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# Impact of Load Balancing on the Performance of Scheduling Algorithms in Grid System

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***Abstract*—The paper shows that load balancing with percentage load conversion, improves the performance of basic scheduling algorithm as FCFS (First Come-First Serve), EDF (Earliest Deadline First) in Grid system.Load conversion is the percentage of jobs migrated from all clusters to clusters having high processing speed machines.The result is shown based on experiment on Grid simulator Alea2.The paper compares the Performance of FCFS and EDF-BF algorithm for different percentage of load conversion in Grid system. FCFS showing better performance in terms of parameters like machine usage, waiting time/running time of job etc.**

***Index Terms*— load balancing, scheduling, grid environment, load conversion.**

## I. INTRODUCTION

Basically, grid[2] resources are geographically distributed computers or clusters, which are logically aggregated to serve as a unified computing resource. Due to uneven task arrival patterns and unequal computing capabilities, the computing node in one grid site may be overloaded while others in a different grid site may be under-utilized. As a result, to take full advantage of such grid systems, issues of task allocation and load balancing represent a common problem for most grid systems. Load balancing mechanism aims to equally spread the load on each computing node, maximizing their utilization and minimizing the total task execution time.In general, load-balancing algorithms can be roughly categorized as centralized or decentralized in terms of the location where the load balancing decisions are made. A centralized load balancing approach can function either based on averages or instantaneous measures according to the type of information on which the load balancing decisions are made. The first type of load balancing takes a holistic view of the tasks waiting to be processed and makes an optimal decision over the entire group of tasks systematically while the second makes an instantaneous load-balancing action for one task performance criteria[5]. In this chapter a novel approach with respect to CPU speed, one of the Quality of service(QoS) constraint has been presented. In grid simulator Alea2, some percentages of loads are transferred from all clusters of machines to some of the selected clusters having machines with high processing speed. This is done manually by modifying the dataset file of the simulator. Percentage of jobs to be moved from one location to another is termed as load conversion. Here we have studied how the load balancing with load conversion effect the performance of existing scheduling algorithm.This paper describes the Load balancing algorithm,gives the experimental result of the simulation in Alea2 grid simulator. Finally, the paper is concluded with analysis.This paper proposes an improved load balancing algorithm with load conversion based on quality of service (QOS) i.e. CPU speed of machines, on the clusters of grid. Load conversion is the percentage of jobs to be moved from one location to another. For example 10% load conversion means 10 percent of loads from all clusters move to clusters with machines having high CPU speed.

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Load balancing with load conversion works well with FCFS algorithm. Machine usage/day and Used CPU/day is increased, Waiting Jobs/day is decreased with this algorithm for the First Come-First Serve (FCFS) algorithm. This algorithm is showing good behavior For Earliest-Deadline-First (EDF) algorithm, except for 10% load conversion in some cluster.

## II. Related Work

Y. Zhu[6] presented a survey on Grid Scheduling. This survey focused on the design of scheduling systems for computational Grids. This survey investigated challenges for designing grid scheduling system. A Grid scheduling framework and a common Grid scheduler architecture was proposed by the author. Finally a complete taxonomy for describing Grid scheduling systems was presented. G.Mateescu[7] used a resource selector for scheduling jobs requiring multiple resources. The job queue is managed by a FIFO fashion with dynamic priority correction. If the reservation fails for a job in a scheduling cycle, the job's priority will be promoted in the queue for the next scheduling round. The ranking of the candidate resources was done by resource selector with their number of processors and memory size.Dalibor Klusáček and Hana Rudová[3] have described the Grid and cluster scheduling simulator Alea 2. It is designed for study, testing and evaluation of various job scheduling techniques. This event-based simulator is able to deal with the heterogeneity of jobs, resources, and the dynamic runtime changes. The Alea 2 is based on the popular GridSim toolkit and represents .Many parameters like the machine usage, the average slowdown or the average response time are included. H. Chen and M. Maheswaran [8], proposed an adaptive local rebalancing heuristic. Tasks are initially distributed to all resources in this heuristic. Rebalancing happens inside a "neighborhood" in place of global rebalance, where all resources are interconnected together. This approach has several advantages a. The initial loads can be distributed quickly to all resources. The rebalancing process is scalable and distributed.. Hao, X., Dai, Y., Zhang, B., Chen, T., Yang, L[9] presented a Grid resource selection based on Neural network aiming at offering QOS on distributed, heterogeneous resources. Most current research concentrates on how to guarantee the QoS requirements of the applications like Montero, R. S., Llorente, and E. Heudo[10], but few of them study how the QoS requirements affect the resources assignment and the performance of the applications. For the present study load balancing algorithm is designed and studied its effect on the existing scheduling algorithms available in Alea grid simulator in terms of parameter like machine usage per day, waiting time/day, used cpu, available cpu etc.

