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Models for Resource Selection in Grid Environment

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Abstract: ***A Grid system is comprised of large sets of heterogeneous and geographically distributed resources that are aggregated as a virtual computing platform for executing large-scale scientific applications. As the number of resources in Grid increases rapidly, selecting appropriate resources for tasks has become a crucial issue. The roles of resource selection mechanisms are to identify, select and allocate the most suitable resources for a given set of tasks. The selection of resources that best fitting tasks in Grid environments is an essential and critical factor to system performance. Since it involves using resources from different places, from different ownerships and with different individual qualities, it requires a complex resource management process for its proper functioning. This paper provides a brief overview on grid computing and its resource management processes, important factors considered & comparison of different resource management processes and future outlook of grid computing and its resource management.***

Keywords: Grid Computing, Resource Selection, Matchmaking Model, Bidding Model, Resource Reservation.

I. Introduction

Grid is a network of geographically distributed resources including computers, peripherals, switches, instruments, and data. Grid computing is a term referring to the combination of computer resources from multiple administrative domains to reach a common goal. It enables sharing of resources. Grid computing is an integrated computer network linking large geographically distributed and heterogeneous computer systems and resources, which eliminates the need for dedicated servers for job computations but uses distributive resources collectively to enhance computational power. It is a type of distributed computing different from other types like cloud computing and cluster computing. In this case, the resources are scattered over a wide span of area belonging to different individuals or companies, which are used to solve different segments of one single problem whose solution is gotten only after combining all the individual solutions of the segments computed by the different allocated resources.

The resource allocation process in grid environments consists of three main phases; the first phase is resources discovery, the most important issues when dealing with resource discovery is how to publish the resource information by providers and how those resources can be discovered by grid clients *[1-2]***.** This information is handled and supported by a resource registry *[1]***.** The second phase is resource selection which regarding with the process of selecting the best resources to execute a certain task *[3]***.** The last phase of resource allocation process is resource usage which is concerning with running the task on the selected resources and monitoring the execution *[1]***.** In this paper we are focusing on resource selection phase and its issues.

In this paper, we are going to identify and classify the mechanisms used in the implementation of grid resource selection process, as well as describing the most significant features of grid resource selection mechanisms. We aim to highlight the main aspects of the selection mechanisms, which can benefit researchers and developers of grid resource management systems. The paper is organized as follows. Section 2 illustrates the related works, followed, in Section 3, by the description of phases of resource allocation process in grid computing. Section 4 presents the taxonomy that categorizes the resource selection mechanisms.Section 5 represents types and challenges of bidding model. We conclude the paper in Section 6.

II. Related Work

A grid computing as ―coordinated resource sharing and problem solving in dynamic, multi- institutional virtual organizations‖. The sharing mentioned in the definition is not a simple file sharing but rather direct contact and access to resources and services in a secure manner [4-5]**.**

Krauter et al *[6]* presented a taxonomy of grid resource management systems; this taxonomy mainly focused on categorizing grid systems and the whole process of resource management in grid. However, this study does not focus on resource selection in details.

Nassif et al In ***[7]*** illustrates a taxonomy and new resource selection system; however this taxonomy and system are based on decision theory, case-based reasoning, and fine-grain policies. A Resource selection in Grid system is concerning with selection a resource or a set of resources to perform the submitted tasks. There are many mechanisms to select the appropriate resources for specific task. These mechanisms often depend on the user and the application requirements *[8]***.**

Bidding-based model emerged to address the expired information and the performance problems that appear when using matchmaking model *[9]*.

The term resource management in grid computing can be defined as those operations that control the way that grid resources and services are made available for use by entities like users, applications and services *[10]* to ensure efficient utilization of computer resources and for optimization performance of specific tasks. Due to the complexity, heterogeneity and dynamic nature of grid computing environments, resource management is faced with challenges making it a complex task to match the capabilities of available resources to the needs of the entities listed above *[10-11]*.

III. Resource Allocation Mechanisms

The resource Allocation process in grid systems as shown in figure 1 consists of three main phases: resources discovery, resource selection and resource usage. Following is a brief description of the resource allocation phases.

