Chapter XI

Adaptive Resource Management in Grid Environment

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ABSTRACT

Resource Management System (RMS), which manages the Grid resources and matches the applications' requests to the proper resources, is one of the most important and complex parts in Grid systems. In fact, because of the complexity of Grid environment, one resource management approach alone can not satisfy different applications' requirement. Therefore, a novel Adaptive Resource Management (ARM) mechanism is provided here. This mechanism is based on multidimensional Grid QoS, which dynamically organizes Grid resources into Task Resources for feasible distribution. Moreover, this management mechanism can select appropriate management approach according to different applications' requirements, which is well adapted to dynamic Grid environment.

INTRODUCTION

All the facilities, which can be shared and utilized in Grid environment, can be viewed as Grid resources, such as machines, services, and networks. The most predominant quality of Grid is the seamless resources sharing and cooperation in large distributed areas. Central to the Grid system is the Resource Management System (RMS), which manages the Grid resources and
matches the applications’ requests to the proper resources.

At this point, the most common purposes of Resource Management System in such a complex environment can be separated into two categories: system-centric policy and user-centric policy. The former attempts to optimize system-wide measurement of performance, while the latter concentrates on delivering maximum utility to the users of the system based on their QoS requirements (Buyya, et al, 2005).

Generally, the functions of RMS include resource storage, resource organization/discovering, resource matching/allocating, and resource monitoring/recovery. According to Ding (2002), most RMSs have a common service process as follows. When an application makes requests, the RMS adds them into the request queue and then schedules them to different RM (Resource Management) servers for mapping. After that, the RM servers discover the proper resources and establish the relationship between the requests and the resources. Finally, the discovered resources are available to the application.

The literature records a great deal of research on RMS since the onset of Grid research. In Grid computing architecture, the Grid resource management component (Foster and Kesselman, 2004; Krauter, 2002) is a fundamental middleware. Being widely adopted by the industry to build a Grid, the Globus Toolkit provides a set of components for Grid control, management, and execution. The Globus Resource Management and Allocation (GRAM) component is a classic resource management example and the Monitoring and Discovery Service (MDS) component facilitates the selection of Grid resources. Some other systems, such as DI-Gruber (Dumitrescu, 2005), utilize Globus components.

Although much contributing work has been done in this field, an efficient RMS in Grid environment is still a challenging and important problem due to the following reasons:

1. Resources in Grid environment are geographically distributed, and in most cases they belong to different autonomously administered domains, which use resource management approaches and control models.
2. Resources in Grid environment are heterogeneous. One level resource management can not control all of them well.
3. Resources in Grid are dynamic. For example, the resources’ joining and leaving are dynamic, and the current resources performance is changing.

As a result, in the last few years, along with the development of application requests, the adaptive resource management has become popular. Duran-Limon (2004) points out two aspects—openness and ease of use, which are essential to achieving adaptive resource management in middleware. However, some contributing work (Dai, 2008; Kyong, 2006) have been done in this field.

**BACKGROUND**

Currently, there are different research interests and technologies in RMS as follows:

**Resource Description**

From Ian Foster (2004) point of view, the primary goal of Grid resource management is to establish a common proposal, through which the resource provider agrees to provide the ability for resource consumers to execute some tasks. For resource consumers, they should provide their requests based on resources’ characters. As a result, there should be some rules for resource description. The widely used languages for resource description in Grid environment are RSL (Resource Specification Language) in **Globus Toolkit** and ClassAds in Condor. In industry, as the basic