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Resource Scheduling and Evaluation of Heuristics with Resource Reservation in Cloud Computing Environment

Prof. Krunal N. Vaghela
Research Scholar, School of Engineering RK University, Rajkot, Gujarat.
Email: krunal.rkcet@gmail.com
Dr. Amit M. Lathigara
Associate Professor, Faculty of Engineering, Marwadi University, Rajkot
Email: amit.lathigara@gmail.com

ABSTRACT

The "cloud" is a combination of various hardware and software that work jointly to bring many aspects of computing to the users as an online service. Some uniqueness of Cloud Computing is pay-per-use, elastic capacity, misapprehension of unlimited resources, self-service interface, virtualized resources etc. Various applications running on cloud environment would expect better Quality of Service (QoS) from Cloud environment. Improvement in Quality of Service (QoS) is possible through better job scheduling and reservation of resources in advance for execution of jobs. In this paper effects of Reservation Rate and Time Factor on the performance parameters like Resource Utilization, Waiting Time, Minimum Execution Time and Success Rate of Reserved jobs have been studied for various job scheduling algorithms and their performance have been calculated in resource reservation environment in Cloud.

Keywords - **Cloud Computing, Max-Mix, Min-Min Resource Reservation, Priority Scheduling**

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I. INTRODUCTION

Cloud is a parallel and distributed computing system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers. Main goal of cloud is to give access to assorted resources to users whenever and however they need [7]. Various resources of cloud are processing power, data storage system, operating system, application software, infrastructure etc [8].

When resources are physically scattered and owned by variety of service providers or service consumers, resource administration plays very crucial role in achieving QoS. Scheduling is assigning set of jobs to set of resources [6]. Output of almost every scheduling algorithm depends on efficient scheduling [9]. Resource reservation is a scheduling technique for reserving a single or group of resources for a particular time for access only by a specified user or group of users [1].

Scheduling can be categorized in two types: static scheduling and dynamic scheduling [4]. In static scheduling resources are allocated prior to execution of jobs and in dynamic scheduling scheduler keeps allocating the resources as jobs keep arriving for execution [8].

In this paper effects of Resource Reservation Rate and Time Factor on the performance parameters like Resource Utilization, Waiting Time, Minimum Execution Time and Success Rate of Reserved jobs have been studied for various job scheduling algorithms and their performance have been evaluated in resource reservation environment in Cloud.

II. RELATED WORK

Resource Broker or scheduler maintains two separate queues [10]. One for the jobs which need advance resource reservation and another for jobs which do not need any resource reservation. So first resources will be allocated to the jobs which are having reservation on the required resource while in the free slots resources will be allocated to other jobs which do not require any reservation. In the case of online scheduling, if job with reservation finishes its execution before predicted time then resource will be allocated to next job in queue immediately. In rigid resource scheduling, if job finishes its execution before time than next job in queue will have to wait till its pre-defined starting time which leads to poor resource utilization [5].

Comparison of various job scheduling algorithms is given in below TABLE 1.

III. SIMULATION RESULTS AND DISCUSSION

Simulation has been done with single resource environment in Cloud. Each resource is having one processor. Capacity of processor is 200 MIPS (Millions of Instruction per Second). Simulation has been performed for 3000 jobs having random execution time.

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Definition of scheduling algorithm simulation variables:

1. Reservation Rate: It is the ration of jobs which require resource reservation to total number of jobs.
2. Time Factor: It is the time at which jobs need to be submitted to scheduler in advance.
Definition of scheduling algorithm performance parameters:
1. Resource Utilization: This is ratio of running time of processor of resource to total time. Total time also includes idle time of processor.
2. Waiting Time: This is the time from which user submit job which does not require reservation to scheduler to it actually starts its execution. It is waiting time of non-reservation jobs.
3. Minimum Execution Time: It is total execution time of all the jobs i.e. with/without reservation by respective scheduling algorithm.
4. Success Rate of Reserved Jobs: It is ratio of total successfully executed reserved jobs to total no of scheduled job.

Effect of Reservation Rate and Time Factor on job scheduling algorithms like Priority Scheduling, Min-Min and Max-Min have been calculated and analyzed with performance parameters Resource Utilization, Waiting Time, Minimum Execution Time and Success Rate of Reserved jobs.

As shown from Fig. 1 to Fig, 3, initially Reservation Rate is 0; it means there is not any job which requires any resource to be reserved. With increase in Reservation Rate, Resource Utilization is also increased. When Reservation Rate increases i.e. more no of jobs with requirement of resource reservation, increase in waiting time has been observed. Here jobs which require resource reservation will get prior chance to be executed. So, non-reserved jobs need to wait for resource till it gets ideal. Hence increase in Waiting Time is observed with increase in Reservation Rate. Delay in execution of non-reserved jobs will affect overall completion time. So more the reserved jobs, more delay in overall completion time. So, increase in Minimum Completion Time observed with increase in Reservation Rate.

