IPBGA: A Hybrid P2P Based Grid Architecture by Using Information Pool Protocol

Deng Li[1], Hui Liu[2], Zhigang Chen[1], Zhiwen Zeng[1], and Jiaqi Liu[1]

[1] School of Information Science and Engineering, Central South University, Changsha 410083, China
dongxuanlee@gmail.com, czg@csu.edu.cn
[2] Department of Computer Science, Missouri State University, Springfield, MO 65897, USA
huiliu@missouristate.edu

Abstract. Current representatives of Grid systems are Globus and Web Services, however, they have poor scalability and single point failure. It is a hot research topic to build a P2P and grid hybrid framework for resource management and task schedule. We propose Information Pool Based Grid Architecture (IPBGA), which is a real sense hybrid of P2P and grid instead of only introducing P2P methods into grid systems for resource management. The key of IPBGA, information pool protocol, is presented. In our information pool protocol, all of resources and tasks are abstracted into information, and resource requests for tasks and task appeals for resources are viewed as information services, then grid resource management and task schedule are treated as information matching. Therefore, our architecture is very adaptive to heterogeneous, dynamic, and distributed grid systems. We use tri-information centers for collecting information, which strengthens the robustness of our system. Simulation experiments show information pool protocol of IPBGA is more efficient in resource management and task schedule, and has less bandwidth and processing cost compared with other hybrid P2P systems.

Keywords: Information aggregation, information matching, hybrid P2P based grid architecture, information pool protocol.

1 Introduction

The representatives of Grid systems are Globus[11] and Web services[9]. However, these systems are based on client/server (CS) mode. As the services are published and discovered in centralized mode, they have poor scalability and a single point of failure. Thus, many service oriented grid architectures have been proposed, which absorb the advantages of pure P2P and C/S modes. In [4], storage nodes periodically report their states and file lists to a centralized server that is used to maintain whole information. It is not totally decentralized since only nodes request resources in P2P mode. In order to provide large-scale intelligent services in knowledge grid, Zhuge, Sun and etc. [5] propose to incorporate a semantic overlay with an underlying structured P2P network that provides object location and management services, but they mainly discuss searching and location algorithms in P2P. In [7], an interesting

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preliminary work is presented to extend P2P computing with a framework that allows Grid computing over the internet. In this five-layer sandglass grid architecture, services layer lies above connectivity layer and management layer. However, the authors build this grid architecture without using concepts of combination of virtual organization and services abstraction, thus the coupling of services and structures is very loose. Aberer and etc. [6] introduces a self-organizing P2P system called P-Grid which is a peer-to-peer lookup system based on a virtual distributed search tree. P-Grid has the advantages of both structure P2P systems and unstructured P2P systems. On the other hand, it is not fault-tolerant because of its index tree structure.

We can see most of the current researches focus on either P2P based algorithms for transferring data to reduce the burden of centralized server [8] or utilize P2P routing algorithms to locate available resources. Thus, they just adopt P2P mode as an improvement to pure grid systems, and introduced P2P mode only into resource management aspect of grid systems.

In our paper, we analyze SOA, P2P, and grid in details, and integrate them together to build a fault tolerant architecture. The new architecture we propose in this paper is called Information Pool Based Grid Architecture (IPBGA) in which virtual organization is separated into information services layer and cooperation layer via service oriented method. Information services layer is responsible for collecting information for all the available resources, and then builds complete view for shared dynamic resources. The structure of information service layer is in P2P mode. Through local optimization of autonomous system, nodes can cooperate with each other to transfer tasks in cooperation services layer based on the complete view provided by information services layer. Therefore, our architecture itself is hybrid P2P based grid mode. It is proved that our architecture is robust, and has less processing cost and bandwidth cost than other grid systems via simulation experiments.

In section 2, our proposed architecture, IPBGA, is introduced, and the integration of IPBGA with SOA and P2P is explained. In section 3, detailed descriptions of fault-tolerant information pool protocol (IPP) and process of information matching are given. The experimental results are presented in section 4. Finally, the conclusion and future work is given in section 5.

2 Overview of IPBGA

Our goal in describing the new grid architecture is to identity fundamental system components, specify the purpose and function of these components, and indicate how these components interact with one another. Our architecture and the subsequent discussion organize components into layers, as shown in Fig. 1. Components within each layer share common characteristics but can build on services and behaviors provided by the lower layers.

Grid available resources are typically described in terms of standard service interfaces. We build complete view about resources and tasks among autonomous systems via abstracting and encapsulating the resources and tasks into information services.