

A Study on Dynamic Load Balancing in Grid Environment

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Abstract— Grid computing is a collection of computer resources from multiple locations to reach a common goal. Grid computing distinguishes from conventional high performance computing systems that are heterogeneous and geographically dispersed than cluster computer. One of the major issues in grid computing is load balancing. Classification of load balancing is: Static – Dynamic, Centralized – Decentralized, Homogeneous – Heterogeneous. Techniques like: Ant Colony Optimization, Threshold based and Optimal Heterogeneous are used by some researcher to balance the load. This survey paper discusses set of parameters to be used for comparing performance of each of them. In addition to that it says which technique is more useful for grid environment.

Key words: Load balancing; dynamic; grid environment

I. INTRODUCTION

Distributed computing is a collection of computers or systems that are connected in LAN to solve computational problem according to user requirement. All the systems are distributed geographically at different locations. They have their own resources like memory, hard disk etc. A distributed system uses software to coordinate tasks that are performed on multiple computers simultaneously. The computers interact to achieve a common goal, and they interact by sending each other message.

Grid computing is a collection of computers or systems that are situated at different locations that are used to perform particular task. All the systems are connected with each other generally in mesh like network.

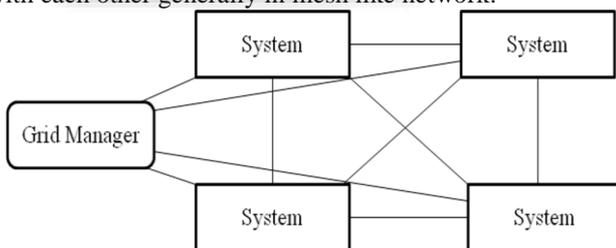


Fig. 1: Grid computing

From the fig. 1 all the systems are connected with each other n * n network. These systems are connected with one system which is connected with other system called grid manager. Grid manager manages the things like scheduling, load balancing, task distribution, task assignment etc.

In large institutes or corporation, there are multiple users who are using computers so sometimes load on one system get increased while system remains idle. So some systems overloaded while other are under loaded. At that time it is necessary to balance the load so all the users get served appropriately and in time.

II. RELATED WORK

There are different techniques available to balance the load in grid environment:

- 1) Centralized
- 2) Decentralized
- 3) Static
- 4) Dynamic

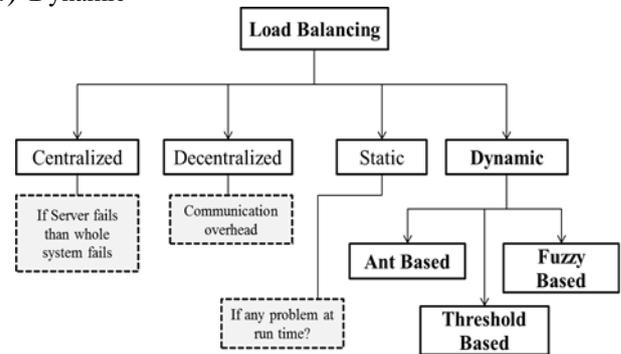


Fig. 2: Types of load balancing techniques

Fig. 2 shows that different types of load balancing technique in grid environment like:

A. Centralized

One system work as central system that gathers information of load of all the systems than distribute new task to all the systems according to the load capacity of that system. Sometimes it possible that if server goes down than whole grid system is of no use.

B. Decentralized

All individual systems have their own load information. By message communication all the system get load information of other systems also. But in large area there are so many systems in grid environment so it is very difficult to know the load information by message communication. It makes communication overhead and creates traffic.

C. Static

As per its name, there are predefined criteria to balance the load. So if any problem occurs at run time than it create problem. Because now a day the scenario is all depend on run time management.

D. Dynamic

According to the today's need, there is runtime change in a load of a grid. So to handle such situations, underneath load balancing algorithm are to be skilled for it. Several researchers have proposed set of algorithms for the same. Amongst set of algorithms, following are finest for a typical heterogeneous grid.

- 1) Optimal and dynamic
- 2) Ant based
- 3) Variable threshold
- 4) Fuzzy logic

To understand following approaches, there is a need to define new taxonomy of it.

- 1) Grid resource: Service provided to users. Distribute the job to execution unit.

