Chapter 2.12
A QSQL-Based Service Collaboration Method for Automatic Service Composition, and Optimized Execution

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ABSTRACT

In scientific computing environments such as service grid environments, services are becoming basic collaboration components which can be used to construct a composition plan for scientists to resolve complex scientific problems. However, current service collaboration methods still suffer from low efficiency for automatically building composition plans because of the time-consuming ontology reasoning and incapability in effectively allocating resources to executing such plans. In this chapter, the authors present a QSQL-based collaboration method to support automatic service composition and optimized execution. With this method, for a given query, abstract composition plans can be created in an automatic, semantic, and efficient manner from QSQL (Quick Service Query List) which is dynamically built by previously processing semantic-related computing at service publication stage. Furthermore, concrete service execution instances can be dynamically bound to abstract service composition plans at runtime by comparing their different QoS(Quality of Service) values. Particularly, a concrete collaboration

framework is proposed to support automatic service composition and execution. Totally, the authors'
proposed method will not only facilitate e-scientists quickly create composition plans from a large scale
of service repository; but also make resource's sharing more flexible. The final experiment has illustrated
the effectiveness of their proposed method.

1. INTRODUCTION

In high performance computing field such as climate, biology, we often need to integrate resources across distributed, heterogeneous, and autonomous systems to enable e-scientists to solve complex scientific problems in collaborative way. Currently, service oriented grid computing platforms are becoming their problem-resolving environments where a service is a basic collaboration component. In such service grid environments, scientists can not only construct composition plans by selecting different services from large service repositories, but also submit their composition plans to grid computing platforms for executing them. Recently, many methods have been proposed aiming at enhancing the automation in constructing a composition plan and simultaneously improving the comprehensive utility of allocating resources to execute such plans. However, current such collaboration methods still face the following solid problems. On one side, they still remain at low efficiency stage for automatically building a composition plan because of the involved ontology reasoning and manual processing. For example, semantic service composition methods that take semantics of services into account to automatically solve the discovery and composition problem, have been a recent active research field [Keita Fujii et al., 2005, Danny Gagne et al., September 2006, Ulrich Küster et al., May 2007, Brahim Medjahed et al., 2005, Katia Sycara et al., 2003]. However, they mostly rely on taking direct ontology reasoning style which is generally time-consuming to lead to a low efficiency. For instance, the paper[Matthias Klusch et al., May 2006] provided a hybrid match method based on the direct reasoning for OWL-S[David Martin et al., 2004] described services. The provided examples contain 582 services, 29 query requests, the average response time for each query is about 8 seconds when being simulated in the computer with 2.4G cpu, 1024M memory. Therefore, if there is no single service satisfying the requests, a composition plan by constructing multiple services has to be generated, thus the response time will be much longer. On the other side, when executing a composition plan in a service grid platform, the flexibility of scheduling resources to execute single service has not been well addressed. For example, the traditional meteorological application programs are often bundled with specific hardware resources or platform, which means that these programs are only to be able to be executed in those grid nodes in which concrete meteorological application programs have been deployed previously. As such, even if other grid nodes are free, the user-selected meteorological application service can only be responded and processed by those grid nodes. As a result, grid resources cannot be shared and collaborated efficiently and flexibly.

For the aforementioned issues, in this chapter, we present a QSQL-based collaboration method to support automatic service composition and optimized execution. With this method, QSQL where the important reasoning relationships among ontology concepts and the published service information have been recorded in specially-designed data structures can make sure the quick query response during service discovery. Based on QSQL, service composition can be reached in an automatic, semantic and efficient manner. Particularly, when executing a composition plan, concrete service execution instances which can implement single service interface in different grid

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