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Dynamic Resource Allocation in Grid Computing

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Abstract: Grid computing is a term referring to the combination of computer resources from multiple administrative domains to reach a common goal.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, allocating appropriate resources for tasks have become a crucial issue. This paper proposes a resource allocation algorithm in grid environment to maximize scalability and resource utilization & to minimize the total time for task completion in effective and efficient way. This algorithm uses a mechanism to reserve the best resource for the task. Unlike traditional reserved algorithms this algorithm reserves only the best resource and hence it allows other resources to participate in other bidding processes. We believe the proposed algorithm can allocate the most fitting resources for tasks execution and achieve a good performance in terms of effectiveness and efficiency.

Keywords: Grid computing, Bidding Process, Call-for-proposal message, Resource Management, Resource allocation

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 technologies emerged in the middle of 1990s to satisfy the rising demand for bandwidth, storage, and computational resources. Ian Foster in *[1]* defines grid computing as ―coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations‖.

Resource management in grid environments is a great challenge; this is due to the heterogeneity of resources in grid environments and in addition to that, grid resources belong to diverse administrative domains and apply different management policies *[2]*.A common problem arising in grid computing is to select the most efficient resource to run a particular program.

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 *[4-5]***.** 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 *[4]***.** In this paper we are focusing on resource allocation phase and its issues.

This paper is organized as follows: Section II illustrates the related work, followed, in Section III which introduces resource management in grid. Section IV presents a modified resource allocation algorithm, Section V presents advantages of proposed algorithm, Section VI defines the simulation results and section VII represents conclusion and future scope.

II. Related Work

Darshan Kanzariya, Sanjay Patel *[6]* presented the various grid resource allocations strategies to select the most efficient resource to run a particular program.

In *[10]* taxonomy the authors described the basic features of resource brokers and grid middle wares.

Krauter et al *[7]* presented taxonomy of grid resource management systems; this taxonomy mainly focused on categorizing grid systems and the whole process of resource management in grid.

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 *[8-9]***.**

III. Resource Management In Grid

The term refers to managing the different types of resources like bandwidth, processing power, etc. so that they can be efficiently utilized and satisfy the need of the users. As resources are limited in the environment and number of users are far much greater than the number of resources, so we need to perform resource management so that effective utilization of resources take place.

The various challenges that Resource Management in Grid Environment faces are as follows:

a. Satisfactory end to end performance through multiple domains.
b. Availability of computational resources
c. Handle of conflicts between common resource demand
d. Fault tolerance
e. Inter domain compatibility

IV. THE PROPOSED ALGORITHM

Major Problem faced during resource allocation is bidding process challenges

a) Reserved bidding model wastes the resources, this is because 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 all other resources miss the opportunity to participate in other bidding processes and serves other grid clients before they are rejected by the original grid client.
b) On the other hand non-reserved bidding process lead to unexpected completion time for tasks. This happens because the resource provider must participate in more than one bidding processes by the same resources simultaneously. This makes the grid clients compete on those resources and the competition may cause unexpected completion time for the submitted tasks.

The proposed steps that need to be followed while performing resource allocation in Grid Environment.

A. Algorithm for Grid in Client side for each task:

In this it is assume that a bidding process for resource provider is organized. Call for procedure message is send to each resource provider, asking for their participation in the bidding process. Number of bids for resource from different resource provider is submitted with amount of time they can serve. A best bid array is maintained in which all the best bids from different providers are saved. Now if a task arrives, it sends a message, asking to allocate resource. Then system asks the task about its requirement about the type of task and the time it needs to get execute. After getting information about the task requirement, system search for the best resource from the best bid array according the time the particular task needs to get executed (means if we have more the one same type of resource, than it follows the algorithm for the best fit. It allocates that resource which has time greater than or equal to the time task needs and must least for all resources having more time). Same procedure will follow for the whole event. Algorithm for this is as follows:

Algorithm steps in Grid Client side for each Task

```
Create a 2-D array named best_bid_array
Create a 2-D array named bid_array
Specify task requirement in CFP message
Send the CFP message to all available resource providers
initialize    i←1
        repeat
                Received_bid (with time available) ← received_bid_from_provider
                i=i+1
        loop_ends
sort (received_bid) // in descending order, max value at location [1]
best_bid  ← received_bid[1]
initialize    i←1
        if received_bid[i] = best_bid
        then
                best_bid_array[i]  ←  received_bid[i]
        endif
call resource_allocation algorithm
end
```

Algorithm resource allocation

```
Submission of task with required resource time.
sort (best_bid_array[i])   //with respect to time available
initialize   i ← 1
repeat
        if   time available for (best_bid_array[i]) > resource time required for task
                then
                i=i+1
        else
                resource_allocated   ←   best_bid_array[i-1]
                break
        endif
end_loop
end
```


