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SURVEY ON META-SCHEDULER IN GRID ENVIRONMENT

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Abstract

Grid computing plays a major important role in resource allocation and scheduling of user jobs in the appropriate grid site. Many types of approaches are used in scheduling they are system centric approach and complementary approach. System centric approach is based on traditional algorithms and complementary approach is based on auction principles. To optimize the user centric and system centric objective the market based models are used. This paper addresses various meta-scheduling approaches. Meta-Scheduler receives jobs, select available resources according to the availability and checks performance criteria to plan jobs to resources. Meta-schedulers are used to assign jobs to resource providers based upon the user requirements. Meta-schedulers have been evolved in order to solve the resource allocation problem in a distributed network of systems. This paper will show that the double auction based meta-scheduler mechanism is efficient and it favours both user and resource provider needs.

Keywords: Grid; Meta-scheduling; Double auction based meta-scheduler; Local scheduler

1. Introduction

Grid computing, in the latest years, has emerged as one of the most important technologies for solving the problem with multiple computers made up of multiple processors. The capabilities of grid computing are exploiting underutilized resources, parallel CPU capacity and high reliability. The ordinary servers utilize only 20% of available resources but in grid computing, it utilizes almost 90% of available resources. The features of grid computing are cost effective use of computer resources and ability to perform higher throughput computing. Resource allocation is one of the most important system services of grid computing. A common problem of grid computing is to select the most efficient resource to run a particular program. Grid computing is an issue resolving the environment to utilize the unused resources efficiently to balance load across resources to ensure effective utilization.

Meta-schedulers map jobs to computational resources that are part of a grid, which will have the local schedulers. Meta-schedulers have been used to solve the resource allocation problem in the distributed environment. The job of a meta-scheduler is to collect the job request and resource information, and to allocate the job to the unused resources for scheduling.

Auction model is the powerful model for allocating the resources in a grid environment. Auction is an economic mechanism for allocating the resources among the group of users. The benefits achieved by the user and resource provider are different for various auction models.

The rest of the paper is structured as follows. Section 2 presents the meta-scheduler. Section 3 discusses about the various traditional meta-scheduling approaches and Section 4 discusses about the scheduling mechanisms of a meta-scheduler, Section 5 discusses about the economic meta-scheduler.

2. Meta-scheduler

Meta-schedulers are different from local scheduler. Both the schedulers aim at resource allocation and management. Local schedulers are used at cluster level scheduling to achieve load balancing, whereas meta-schedulers are used to assign user jobs to resources based upon the user request. There are three goals for a meta-scheduler, first is to balance the demand and supply values, second is to increase the efficiency of load balancing and third is to allocated user applications fairly to the resources for scheduling.

There are many types of meta-schedulers like traditional and economic meta-schedulers. Traditional meta-schedulers are GridWay [7], Moab, Glite are system centric approaches. In this type of meta-schedulers only resource providers will be getting benefited by favouring the system's performance. But in economy based meta-schedulers it will favour both the user and system centric approaches, in this type both the user and resource provider will be benefited.

Meta-scheduler maintains information about all resources. Each time a job is submitted; meta-scheduler will send the job for execution or arranges the jobs in a queue for scheduling in the local scheduler. Meta-scheduler will run the scheduling algorithm at periodic interval to collect the current data availability from both the users and resource providers'. The job allocation or the resource allocation is private to the meta-scheduler. The key idea of a meta-scheduler is to distribute jobs to multiple sites, instead of sending the jobs to most lightly loaded site. Through a collaborative work of a local and meta-scheduler a better scheduling decision can be observed.

The meta-scheduler is a software technique which is used for optimizing computational workloads by combining organizations multiple resources, allowing batch jobs to execute at the best location. The characteristics of a meta-scheduler are flexibility, scalability, load balancing, real time data and local autonomy. Grid meta-scheduler will maintain the scheduling history records.

2.1 Working of a Meta-Scheduler

The meta-scheduler will collect the information from the user and resource provider simultaneously at regular periodic intervals. Resource provider will have n-number of grid sites and each grid site will have a local scheduler. The users will be submitting their job request and resource provider will submit the resource queue characteristics to the meta-scheduler. Then the meta-scheduler will match jobs to the resources for execution. Meta-scheduler will maintain the pending jobs in its queue and in the next scheduling cycles those pending jobs will be executed.