Now one interesting observation is, till some increase in Reservation Rate, Success Rate of Reserved job showing positive results as it keep increasing. After some increase, negative effect is observed in performance of reserved jobs. Reason for this negative effect is, when there are more number of reserved jobs, requirements of such jobs get conflicted with one another and as a result overall performance of reserved job get negatively affected.

To summarize, up to some Reservation Rate, we are observing positive effect on all mentioned parameters in all three scheduling algorithms. But beyond some acceptable Reservation Rate, due to conflicting requirements of reserved jobs, negative effects have been observed.

As shown from Fig. 4 to Fig, 6, when we are increasing Time Factor, Resource Utilization decreases. The reason behind this decrease is, where we are submitting jobs earlier to the scheduler, it will get more time to schedule the jobs. So scheduler can schedule the jobs with minimum scheduling overhead and optimize resource utilization. Other parameters like Waiting Time, Minimum Execution Time and Success Rate of Reserved jobs are showing negative effect with increase in Time Factor. Earlier the submission, reserved jobs will be scheduled prior to non-reserved jobs. So it will affect overall performance of scheduling algorithms with respect to mentioned parameters.

IV. FIGURES AND TABLES

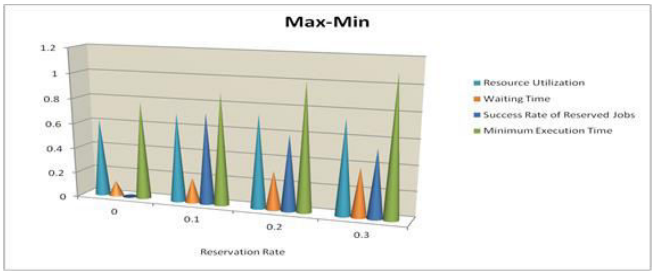

Fig.1. Effect of Reservation Rate on All Performance Parameters for Max-Min Algorithm

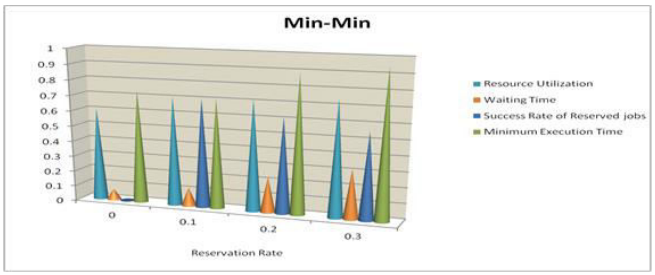

Fig.2. Effect of Reservation Rate on All Performance Parameters for Min-Min Algorithm

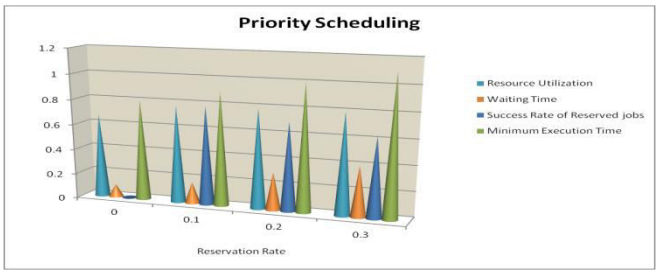

Fig.3. Effect of Reservation Rate on All Performance Parameters for Priority Scheduling Algorithm

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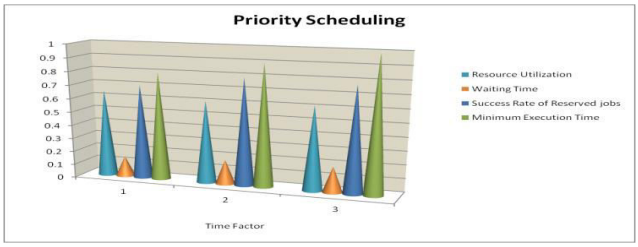

Fig.4. Effect of Time Factor on All Performance Parameters for Priority Scheduling Algorithm

