Grid Resource Broker Using Application Benchmarking

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Abstract. While the Grid is becoming a common word in the context of distributed computing, users are still experiencing long phases of adaptability and increased complexity when using the system. Although users have access to multiple resources, selecting the optimal resource for their application and appropriately launching the job is a tedious process that not only proves difficult for the naïve user, but also leads to ineffective usage of the resources. A general-purpose resource broker that performs application specific resource selection on behalf of the user through a web interface is required. This paper describes the design and prototyping of such a resource broker that not only selects a matching resource based on user specified criteria but also uses the application performance characteristics on the resources enabling the user to execute applications transparently and efficiently thereby providing true virtualization.

1 Introduction

While Grid computing is rapidly evolving and becoming more widely accepted, traditional scientists may still find the use of middleware technologies cumbersome. While the middleware provides effective means to aggregate and virtualize resources, the discovery and categorization of vast resources in this heterogeneous and dynamic environment presents a problem for the end user due to the complexity of the information involved. A general purpose resource broker that facilitates the user's resource selection and job submission automatically is required. While Grid Information Services [11] provides an overview of the available grid resources as well as provides information about the current status of the grid, an average user may be overwhelmed with the information to process, or the user may not have enough experience to select the best available resource. Automation of this selection process would simplify and expedite this process. This Resource Broker was developed as part of the framework available for extension as well as modification that performs application specific resource selection. In order to simplify the process of resource selection and job submission for users, the application's interface is a web-based portlet built as an extension to the Open Grid Computing Environment (OGCE) [15]

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with a simple resource request format. The application is currently being tested to work with mpiBLAST [3]. The primary focus of this research is to design and prototype a resource broker that will not only select a matching resource based on user specified criteria but also use the application performance characteristics on these different resources and enable the user to execute the applications transparently thereby providing true virtualization.

2 Related Work

Resource brokering has been an important area of research for the development of Grid computing. Most research that has been done on resource selection of heterogeneous resources has essentially been from the viewpoint of an application. Condor [13] with its *matchmaker* is another project that is very relevant to the idea of general resource selection. It is based on *ClassAd language*, which allows users, as well as owners of resources, to specify arbitrary restraints. The *matchmaker* is used to match user requests to the available and appropriate resources; in case of multiple matching resources, a ranking system is employed. This ranking system is based on user-specified constraints in order to return the best match.

Nimrod-G [2] is another well-known resource broker. The main functionality provided by the Nimrod-G is automation of creation and management of large parametric experiments [17]. Besides the plain submission of a request for a resource search, users have an option to specify time and cost constraints which are later used in selecting the resource. If the constraints cannot be met, tradeoffs are explained to the user [2,17].

Another well-established resource broker is the Application-Level Scheduler (AppLeS). It is mainly used for scheduling and deploying of parameter sweep applications where tasks have no or little inter-task communication [6]. The main advantage of this resource broker is fault tolerance where any errors are processed and jobs resubmitted on other resources without the need for user intervention[6].

This research focuses on creating a general and easily applicable system that uses application benchmarking. The inspiration behind this application is to bring the resource selection and job submission in the grid to a practical level with user friendly orientation. Incorporation of the resource broker into the OGCE achieves the goal since the installation of the entire system is simple and part of a single package. Once the package is installed within a virtual organization, it can be accessed without any additional user-end configuration. Other approaches have not been completely integrated into a single yet complete system designed for easy installation and access.

3 The Resource Information Problem

The resource selection process is based on information available about a resource. Unlike the local resource schedulers (*e.g.,* PBS [18], LSF [21], LoadLeveler [10], SGE [8]) that implement fine-tuned scheduling policies based on resource requirements running on the nodes as well as those waiting in the queue, resource selection and application-level scheduling in the Grid has a limited amount of