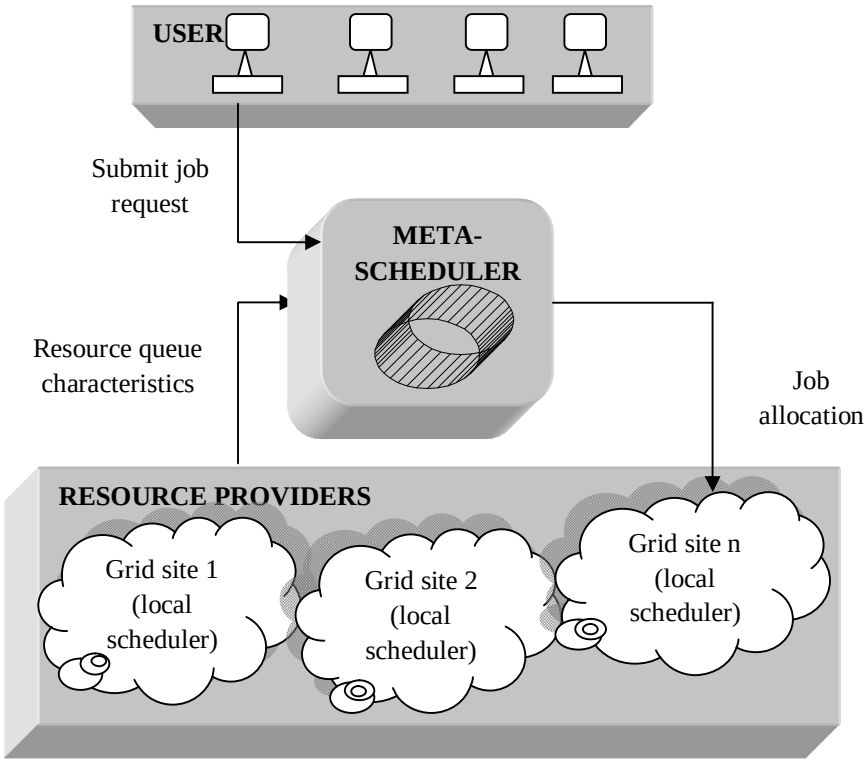

Figure 1 Working of meta-scheduler

3. Traditional meta-scheduling approaches

3.1. GridWay meta-scheduler

GridWay [7] meta-scheduler is a open source meta-scheduler that enables large scale, secure, reliable and efficient sharing of computing resources managed by different local resource managers. Grid meta-scheduler is software that facilitates optimal utilization of the storage and network resources in a Grid. GridWay doesn't support advanced job reservation and it integrates well with globus. Support for the definition of new scheduling policies that allow prioritization of jobs and users. GridWay uses globus services for job submission, and separate credential mapping is not required for authorization. The features of GridWay are rescheduling of jobs detecting performance slowdown, scheduling policies, scheduling dependent jobs, array job support, fault detection, recovery and migration. GridWay limits the number of jobs according to the usage policies. A job is assigned to the first available queue. FCFS is one of the scheduling algorithms used in meta-schedulers like GridWay. This type of meta-scheduler will lead to more number of jobs missing their deadline and it is a system centric approach where it favours the system performance over a increasing number of users.

3.2. Maob meta-scheduler

It is a type of a traditional meta-scheduler in which the resource provider will be benefited. Maob [7] meta-scheduler is a system-centric approach in which it favours the system performance over a increasing number of users. Thus it leads to more number of jobs not meeting their deadline. Maob meta-scheduler will not perform effectively while rescheduling of jobs and it doesn't integrate with globus.

4. Scheduling mechanisms used by a meta-scheduler

There are many scheduling mechanisms [4], [6] used by a meta-scheduler, they are:

4.1 Shortest Job First (SJF)

In this mechanism, the jobs are prioritized on the basis of estimated runtime. This is very common algorithm used by resource management systems and in cluster management.

4.2 First Come First Serve (FCFS)

In FCFS [7] jobs are assigned to the first available queue slot and those jobs will be given the higher priority and will be scheduled first. The queues are sorted based on their initial valuation. This type of algorithm is commonly used in GridWay meta-schedulers.

4.3 Earliest Deadline First-Fastest Queue (EDF-FQ)

In EDF-FQ the jobs with the earliest deadline are scheduled first to the resource queue slot with the least waiting time value.

4.4 Highest Valuation to Fastest Queue (HVFQ)

The job with the highest user valuation is assigned to the queue slot with the least waiting time. This algorithm is commonly used in auction mechanism like vickery auction in which the users will be benefited.

5. Economic meta-schedulers

5.1. A distributed economic meta-scheduler

DRIVE [2] (Distributed Resource Infrastructure for a Virtual Economy) is a novel meta-scheduler used for efficient resource allocation in global grids and it is based on VO (virtual organization) model. In this VO model, the VO members will conduct resource allocation auction by spreading the burden of allocation of the participating entities. DRIVE has a plug-in auction mechanism that facilitates the use of combinatorial auction protocol by making it a suitable meta-scheduler. DRIVE infrastructure provides a security within a trusted organization or on global grids and it thus avoids the use of trustworthy protocols within the trusted environment.

5.2. Double auction based meta-scheduler

In double auction [6] both the buyer and seller will be submitting their values to the auctioneer. Here the auctioneer will be acting as a meta-scheduler, buyer will be user and seller will be resource provider. Here the meta-scheduler will be constructed based on double auction mechanism. In double auction based meta-scheduler there are three stages collecting, valuating and matching. In the collection stage the meta-scheduler will collect the user job request and resource queue characteristics from the resource provider. After the collection stage the meta-scheduler will evaluate the ask and bid values, and it will be private to the meta-scheduler. After evaluating the ask and bid values meta-scheduler will sort the ask values in ascending order and bid values in descending order will perform the matching of jobs to the resource provider for execution. If the bid values is greater than ask value then only the match will be made, otherwise the unmatched jobs will be kept in the meta-scheduler itself in the next scheduling cycle with a new computed ask and bid values matching will be performed again.

This double auction based meta-scheduler satisfies both the user and resource provider requirements. More number of jobs are scheduled with higher success ratio. The goal of this type of scheduler is to benefit the user by preventing them from starvation of jobs by taking into account their deadline and execution time of jobs and the resource provider by balancing their loads efficiently.

Meta-schedulers	Scheduling policy	System centric/user centric	Jobs missing deadline
Gridway meta-scheduler [7]	FCFS	System centric	More
Maob meta-scheduler [7]	FCFS	System centric	More
Distributed economic meta-scheduler [2]	Auction based	User centric	More
Double auction meta-scheduler [6]	DAM	Both	Less

Table 1 Comparison on meta-schedulers

6. Conclusion

This paper presents the traditional and economic meta-schedulers and different types of meta-scheduler approaches. The traditional meta-schedulers are either system centric or user centric approaches. But the economic based double auction model favours both the user and the resource provider's needs. It is an efficient model for resource allocation in grid environment.

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