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ABSTRACT

Grid systems integrate distributed resources to form self-organization and self-management autonomies. With the widespread development of grid systems around the world, grid collaboration for large-scale computing has become a prevalent research topic. In this paper, the authors propose a meta-grid framework, named the Grid-to-Grid (G2G) framework, to harmonize autonomic grids in realizing a grid federation. The G2G framework is a decentralized management framework that is built on top of existing autonomic grid systems. This paper further adopts a super-peer network in a separate layer to coordinate distributed grid systems. A super-peer overlay network is constructed for communication among super-peers, thus enabling collaboration among grid systems. This study proposes the G2G framework for use in a Grid-to-Grid federation and implements a preliminary system as a demonstration. Experimental results show that the proposed meta-grid framework can improve system performance with little overhead.

Keywords: Convergence, Grid Computing, Grid-to-Grid (G2G), Peer-to-Peer (P2P), Super-Peer

INTRODUCTION

A grid computing system is a distributed computing system for solving complex or high-performance computing problems as encountered in bioinformatics, healthcare systems, ecosystems, and even experiments involving the use of the Large Hadron Collider. In such a computing environment, a virtual organization is a self-organization and self-management group which shares the computing resources (Foster, Kesselman, & Tuecke, 2001). Grid systems employ the middleware as the abstract interface to integrate large-scale distributed computing resources. Therefore, the aggregated capability for distributed computing and data accessing can be improved by integrating geographical distributed resources.

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centralized or hierarchical architectures to develop grid systems based on the Open Grid Service Architecture (OGSA) (Foster, Kesselman, Nick, & Tuecke, 2002). Most grid systems, though, cannot be integrated for collaborative computation. This is why grid collaboration for large-scale computing has become a prevalent research topic. The integration of distinctly autonomic grid systems into a grid federation is one prospective approach. What poses a challenge to realizing grid federations, however, is how to harmonize various grid systems without bringing a heavy burden on existing grid infrastructure.

In order to coordinate multiple diverse grid systems, a grid system requires a mechanism for achieving the cross-grid convergence of diversely autonomic grid communities. There are two ways to accomplish cross-grid integration. One is to enhance the grid middleware by modifying the original mechanism in existing grid systems, while the other is to develop a meta-grid framework on top of existent grid systems. The former burdens an existent grid system with lots of efforts to harmonize with other grid systems; moreover, there is no mature cross-grid middleware for integrating with distinct grid systems. On the other hand, the latter increases the extra overhead for the existent grid systems. In this paper, we present a meta-grid framework, named the Grid-to-Grid (G2G) framework, to form a federation consisting of multiple institutional grid systems. The G2G framework can harmonize autonomic grid systems and achieve cross-grid collaborative computing with seamless modification for existing grid systems.

Past studies have applied decentralized approaches to exploit the system scalability of grids in the development of the grid management architecture. In general, a centralized or hierarchical architecture is not suitable for large-scale grids (Mastroianni, Talia, & Verta, 2007). Reasons for this include the potential bottleneck at root, the scalability limit of a grid, and load imbalance problems. Integrating grid systems with the P2P paradigm can improve the scalability of a grid federation. Therefore, we attempt to exploit a decentralized G2G framework to realize synergy between P2P networks and existing grid systems. In consideration of the scalability and the efficiency of the grid management architecture, this study utilizes a super-peer network (Yang & Garcia-Molina, 2003) to develop our G2G framework for the coordination of multiple autonomic grid systems. Each super-peer represents an autonomic grid system in our G2G system. To achieve a decentralized G2G framework, the super-peer network adopts an overlay network for communication among super-peers in different grid systems through a federation of wide-area grids.

This paper introduces a meta-grid framework of the G2G system based on a super-peer network. We also present a preliminary implementation of the proposed G2G framework and develop a Grid-to-Grid network based on the overlay network in which each grid system communicates and negotiates with other grid systems. The remainder of this paper is organized as follows. Section 2 discusses related works. In Section 3, we present the overview of the G2G framework and the implementation of a G2G prototype. The experimental results of the G2G system are shown in Section 4. We conclude this paper with the future work in Section 5.

RELATED WORKS

Scalability in large-scale grid systems has posed research challenges in recent years. There are some studies (Ranjan, Harwood, & Buyya, 2008; Trunfio et al., 2007) that discuss the adoption of the P2P technique to improve the scalability of grid systems. Some similarities and differences between P2P computing and grid computing were presented in the literature (Foster & Iamnitchi, 2003; Talia & Trunfio, 2003). Several previous studies aimed to improve the centralized-based grid infrastructure by using the P2P technique.

A decentralized event-based object middleware, DERMI (Pairot, Garcia, & Skarmeta, 2004), is proposed to favor the scalability
Matrixes of Weighing and Catastrophes
José G. Hernández Ramírez, María J. García García and Gilberto J. Hernández García (2013). Development of Distributed Systems from Design to Application and Maintenance (pp. 213-228).
www.igi-global.com/chapter/matrixes-weighing-catastrophes/72255?camid=4v1a

Supercomputers in Grids
www.igi-global.com/article/supercomputers-grids/2164?camid=4v1a