- 2) Job/gridlet/task: It is workload provided by user to the grid resources.
- 3) Grid resource broker: Which resource is available and whom it to be submitted, this decision is taken by central entity called grid resource broker.
- 4) Processing entity: It is the interface between user and grid resource.

E. Optimal and Dynamic:

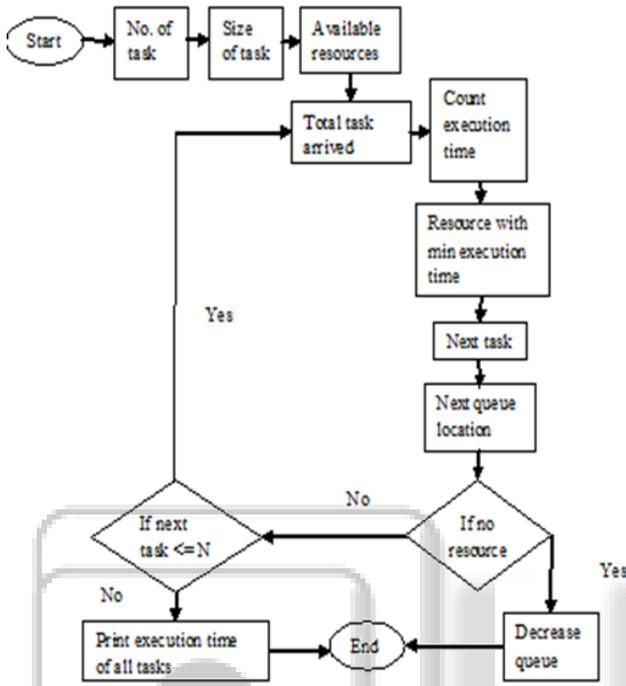


Fig. 3: Flow diagram of optimal and dynamic technique for load balancing^[1]

Diagram is created based upon the theoretical explanation by Jagdish Chandra Patni^[1]. The steps of an algorithm are as below:

1.	Count the number of task
2.	Calculate the size of task
3.	Find the available resources
4.	Count the total task arrived
5.	Calculate the execution time of each task
Execution time = task / resources	
6.	Allocate the job in First Come First Serve manner
7.	For the other tasks in queue find execution time of resources and check with other resources
8.	Next task is arrived
9.	Increment in queue
10.	If there is no any resources
a.	Go to step 11
11.	If next task <= number of task
a.	Go to step 4
12.	Print execution time

Table 1: Algorithm of optimal and dynamic approach

F. Ant based

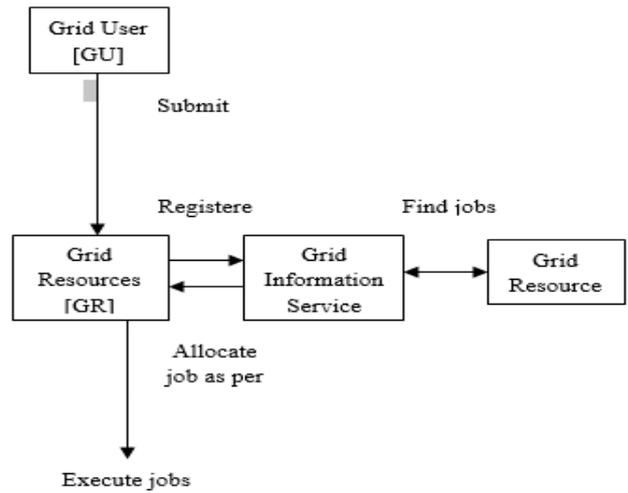


Fig. 4: Basic diagram of ant based technique for load balancing^[4]

Fig. 4 shows there are 4 components are used in ant based approach. In Rohit Saxena^[4], Grid User [GU] submits jobs to Grid Resources [GR] to Grid Information Service [GIS]. GR also register to itself to GIS. GRB finds the job from GIS that are registered by GU and according to the load on resources allocate job to resources. GR execute that particular job that is assigned by GIS.

