A Flexible Job Scheduling System for Heterogeneous Grids*

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Abstract. Job management is the most complicated and kernel component of grid system. However, due to the dynamic, heterogeneous and dispersed nature of grid environment, grid job submission and scheduling are always intractable issues that needs to be addressed, especially across heterogeneous grids. In this paper, a Flexible Job Scheduling System (FISS) is designed, which exploits and extends JSDL to support the job submission with different QoS requirements across heterogeneous grid platforms. Based on the extended JSDL, multiple types of jobs are supported, including WS, WSRF, GRS. Moreover, it conduces to the interoperation among heterogeneous grid systems. Experiments are carried out and proven that FISS proposed in the paper can improve the efficiency and utilization of grid system while satisfying users’ QoS requirements and achieving the interoperability among heterogeneous grids.

1 Introduction

Grid computing is emerging as a novel infrastructure for the coordinated resource sharing, problem-solving and services orchestration in dynamic, multi-institutional Virtual Organizations (VOs) by integrating large-scale, distributed and heterogeneous resources [1, 2]. Users, ranging from scientific communities, business communities to general consumers, are utilizing grids to share, manage and process large data sets and construct large-scale applications. Job scheduling is the most complicated and the kernel component of a grid system. It accepts users’ job requests, and then interacts with information center to select and invoke relevant services according to specific QoS requirements and scheduling policy. Due to the dynamic, heterogeneous and distributed nature of grid environment, grid job scheduling is confronted with significant challenges such as security, quality of service, and lack of central control within distributed virtual organizations.

In addition, with the rapid development of the grid, a wide variety of grid middlewares and grid systems have been developed in numerous research projects all over the world, such as Globus Toolkits [3], CGSP [4], UNICORE [5], GOS [6]. Though

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developed based on the idea of OGSA which is the de facto standard of grid, most grid systems have its own implementations for specific application. Hence, existing grid systems differ from each other in management so that the interoperability among them is poor. Recently, interoperability among heterogeneous grids is a hot research point attracting more attentions, which can integrate more grid resources and eliminate the grid resource island. However, to achieve interoperability among heterogeneous grids, some issues must be addressed such as security, information service, job management, and data management. Because most of grid platforms are built for specific applications, the types of jobs supported by each grid vary greatly. Even though the jobs in different grid platforms provide similar functionality, the access interface and types of parameters are different greatly, which bring new challenges to grid job scheduling.

A grid job scheduling system must be able to provide uniform job submission interface and support various types of jobs, shielding the heterogeneity of grids and making grid systems look the same. There are already different languages to describe and submit grid jobs, e.g. JDL of EGEE [7], Globus RSL [8]. However, these job description languages are designed for particular projects and can not interoperate each other.

In this paper, a Flexible Job Scheduling System (FISS) is designed, which exploits and extends JSDL to support job submission of various types of jobs, such as WS, WSRF, and GRS. Moreover, it conduces to the interoperability among heterogeneous grid systems by adopting virtualization layer and plug-in technologies. Experiments are carried out and experimental results prove that FISS proposed in the paper can improve the efficiency and the utilization of a grid system while satisfying users’ QoS requirements and achieving the interoperability among heterogeneous grids.

The rest of the paper is organized as follows. Section 2 reviews the related work. We propose FISS in section 3. Section 4 introduces the components of FISS. The experimental evaluation is presented in section 5. Finally, we conclude and give some future work about our research in section 6.

2 Related Work

There are already different languages to describe grid jobs. Some of them are included in large projects and adapt to the project requirements, such as Job Description Language (JDL) for Enabling Grids for E-sciencE (EGEE), Globus Resource Specification Language (RSL). The European Data Grid JDL is proposed in the context of the European Data Grid Project and afterwards adopted by the EGEE project [10]. It is based on the classed language and can be used as the language substrate of distributed frameworks. JDL allows specifying grid job attributes such as Job Type, Executable, Arguments, Stdinput/Stdoutput. The Globus Resource Specification Language (RSL) provides a common interchange language to describe resources and jobs. The current version is RSL-2, namely, the Web Services versions (GT3 and GT4). RSL-2 is based on XML technology and allows specifying a more extended set of attributes than its predecessor.

The above mentioned job description languages are designed for their own applications so that they are poor at interoperation. Since there are a lot of different