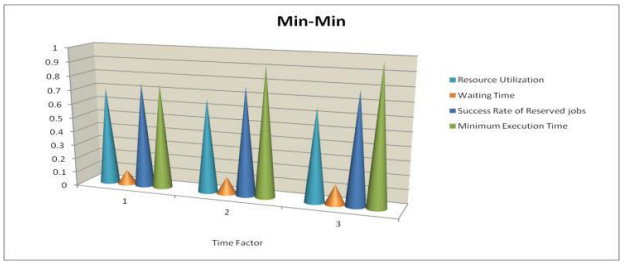

Fig.5. Effect of Time Factor on All Performance Parameters for Min-Min Algorithm

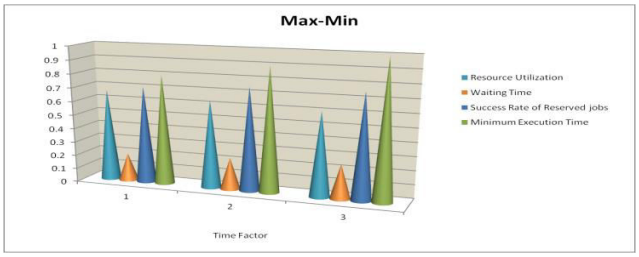

Fig.6. Effect of Time Factor Rate on All Performance Parameters for Max-Min Algorithm

Table 1. Comparison of Various Scheduling Algorithms

Sr. No.	Job Scheduling Algorithms	Advantage	Disadvantage
1	Opportunistic Load Balancing (OLB) [2].	Implementation is simple	Expected completion time will not be considered. Poor execution time
2	Minimum Execution Time (MET) [2].	Job is allocated to machine with best execution time for that job	Few machines may be over utilized and few will be underutilized, which may lead to load misbalancing
3	Minimum Completion Time (MCT) [3].	Combine few benefits of OLB and MET	Causes few jobs to be allocated to machines which do not have the minimum execution time for those jobs
4	First Come First Serve (FCFS)	Very simple to implement. Fair for shorter jobs	Long jobs make short jobs wait and unimportant jobs make important jobs wait
5	Shortest Job First (SJF) [12]	Better for batch jobs	Execution time should be known in advance
6	Longest Job First (LJF) [12]	Better for batch jobs	Execution time should be known in advance
7	Priority Scheduling [11]	Urgency of the job will also be taken in to consideration.	Priority should be known in advance.
8	Min-Min [2].	Considers all tasks which are yet to be matted while taking each mapping decision	Execution time should be known in advance
9	Max-Min [2]	Considers all tasks which are yet to be matted while taking each mapping decision	Execution time should be known in advance
10	Duplex [2]	Combination of the Min-Min and Max-Min heuristics	Overhead of combining Min-Min and Max-Min.
11	Round Robin	Less complexity and load is balanced more fairly	Pre-emption is required
12	Genetic Algorithm	Better performance and efficiency in terms of makespan	Complexity and long-time consumption
13	Simulated Annealing	Finds more poorer solutions in large solution space, better makespan	QoS factors and heterogeneous environments can be considered
14	Switching Algorithm	Schedules as per load of the system, better makespan	Cost and time consumption in switching as per load
15	Suffrage heuristic	Better makespan along with load balancing	Scheduling done is only based on a suffrage value

V. CONCLUSION

In this paper effects of Reservation Rate and Time Factor on the performance parameters like Resource Utilization, Waiting Time, Minimum Execution Time and Success

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Rate of Reserved jobs have been studied for various job scheduling algorithm like Priority Scheduling, Min-Min and Max-Min, and their performance have been calculated in resource reservation environment in Cloud. Up to some Reservation Rate, we are observing positive effect on all mentioned parameters in all three scheduling algorithms. But beyond some acceptable Reservation Rate, due to conflicting requirements of reserved jobs, negative effects have been observed. We are observing decrease in utilization of resources by increasing prior submission time of jobs because scheduler will get more time to schedule jobs for available resource. For the other parameters, in all scheduling algorithms, negative effect has been observed with increase in Time Factor.

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Biographies and Photographs

Prof. Krunal Vaghela received the B.E. degree in Computer Engineering from Saurashtra University, Rajkot, in 2004 and Master's Degree from NITTTR Chandigarh in 2014. He is research scholar at School of Engineering RK University, Rajkot, India. After completion of B.E. he worked for many companies as Project Engineer. Since 2009, he is working as Assistant Professor at Department of Computer Engineering, RK University, Rajkot, India.
His areas of interest are Grid Computing, Cloud Computing, Computer Networks, Information Security and Mobile Computing.

Dr. Amit Lathigara is working as Associate Professor at Marwadi University, Rajkot, India and having extensive teaching experience of more than 13 years. He has completed his master from Anna University, Coimbatore and Ph.D. from RK University. He has written more than 20 research papers published in reputed journals and conference proceedings.
His preliminary research area focuses on routing in Mobile ad hoc network and resource and job scheduling under Cloud environment.