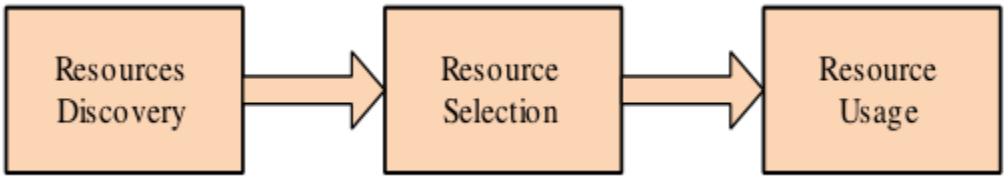

Fig. 1 Resource Allocation Phases

A. Resource Discovery

Resource Discovery is the process of finding the appropriate resources that match the users job requirements ***[12]***. The most important issues when dealing with resource discovery is how to publish the resource information by providers and how those resources can be discovered by grid clients One of the most important requirement for grid systems is an efficient resource discovery technique, which helps managing the resources and scheduling the users jobs. The activities of the resource discovery in grid systems involve resource registration in directory services and searching for the suitable resource types that match the application needs. A range of solutions has been proposed for resource discovery, including the hierarchical, peer-to-peer and centralized approaches.

B. Resource Selection

The second phase of resource allocation process is selecting a number of resources that have been discovered in phase one resources to perform the users applications*[13]*. In some cases, resource selection phase is interleaved with the discovery phase to collect more information on the resources that have met the requirements.In some resource management approaches, the discovery and selection phases are twisted together and recognized in one single element so it is difficult sometimes to find out differences between resource discovery and selection phases.

C. Resource Usage

This phase focuses in running the users applications on the selected resources and monitoring the execution. After Service Level Agreement (SLA) is initiated between the grid client and the resource provider, tasks can be implemented via the allocated resource. The resource provider may reserve some resources to achieve QoS in the agreement; also in some cases data is transferred from the grid client to the resource provider in order to process it with GridFTP. Furthermore some output files may move from the resource provider to the grid client if any. In this phase also the user can monitor the tasks during execution and when the task is ended, the grid client is informed by the provider *[8]*.

IV. Resource Selection Models

In recent years many attempts have been made on the resource selection in the Grid environment and the following models have been presented as an approach to select resource.

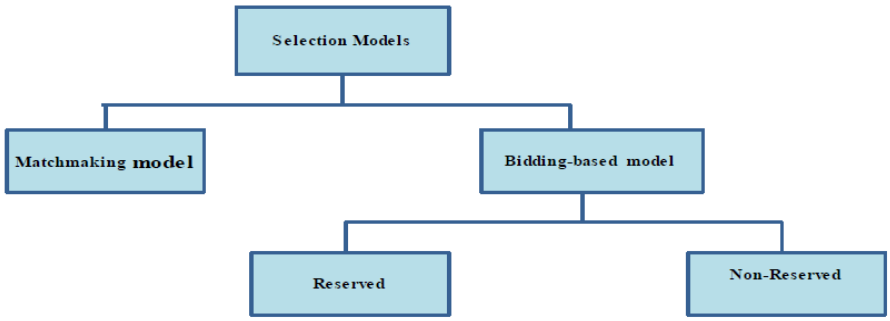

Fig. 2 Selection Models

A. Matchmaking Model:

Matchmaking model emerged to address several resource management issues in Grid systems; the function of resource matchmaker is registering the status of all resources announced by resource providers and running matching programs (Fig. 3). The raise in numbers of resources and the regularity of task demands generate overload problems hence the matchmaking methods might lead the matchmaker to performance problems *[15]***.** Furthermore the matchmaker information often are out of dates, this is because the status of resources changes frequently and the matchmaker does not learn about the resources status until the resources advertise their new status to the matchmaker *[15]*. Moreover, the matchmaker, like other centralized systems, represents performance bottleneck and single point of failure.

