Super-peer-based coordinated service provision

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Leveraging P2P technologies for Web service provision attracts considerable research interests. One of the challenges is how to enable the service providers to adapt themselves in response to dynamic service demand. More specifically, one interesting research issue is coordinating the service groups in order to enable inter-group collaboration and resource sharing. In this paper, we propose a super-peer-based coordinated service provision framework (SCSP), consisting of an S-labor-market model (super-peer-based labor-market model), a recruiting protocol based on a weighting mechanism, and an optimal dispatch algorithm. In the SCSP, the S-labor-market model is designed to build the coordination among service groups by employing the proposed recruiting protocol. The optimal dispatch algorithm is designed to select the optimal service peers within a service group to process service requests. Finally, we perform simulations to evaluate the SCSP with four application scenarios. The experimental results show that our SCSP is efficient in coordinating the service groups, and possess good scalability and robustness.

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1. Introduction

Web services have emerged as a popular middleware to offer dynamic integration and interaction of heterogeneous software artifacts (Alonso et al., 2004). Some typical applications include enterprise integration, e-business, and Web applications like weather forecasts, context-aware map services, etc. (Alonso et al., 2004). Web services are loosely coupled, reusable software components, which encapsulate discrete functionality and are accessible through standard internet protocols (Fensel and Bussler, 2002). The Web service architecture supports service provision, service registry, and services consumption.

One of the challenges in Web service provision is how to make the Web service providers to adapt themselves to the changes in dynamic service demand (Brazier et al., 2009; Chen et al., 2008; Cuenca-Acuna and Nguyen, 2004; Foster, 2005; Pacifici et al., 2005; Papazoglou et al., 2007). In particular, how to enable the service providers to automatically monitor their resources and tune themselves to meet end users or business requirements on the quality of Web services (e.g. service response time) by deploying new instances of services or removing the existing ones. This challenge widely exists in the application areas that are computational intensive with dynamic fluctuations in service demand, such as in the fields of cosmology, climate and computational grid services (e.g. Condors (Butt et al., 2006) and bioinformatics analysis (Chakravarti et al., 2005)). In these applications, on one hand, simple Web services are required; on the other hand, a considerable amount of computation (i.e. a large number of Web services) is required to process the large sets of data (Foster, 2005). Furthermore, as Web service entities are autonomous and heterogeneous, how to connect and coordinate them is a delicate and time-consuming task (Benallalah et al., 2002). For the above challenge of Web service provision, some studies adopted the central server infrastructure for Web service provision (e.g. Chappell, 2004; Dhesiaseelan and Ragunathan, 2004). In these methods, a Web service container works as an administrative server to provide service components and to connect business services and low-level services.

Some studies used cluster with resource managers to monitor and configure Web service provision dynamically (e.g. Pacifici et al. 2005; Whalley et al. 2006). Other studies applied peer-to-peer (P2P) technologies for Web service provision to increase scalability and robustness (e.g. Benallalah et al. 2002; Chen et al. 2008; Cuenca-Acuna and Nguyen, 2004; Gu and Nahristedet, 2006; Kanellopoulos and Panagopoulos, 2008; Sioutas et al. 2008). In addition, some specifications also work on the cooperation of Web services, such as WS-Coordination (Burdett and Kavantzas, 2004) and WS-Choreography (Cabrera et al., 2005). In this paper, we propose a super-peer-based coordinated service provision framework (SCSP) to coordinate service groups and their service peers, which enables service groups to adapt to dynamic service demand. The SCSP framework is efficient in coordinating the