Reputation Management for Composite Services in Service-Oriented Systems

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ABSTRACT
This paper investigates the problem of reputation management in composite services. The authors propose a novel reputation propagation technique in composite services. The proposed approach provides a fair distribution of reputation values so that a component service is neither penalised nor awarded for the poor and good performance, respectively, of other peer component services. Experiment results indicate that the proposed technique propagates the “fair share” of reputation from the composite service to its component services.

Keywords: Composite Services, Reputation, Reputation Management, Trust Management, Web Services

INTRODUCTION
With the help of Web Services standards and technologies, development and deployment of services on the Web has become easier, and is no longer limited to large enterprises. A large number of individual entrepreneurs as well as small and medium scale enterprises have started deploying their services on the Web (Saulles, 2008). The ultimate goal of the Web services technology is enabling the use of Web services as independent components in “service-oriented enterprises” that are automatically (i.e., without human intervention) formed as a result of consumer demand and which may dissolve post demand-completion. The service-oriented Web (Service Web) thus represents an attractive paradigm for tomorrow’s interactions spanning a wide range of domains from e-economy to e-science and e-government. The number of Web users has also grown phenomenally from 0.4 percent of world population in 1995 to 23.3 percent in December 2008 (Internet World Stats, 2008). A significant portion of these users have started consuming services over the Web. Consumers can now access a large pool of services with varying qualities providing similar kinds of functionalities (Hull, Benedikt, Christophides, & Su, 2003). For example, a traveller can access a large number of services offered by online travel agencies (providing similar functionalities). A consumer thus faces a difficult task of
choosing the best service(s) that meets his/her requirements, as some services may not even deliver what they promise (resulting in bad track records). This implies that a service consumer needs to trust the ability of the provider to deliver the required functionality before starting the interaction. Hence, trust is one of the essential and important criteria a consumer can use in selecting the right services. The importance of trust management in Web Services is evident from the interest in both the academic and business communities (Ruohomaa & Kutvonen, 2005; Zhao & Varadharajan, 2008).

A wide range of approaches for managing trust on the Service Web have been proposed in the literature. These range from enforcing rules and regulations to the use of trusted third party certificates. On one hand, rules and regulations are not globally enforceable, while on the other, third party based trust is not scalable to the Service Web. Security technologies based approaches have also been used in some application scenarios (Anderson et al., 2005; Lin, Varadharajan, Wang, & Pruthi, 2005) to establish trust. These approaches are mainly successful in achieving authorization, authentication and confidentiality, but not necessarily trust. The lack of applicability of previous trust management approaches is due to the following reasons: (i) the Service Web is an open and dynamic environment, (ii) the service providers may not be known a priori to the customers and vice versa, and (iii) a central authority for trust management is not feasible. Consequently, reputation based approaches have been proposed as a practical alternative to manage trust on the Service Web (Ruohomaa, Kutvonen, & Koutrouli, 2007; Chang & Hussain, 2006), in both industry applications and academic research (Resnick, Kuwabara, Zeckhauser, & Friedman, 2000; Tennenholz, 2004).

We define trust as the belief that a service consumer has about the intention and the ability of a service provider to act as expected. Moreover, reputation is defined as a mechanism of establishing the belief about the provider’s ability to deliver, through collective perception of the consumers that have interacted with the service provider in the past. This mechanism has been successfully deployed in Internet marketplaces such as eBay (http://www.ebay.com.au), and Amazon (http://www.amazon.com). Many new online business services have also emerged that focus mainly on evaluating reputation of the service providers. The aim of these services is to provide ratings of the providers based on the consumers’ feedbacks. The new consumers can in turn use these ratings for choosing the most trusted service providers for interactions. Bizrate (http://www.bizrate.com), Epinions (http://www.epinions.com) and CitySearch (http://www.citysearch.com) are example companies providing rating services to the consumers. However, this model is largely labour intensive and based on a central authority, which is not applicable in modelling interactions on the Service Web. In order to address the problems mentioned above, researchers have proposed a variety of trust models for the Service Web (Xiong & Liu, 2004; Skogsrud, Benatallah, Casati, & Dinh, 2004; Bertino, Ferrari, & Squicciarini, 2004).

The basic idea behind these trust models is to capture consumers’ perceptions about the consumed service and use them to evaluate the reputation of the service provider. These models work well for a simple service. However, a service may be a composite service, where the service may have several component services which provide the required functionalities with their respective performance (Medjahed, Bouguettaya, & Elmagarmid, 2003). With regard to trust, this means the composite service must somehow reflect and fairly propagate the reputation value received from the consumer to its component services. A composite service can be viewed as a consumer service for its component services. The fair and equitable propagation of the consumer perception of the composite service performance to its component services is challenging because of the following issues:

1. Each component service may have different levels of contributions towards the overall perception of the composite service. A component service may contribute less in
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