## III. Load Balancing Algorithm

[The parameters chosen for the study are Machine Usage/day, waiting/running jobs, requested CPU/day, used CPU/day, available CPU/day etc.]
Step1 :Repeat through steps 2 to 6
Step2: percentage load conversion=5%
Step3 :Choose clusters according to their CPU strength(higher) say m,n,o.
Step 4 :Assign loads(jobs) from all clusters to these(m,n,o) clusters.
Step 5:Simulator is run and the parameters are measured for existing scheduling algorithms.
Step 6:Change load conversion percentage

## IV. Experiment

"Metacentrum data set"[1] is generated from the national grid of Czech republic using PBS-Pro consisting of 5000 jobs, 14 clusters and 806 CPUs. Out of 14 clusters, 3 clusters namely cluster 4, cluster 7 and Cluster 10 are chosen based on their CPU Speed and Model. Load of all the clusters are reallocated one by one to each of the above mentioned clusters to see and analyze the outcome of this reallocation on the overall performance of Grid. This procedure is repeated thrice for 3 different levels of reallocation. First we allocated 5% of workload from all the clusters to Cluster 4 ,Cluster 7 and Cluster 10 one by one to create a new manually manipulate data set then we created 2 more new data set with 10% and 20% allocation.

## V. Experimental result

Two algorithm FCFS and EDF are simulated using Alea 2 simulator and new manipulated Metacentrum data set. Here graphs are displayed for different parameters of FCFS (First Come First Serve) and EDF (Earliest Deadline First) scheduling algorithms.

*A. FCFS Algorithm*

Here graphs are displayed for different parameters of FCFS (First Come First Serve). Here cluster 4, cluster 7 and cluster 10 are the clusters where loads are transferred from all other clusters.

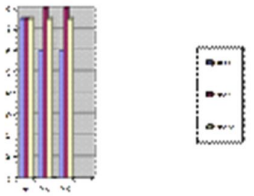

Fig 1: Maximum Machine Usage/Day

Here Graph shows that in most of the cases machine usage is increasing.

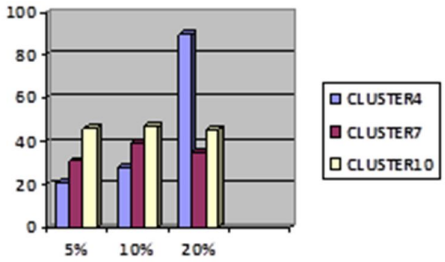


Fig 2: Used Maximum CPU/Day

Here Graph shows that in most cases the CPU usage is increasing.

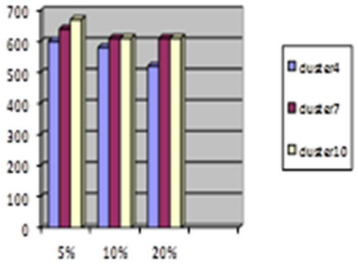


Fig 3: Maximum No. of. Waiting jobs/Day

Here,Graph shows that maximum no. of waiting time/day for jobs have been decreased.

*B. EDF Algorithm*

Here graphs are displayed for different parameters of EDF (Earliest Deadline First). Here cluster 4, cluster 7 and cluster 10 are the clusters where loads are transferred from all other clusters.

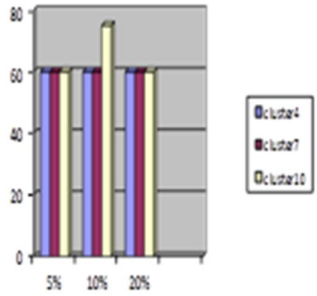


Fig 4: Maximum Machine Usage/Day

Here, Graph shows that for 10% load conversion, in cluster 10 machine usage has increased.

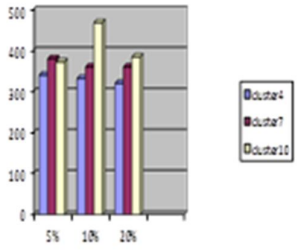


Fig 5: Used Maximum CPU/Day

Here, Graph shows that for 10% load conversion, in cluster 10 CPU usage has increased.

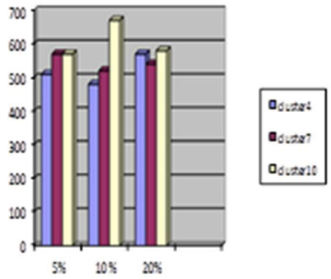


Fig 6: Maximum No. of Waiting JOBS/Day

Here, Graph shows that for 10% load conversion, in cluster 10 waiting time has increased.

## VI. ANALYSIS AND CONCLUSION

From the results it is concluded that load balancing with load conversion works well with FCFS algorithm. Machine usage/day and Used CPU/day is increased, Waiting Jobs/day is decreased with this algorithm for the FCFS algorithm. For EDF algorithm for 10% conversion in cluster 10 this algorithm is showing different behaviour.This experiment clearly shows that the overall performance of FCFS, EDF, EDF-BF can be significantly improved by a slight change in algorithm which is to transfer a particular amount of workload work while adding more QoS constraint in addition to this approach, like network bandwidth and RAM of the machines of the clusters.

## FUTURE WORK

A The load balancing can be done for different percentages of load conversion and then one optimal percentage can be found for best performance of scheduling algorithms in Grid system.

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