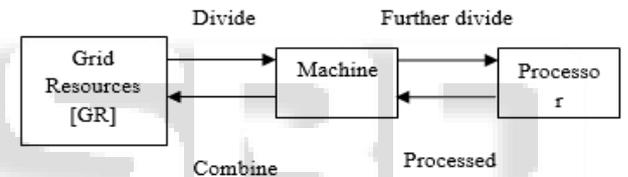


Fig. 5: Working of Grid Resources

Fig. 5 shows how GR work in basic ant based approach to balance the load in grid environment. GR break the job into sub job and allocate to machine according to capacity to handle the load. Machine further divide the job and give it to processing element. Processor process on that job and give result to machine that is processed element. These processed elements are combining by machine and send it to GR.

G. Variable Threshold:

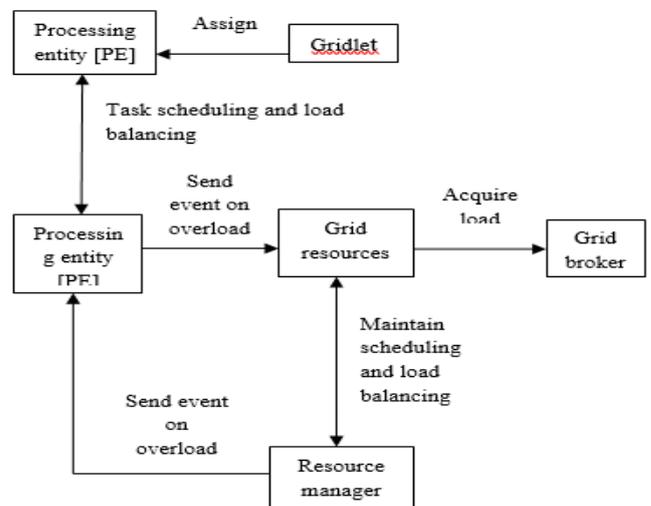


Fig. 6: working of variable threshold technique

Many entities playing important role for variable threshold approach. In Neeraj Rathore [3], there are processing entity [PE], processing entity [PE] manager, grid resources, resource manager and grid broker. Gridlet assign to PE and PE sends this gridlet to PE manager. PE manager is responsible for task scheduling and load balancing. PE manager send gridlet when overload occur in queue. PE manager send event to grid resources. Grid resources have resource manager which is responsible for scheduling and load balancing.

Grid broker acquire load of scheduling from grid resources. Grid broker divide the gridlet and distribute to the systems. There are several parameters like: file size, current load, actual load on system, capacity of the machine to handle the load etc. Generally load is divided into 3 categories: Lightly loaded, normally loaded, heavily loaded pool. While in this technique it divides into 4 categories: Under lightly loaded, lightly loaded, normally loaded, and heavily loaded pool.

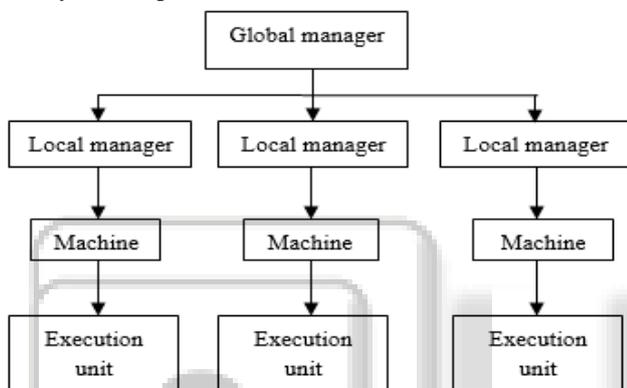


Fig. 7 General hierarchical structure in variable threshold based technique

- 1) Global manager: It is the top most managers that break the jobs and distribute to local manager. Local manager: It is the second layer manager. Local manager once break the sub jobs into other sub jobs and give it to the machine.
- 2) Machine: It gives task to the execution unit for execution.
- 3) Execution unit: Execute the job to the user. Interface between user and machine.

H. Fuzzy based^[2]:

Basic techniques are applied and now its focuses on artificial intelligence. Kun-Ming Yu [2] suggested that fuzzy technique divide into 3 tiers that is similar to basic load balancing technique describe in related work section.

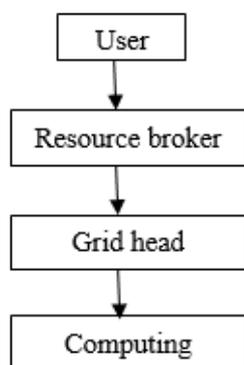


Fig. 8: Tiers of fuzzy based technique

Fuzzy technique is same as basic load balance and tiers are resource broker, grid head and computing.

