Chapter 19
Exploiting P2P and Grid Computing Technologies for Resource Sharing to Support High Performance Distributed System

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ABSTRACT

This chapter identifies challenges and requirements for resource sharing to support high performance distributed Service-Oriented Computing (SOC) systems. The chapter draws attention to two popular and important design paradigms: Grid and Peer-to-Peer (P2P) computing systems, which are evolving as two practical solutions to supporting wide-area resource sharing over the Internet. As a fundamental task of resource sharing, the efficient resource discovery is playing an important role in the context of the SOC setting. The chapter presents the resource discovery in Grid and P2P environments through an overview of related systems, both historical and emerging. The chapter then discusses the exploitation of both technologies for facilitating the resource discovery within large-scale distributed computing systems in a flexible, scalable, fault-tolerant, interoperable and security fashion.

INTRODUCTION

The advances in information technology (e.g. Internet, distributed computing technologies, etc.) have created a new way of doing businesses electronically, and therefore brought about a revolution in e-Business (or e-Commerce). In e-Business models, organizations or enterprises are no longer limited by temporal or geographical distribution and are enabled to automate business processes such as buying, selling, exchanging data, services and products that across enterprise boundaries via these underlying advanced technologies. The entities

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consisting of an e-Business system can be reused and extended across disparate applications over diverse computing platforms. However, most existing enterprise's business systems over the world are heterogeneous. They invariably use disparate systems and technologies. Some are new and some are still supported by backend legacy systems. Many of which are proprietary and can never work together, for example, Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) systems, Workflow Management (WfM) systems and so forth. To seek for a good e-Business solution, it is therefore a fundamental task to make business processes work efficiently among enterprises in an interoperable and integrated way, which must be measured based on the performance and scalability with QoS assurance.

Service-Oriented Computing (SOC) (Singh & Huhns, 2005) has emerged as a new paradigm to facilitate the integration of distributed and heterogeneous components of inter-enterprises in a time manner so as to deliver a large-scale, cost-reduced, high performance distributed business system. The SOC is a process of aggregating, loosely coupling and composing services to dynamically create business processes and run computational tasks across enterprises and different computing platforms in a transparent and coherent way, where a service is a self-contained, self-described software component that can be published, discovered and accessed via a network. Service-oriented approach can allow systems to expose services with functionalities via standardised interfaces in order to integrate different applications and leverage existing investments in legacy applications for resource sharing. We identify several critical requirements for delivering high performance service-oriented distributed computing systems:

- **Scalability:** With guaranteed performance, a scalable system can handle the addition of users, resources /or services with geographically distributed locations
- **Interoperability:** In the context of the SOC, the interoperability means various services of a system can work together without special efforts. There are two levels of interoperability: syntactic and semantic interoperability
- **Fault-tolerance:** A fault-tolerant system can operate continuously regardless of failures occurring or repairing
- **Security:** A system should be accountable and can securely access distributed resources and provide a secure model that can manage trust relationship in distributed services

Most of major IT organisations such as IBM, Microsoft, Intel and SAP have moved towards the service-oriented paradigm and have developed languages and standards to support service-oriented applications in business, health, education and government, for instance, banking systems, retailer systems and hotel booking system. Despite encouraging existing work, there are still open issues on how to deliver a scalable, flexible, fault-tolerance, high-performance and secured distributed business system.

As forms of distributed computing systems, Peer-to-Peer (P2P) (Lua et al., 2005) and Grid computing technologies (Foster et al., 2002) have been widely used for building up efficient distributed computing systems and applications for resource sharing. The P2P paradigm utilizes a symmetric structure among peers to support resource sharing among nodes for better scalability, load balance, and fault tolerance. Large-scale P2P file-sharing networks, e.g. Gnutella (Clip2, 2002), KaZaA (Shi, Liang, & You, 2005) and eDonkey (Heckmann & Bock, 2002), construct unstructured overlay networks of millions of nodes to store and retrieve files in a fully decentralised fashion. Grid computing offers an effective way to build high performance computing systems based on standardised services that implement well-established and largely supported models,