B. Algorithm for resource provider:

At the resource provider, when Call For Procedure message is received it check for its status whether to respond to that message or not. If a resource provider is capable to participate in that bidding process, bid is calculated and sends to the client broker with the amount of time its resource can serve and reserve that resource for that bid. Otherwise, a resource provider can simply ignore that message. If it receives a free token from the client broker it frees the resource. Meanwhile, a task submission message is received it will allocate the resource to that task and charge for it. The process will continue until we logout from the system. Algorithm for the resource provider is as follows:

Algorithm at resource provider

```
start:
repeat
receive CFP from grid client
compare CFP with current status of resource
if capable to participate
then
        calculate the bid
        send the bid to client broker (including amount of time resource can provide)
        reserve the resource for that bid
else
        ignore the CFP
endif
if receive a free token from a grid broker
then
        free the reserve resource for that bid
endif
if receive a task submission message
then
        if resource is reserved for that task or resource is free
        then
                submit the task to the resource
        endif
else
        ignore the message
endif
until logout from grid system
end
```

V. Advantages of Proposed Algorithm

In order to solve the problem of resource allocation, the tasks that need resources can search for these resources by checking onto each site. When a task arrives at a particular site, then it can check for required resource at that site itself .If it gets the resource then the resource is allocated, otherwise it checks for another site at which required resource is available and this process continues. The amount of time for which the resource is required by the task needs to be known and asked by the task itself. As any other task appears the timer decrements itself and after the time has exceeded, the resource is freed and now can be allocated to another site that may have need of that particular resource. Whenever a resource is allocated to the site, then it is charged for that resource. After charging resource is freed when its usage is complete and thus all stages of resource management in grid computing are satisfied.

VI. Simulation Results

The simulations were done in GridSim environment and in figure1, it is clearly shown that total time for completion in modified algorithm tends to decrease as number of task increases as compare to existing approach. This is because of the allocation of best resource available for any task.

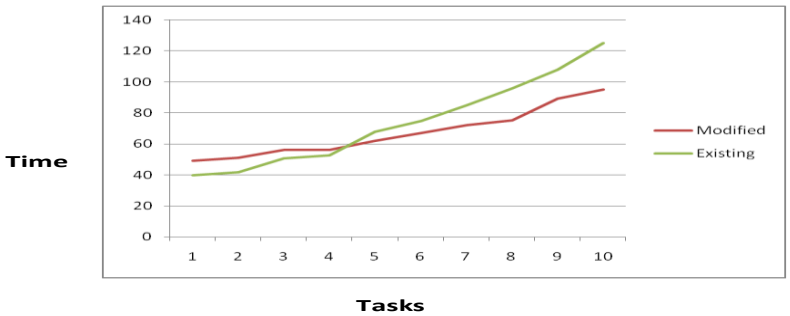

Figure 1: Total time v/s number of tasks

In figure2, it is clearly shown that resource utilization in modified algorithm tends to increase as number of task increases as compare to existing approach. This is because average waiting time of task decreases in the modified approach.

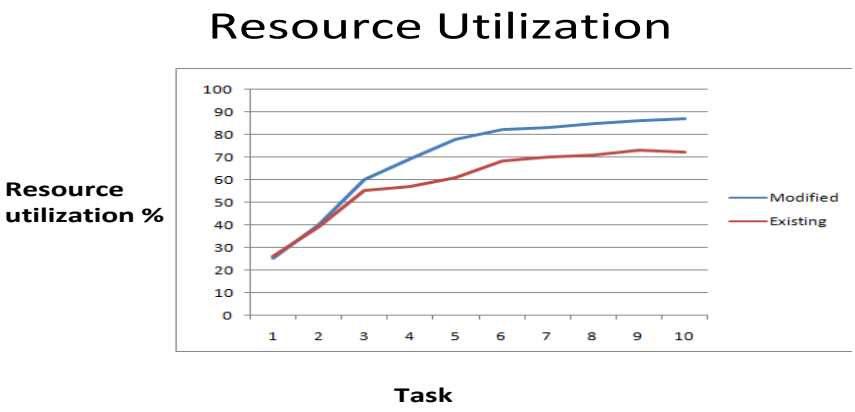

Figure 2: Resource Utilization% v/s Number of Task

VII. CONCLUSION AND FUTURE SCOPE

Due to static nature of number of sites and resources a lot of time is wasted and resource utilization is very low. So we tried to improve resource management in Grid computing. For this we use a dynamic resource reservation model. In this we specify the advantages of using a dynamic approach and develop a model to justify our approach. In this a single (best) resource for task execution is selected for completion of task, it is prerequisite that client specifies the time period it required for task to get executed, it is expected that the task will complete in required amount of time as it is specifies by the client itself. For selection of resource we use a best fit technique. It means we will allocate only that resource which will fit best according to the client requirement. It will increase resource utilization and decreases task waiting time.

The simulation results shows that as the number of tasks increases the total completion time in the modified algorithm decreases as this model reserve the best resource for task execution the client itself specifies the time period in which it finishes the task & submits it to the resource provider so maximum resource utilization increases.

In future, we can optimise the algorithm in a better way to provide solution to the problems that may exist while allocating resources. In this paper we address only those cases where needs of the tasks are similar. We can enhance the system for tasks having different needs.

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