1) Resource Broker

It acts as the coordinator between user and resource provider. It has command line user interface, control center and 3 managers: execution manager, transfer manager, and information manager. It is composed of fuzzy logic workload measurement and neural network training component.

2) Grid Head Tier

It is responsible for sending jobs to computing tier and communicating with resource broker.

3) Computing tier

It is responsible for workload monitor. Computing the jobs arrived from grid head tier.

In this technique it combines fuzzy logic and neural network.

Fuzzy logic is used to measure workload by CPU utilization and memory utilization. CPU utilization includes CPU speed, CPU usage and CPU run queue length. Memory utilization includes total memory, memory usage and swapped memory^[1].

Neural network apply 2 techniques feed forward phase and back propagation phase. It uses 3 loads: Light, medium and heavy. And from these 3 loads it generates 5 rules: Very light, light, medium, heavy and very heavy^[1].

III. COMPARATIVE ANALYSIS

In this section, various technique show comparison based on no. of jobs and time [sec]. Both the parameters are similar in all these techniques.

Sr. No.	Technique	No. of jobs	Time[sec]
1.	Dynamic and Optimal ^[1]	5-50	Arrival Time Execution Time End Time
2.	Ant Based ^[3]	10-60	Finish Time
3.	Variable Threshold ^[4]	1000	Response Time
4.	Fuzzy Based ^[2]	25-100	Turnaround Time

Table 2: Comparison of techniques

From the table 2 comparative analysis dynamic and optimal technique uses 5-50 jobs and time used by this technique are arrival time, execution time and end time. Ant based technique uses 10-60 jobs and only consider finish time. Other parameter is no. of resources and resource utilization. Variable threshold uses 1000 jobs and response time is considered. Fuzzy based uses 25-100 jobs and turnaround time.

IV. DISCUSSION

As discussed in related work section, fig. 3 optimal and dynamic technique include all the parameters like no. of

task, size of task no. of resources, execution time and table 2 shows that no. of jobs are taken 5 to 50 and also consider arrival time, execution time and end time. Fig. 4 depict grid information service [GIS] collect resource and job information and distribute it according to load on processor. From the table 2, ant based technique consider jobs ranging from 10 to 60 and finish time. Third technique is variable threshold technique illustrate in fig. 6, the component are connected with others. There are processing entity manager and resource manager that managing load balance.

Fig. 7 is the hierarchical structure of technique that balances the load in tree like structure. No. of jobs are 1000 and include response time in table 2. Fourth technique describes in fig. 8 that is fuzzy based technique and different from all three techniques. It is working on basic load balance that includes three tiers architecture. Table 2 show jobs are 25 to 100 and turnaround time. After discussing all four techniques conclusion is describe in next section.

V. CONCLUSION

According to discussion, dynamic and optimal is the best among all. Because it counts number of task, size of task, and execution time of the entire task. And also count the arrival time, execution time and end time. While other techniques only consider only one parameter like finish time, response time and turnaround time. In ant based technique, it allocate job to most optimal resource and decrease execution time. In dynamic threshold, it set threshold value at each level according to grid size. In fuzzy, when job increased performance is also increased. In dynamic and optimal technique, execution time of algorithm is reduced.

VI. FUTURE PLAN

In future, in optimal and dynamic approach we can also change to count execution time by adding size of packet. So the execution time will be decreased. And also include finish time for simulation. Load balance is also use artificial intelligence. It uses genetic algorithm and combine fuzzy and genetic algorithm for load balance in grid. Also other parameters included for simulation like throughput, size of task, queue length, resource capacity etc. And no. of jobs is 100 than also it will work well.

ACKNOWLEDGEMENT

It is a genius pleasure to express my deep sense of thanks and gratitude to my mentor and guide Ms. Rachana S. Oza for her timely advise, scholarly advise and scientific approach have a helped me to a very great extent to accomplish this study. I owe a deep sense of gratitude to Mr. Devendra Thakor and Ms. Heta Pujara for their keen interest on me at every stage of my study. I thank profusely all the faculty members, my friends and family for the help and cooperation throughout this work.

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