Exploring Job Migration Technique for P2P Grid Systems

Kuan-Chou Lai, National Taichung University, Taiwan, R.O.C.
Chao-Chin Wu, National Changhua University of Education, Taiwan R.O.C.
Shih-Jie Lin, National Taichung University, Taiwan, R.O.C.

ABSTRACT

P2P Grids can potentially solve large-scale scientific problems by using geographically distributed heterogeneous resources. However, a number of major technical obstacles must be overcome before this potential can be realized. One problem critical to the effective utilization of P2P Grids is the efficient scheduling of jobs. This study addresses the above-mentioned problem by describing and evaluating a P2P communication model, a P2P resource monitoring system and a job migration mechanism. In this study, the authors propose a P2P communication mechanism, which is built to deliver various information across heterogeneous Grid systems. Based on this P2P communication mechanism, they can develop job migration technology and then improve the usage of distributed computing resources.

Keywords: Grid Computing, Heterogeneity, Job Migration, Load Balance, Peer to Peer

INTRODUCTION

Recently, there has been a huge interest in grid computing for developing high-performance distributed computing systems. The grid system is an Internet-scale distributed computing system for sharing resources on a large scale across traditional organizational boundaries, and numerous grid projects have been initiated with various visions of the Grid. In grid systems, the most important issues include how to integrate the dynamically heterogeneous distributed resources, and how to improve the utilization of these integrated resources (Dandamudi, 1995).

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Although these various grid projects have the same goal of sharing distributed resources from different virtual organizations (VOs), they have different middleware, different programming environments, etc., because the goals of VOs are different.

The peer-to-peer (P2P) computing system is another Internet-scale computing model where computers share distributed resources via exchanges among the participating computers (Androusellis-Theotokis, 2004; Li, 2006). Widespread deployment of P2P computing systems offers great potential for corporate applications. The P2P system has the similar objective of the Grid system to coordinate large sets of distributed resources. Therefore,
many projects attempt to integrate these two complementary technologies to form an ideal distributed computing system. (Amoretti et al., 2005; Shan et al., 2002; Shudo et al., 2005)

In this study, we propose a P2P-based mechanism to form a P2P Grid platform and harness the main functionalities of P2P and Grid systems. In general, the job submission in grid systems is carried out by a global resource broker to distribute load. In this article, we propose a campus-to-campus Uni-P2P communication model to integrate the Taiwan Unigrid project (http://www.unigrid.org.tw/) and the Taiwan TIGER project (Yang et al., 2005) by a P2P communication mechanism which builds the communication pipes among sites in different grid systems. This campus-to-campus Uni-P2P communication model also provides a P2P resource monitoring system that captures the dynamic resource usage and a job migration mechanism that improves the idle resource utilization. The concept of super peers, which exhibit more powerful computing ability, bandwidth and hardware capacity, is also considered in this Uni-P2P communication model to improve the efficiency of searching distributed resources.

The Uni-P2P communication model is currently under development and a prototype implementing the main components is in the initial testing phase. In this article, we limit our description to the system architectural features and to the preliminary experimental results in the job migration across different sites and different VOs.

The rest of the article is structured as follows: Related work is discussed in Section 2 followed by P2P concepts and architectural overview in Section 3. Experimental results are explained in Section 4. Section 5 describes future directions of the project.

RELATED WORK

There are many middlewares (e.g., Globus Toolkit, Unicore, gLite, etc.) which have been developed for cooperating with distributed grid resources. Most of them focus on providing the core middleware services for supporting high-level application development functionalities, and depend on specialized servers for maintaining distributed resource information. On the other hand, P2P systems adopt decentralized resource discovery approaches and thus do not rely on any specialized servers to capture distributed resource information. However, P2P systems lack the support of job migration capabilities for load balancing or task scheduling.

In this section, we present the related work of grid information systems and job migration policies.

Resource Monitoring Systems

Commonly used resource monitoring software includes Ganglia, Gstat (LCG), MDS, NWS and REMOS. Ganglia is a distributed resource monitoring system; it monitors system performance and system information such as CPU load, memory usage, hard disk usage, I/O load, and network bandwidth. Gstat is the resource monitoring tool developed by ASGC in order to support the members of EGEE in handling global grid resources. Gstat provides information such as the number of CPUs and their load, the number of waiting/running jobs, and the response time from GIIS. MDS (Monitor and Discovery System) is one of the Globus Toolkits that provides information services and monitors/searches grid resources. NWS (Network Weather Services) is also a distributed resource monitoring system. It monitors the performance of networks and computing resources periodically, and then predicts future system performance by using real time information. REMOS (REsource MOnitoring System) allows the application to capture the shared resource information in the distributed computing environment. However, the above resource monitoring systems do not consider integrating the peer information in the P2P systems and the resource information in the Grid systems. Therefore, we propose a dynamic, distributed resource monitoring systems in the
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