composed software components? (ii) how are these interaction descriptions stored and shared to allow other software artifacts to (re)use them?

Driven by the motivation of reuse, in the present research, we describe an agent-based approach that supports flexible scaling of business processes in a virtualized Cloud computing environment. The approach introduces a Broker-based architecture whose main goal is to address and tackle interoperability challenges at the Cloud application level. It solves the interoperability issues between heterogeneous Cloud services environments by offering a har-
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