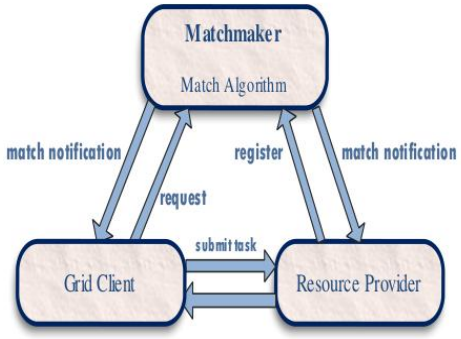

Fig. 3 Resource Matchmaker

B. Bidding Based Resource Selection

Bidding-based model emerged to address the expired information and the performance problems that appear when using matchmaking model *[15]*.The bidding process starts when a Grid client sends call-for-proposal (CFP) requests to all available resource providers; these requests include the task requirements. According to their characteristics and status of their resources, resource providers determine if they can join the bidding process or not. If a resource provider participates in a bidding process, it sends a bid that expresses the status of its resources to Grid clients. The Grid client evaluates the bids received from providers, orders them and selects the resources that offer the best bid *[15-14]*.

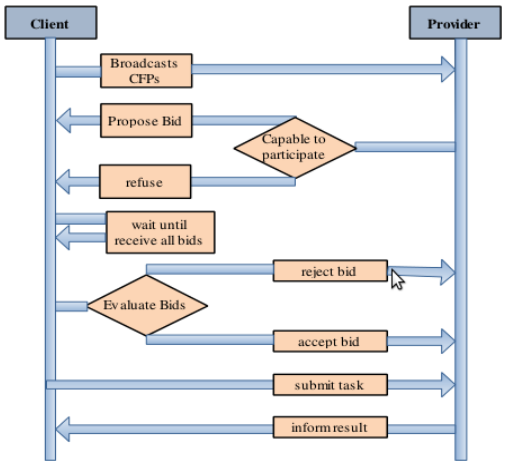

Fig. 4 Bidding Process

V. TYPES OF BIDDING BASED MODEL AND ITS CHALLENGES:

A. Types Of Bidding Process:

Based on the commitments of resources for tasks and the utilization of resources we can categories two types of bidding model, reserved bidding model and non-reserved bidding model.

1) Reserved Bidding Model

In the reserved bidding model when a resource provider decides to join a bidding process, it reserves the resource for that bid to guarantee resource status in the future ***[15].***However if the Grid client later refuses the bid, that resource is squandered. Under these circumstances, other Grid users possibly are ready to agree that bid prior to the original Grid client refuses it; therefore, the likelihood for resource provider to lose the chance for participation in those bidding processes and support those Grid users is high ***[15]***.

2) Non-Reserved Bidding Model

On the contrary to the reserved bidding model, in non-reserved bidding model the resource providers do not reserve the resource for each bid. This approach permits the resource providers to completely utilize and employ their resources; however it does not agree a commitment for the status of the resources to any bid. If more than one Grid user sends CFP to the same resources in the same resource provider simultaneously, the resource provider will participate in all bidding processes but will not guarantee the states of resources for each user and hence the task executing time possibly will not be as estimated ***[15]***.

The bidding approach permits resource providers to reveal information concerning competing tasks to Grid clients such as the characteristics of the offered resources, the number of competitor and other characteristics of competitors. The amount of information exposed is a significant aspect that influences and affects the bidding process ***[15]***.

Furthermore, the non reserved model in most cases does not suit the economic grid environments, in which the grid client is obliged to pay for resource usage. For instance, if a grid client paid for specific resources, and the completion time is a critical factor to the user, then the resource reservation is essential to guarantee that the selected resources are committed to that user.

B. Bidding process challenges

In reserved bidding resource model wastes the providers' resources; this is due to, more than one resource providers reserve their resources for a single bidding process and at the end, the grid client selects only one resource for task execution. And hence other resources miss the chance to participate in other bidding processes and serving other clients before they are rejected by the original grid client.

On the other hand, non-reserved resource model lead to unexpected completion time for tasks. This is due to because the resource provider may participate in more than one bidding by the same resources simultaneously. This makes the grid clients compete for the resources, and this competition may cause unexpected completion time for the submitted tasks.

VI. CONCLUSIONS

Grid computing is an important tool that is used for both scientific and industrial purposes, which provides an environment with a high amount of resources for computational purposes to solve complex problems. These resources can be scientific instruments, storage devices, network bandwidth, sensors and processors which belong to different proprietary organizations. Resource management in grid environments is a great challenge this is due to the heterogeneity of resources in grid environment .This paper describes, in a simple way, the basic models and features of resource selection mechanisms and also various challenges associated with them which can help researchers and developers of grid resource management systems to enhance the grid resource allocation process.

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