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Comparative Study of Various Task Scheduling Algorithms in Grid Computing

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Abstract: Grid computing is used to solve various scientific or technical problems by applying many computers together to accomplish a specific task. It is an infrastructure for resource sharing and task scheduling. In recent times, many techniques have been developed to improve resource scheduling and task scheduling. The main idea to improve these aspects is to reduce makespan and improve resource utilization. Checkpointing is the aspect which can take a close check on the flow of the algorithm and remove the error as soon as it occurs. Replication is a technique which always works if any errors occur; it repeats all the above points after being assigned to other resource. This helps us to catch the error easily and quite easily and faster. The presented paper is to survey about various task scheduling algorithms which control the task scheduling of entire system. After surveying about the algorithms we compare them and the conclusion shows the best algorithm among all.

Keywords: grid computing, task management, fault tolerance, resource utilization.

INTRODUCTION

Grid computing may have differ in meaning in different aspects [1] but in simple language Grid Computing is a technique to connect different computers in a geographically distributed network creating a powerful system which possess the ability to perform various complex operations which normal computers are not able to do.

The scheduling has become one of the major research objectives, since it directly influences the performance of grid applications. Task Scheduling is one of the most important aspect on which many researchers have been done. The scheduler has to work hard in decision making to allocate resources with primary aim to satisfy user deadline and QOS (Quality of Service) Requirement.

There has been researched many algorithms which offer good and better performance for grid task scheduling. Generally, race to complete the task bargains with the user requirement or its budget which compromises in Quality of Service needed by the user. So in this survey paper, we tried to check various parameters which effect the scheduling of tasks in Grid Computing. These parameters are: Quality of Service, Checkpoint, Replication, Failure Recovery and Fault Tolerance. These are some parameters, if found positive, can really reduce the occurrence of problems or errors appearing in task scheduling.

RELATED APPROACHES

The purpose of grid computing is to produce a virtual supercomputer by using free resources available through widespread networks such as the Internet. Zahra et al. [1] stated that this type of resource distribution, changes in resource availability and an unreliable communication infrastructure pose a major challenge for efficient resource allocation. His article uses a new evaluation (distributed) algorithm inspired by the effect of leaders in social groups, the group leaders' optimization algorithm (GLOA), to solve the problem of scheduling independent tasks in a grid computing system.

Subarna et al. [2] reviewed the need of allocating a number of tasks to different resources for the efficient utilization of resources with minimal completion time and economic cost is the essential requirement in such systems. An optimal scheduling could be achieved minimizing the completion time and economic cost using the heuristic approach, which is chosen to be Genetic Algorithm.

Rohaya Latip et al. [3] researched adding fault tolerance capacity with checkpointing and machine failure, to the current research, Selected Most Fitted (SMF) Task Scheduling for grid computing.

Babar Nazir et al. [4] proposed a strategy which maintains fault history of the resources termed as resource fault index. Fault index entry for the resource is updated based on successful completion or failure of an assigned task by the grid resource. Grid Resource Broker then replicates the task (submitting the same task to different backup resources) with different intensity, based on vulnerability of resource towards faults suggested by resource fault index. Hence, user job(s) can be completed within specified deadline and assigned budget, even on the event of faults at the grid resource(s).

Naglaa et al. [5] described that the main aim for several researchers is to develop variant scheduling algorithms for achieving optimality, and they have shown a good performance for tasks scheduling regarding resources selection. However, using of the full power of resources is still a challenge. In this paper, a new heuristic algorithm called Sort-Mid is proposed. It aims to maximizing the

utilization and minimizing the makespan. This strategy of Sort-Mid algorithm is to find appropriate resources.

Ranieri et al. [6] proposed a new multi-criteria job scheduler for scheduling a continuous stream of batch jobs on large-scale computing farms. Convergent Scheduler exploits a set of heuristics that drives the scheduler in taking decisions. Each heuristics manages a specific problem constraint, and contributes to compute a value that measures the degree of matching between a job and a machine. Scheduling choices are taken both to meet the Quality of Service requested by the submitted jobs and to optimize the usage of software and hardware resources.

Malarvizhi et al. [7] stated that In addition to the challenges of managing and scheduling these applications, reliability challenges arise because of the unreliable nature of grid infrastructure. Two major problems that are critical to the effective utilization of computational resources are efficient scheduling of jobs and providing fault tolerance in a reliable manner. Addressing these problems by combining the checkpoint replication based fault tolerance mechanism with Minimum Total Time to Release (MTTR) job scheduling algorithm. Replica Resource Selection Algorithm (RRSA) is proposed to provide Checkpoint Replication Service (CRS). The proposed approach effectively schedules the grid jobs with fault tolerant way thereby reduces TTR of the jobs submitted in the grid. Also, it increases the percentage of jobs completed within specified deadline and making the grid trustworthy.

Ruay-Shiung Chang et al. [8] stated that in the computing grid, task scheduling, in order to discover resources for user's requirements, is important. In general, the task scheduler assigns tasks to a proper resource node for execution, and the resource nodes with better performance would be assigned first. When task loading is heavy and all resource nodes with better performance are assigned, other tasks have to be assigned to the resource nodes with inferior performance. Therefore, if a task is assigned to a resource node without considering the performance factor, the overall execution time will increase obviously. To solve this problem, a task scheduling algorithm that searches for the proper resource for task execution is proposed in this paper.

Ritu et al. [9] introduced a new technique called FTTS (Fault Tolerant Task Scheduler) algorithm which schedules the application tasks with the aim to minimize the execution time along with handling faults by adding fault tolerance. Here, fault tolerance is provided to the system with the help of checkpointing/restart mechanism considering the recoverable or transients faults.

COMPARISON

Comparisons of the following algorithms are done considering their results on few parameters that are Quality of Service Requirement, Failure Recovery, Checkpoint, Replication and Fault Tolerance.

S. No	PARAMETERS	FTTS(Fault Tolerance Task Scheduler)	RFTGS(Replication based Fault Tolerant job scheduling strategy)	CRS(Checkpoint Replication Service)	RRSA(Replica Resource Scheduling Algorithm)
1.	QOS Requirement	No	Yes	YES (Special Attention)	Yes
2.	Failure Recovery	No	No	YES	No
3.	Checkpoint	Yes	No	Yes	Yes(better than all three)
4.	Replication	No	Yes	Yes	Yes
5.	Fault tolerance	YES(BUT LESS THAN RFTGS)	YES(BETTER THAN FTCS)	Yes	Yes

CONCLUSION

From the above survey and comparison among various algorithms, it is quite clear that CRS and RRSA are the two very effective methods of task scheduling. RRSA takes special care of checkpointing by keeping a proper track of the checkpoints. RRSA include CRS in it which makes CRSA the best algorithm among all of them.

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