

# A Survey on Load Balancing in Cloud Computing Environments

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**Abstract:** Load Balancing is the one of the most important parts of the current virtual environment. In the case of cloud computing environments there were various challenges are there in the load balancing techniques like security, fault tolerance etc. Many researchers have been proposed various techniques to improve the load balancing. This paper describes a survey on load balancing schemes in cloud environments. There were various load balancing techniques are used in these papers and their corresponding advantages, disadvantages and performance metrics are studied in detail.

**Keywords:** Cloud computing, Distributed Virtual Environments, Load Balancing, Peer-to-Peer Systems.

## 1. INTRODUCTION

Load balancing is the process of reassigning the total loads to the individual nodes of the collective system to make the best response time and also good utilization of the resources. Cloud computing is an internet computing in which the load balancing is the one of the challenging task. Various methods are to be used to make a better system by allocating the loads to the nodes in a balancing manner but due to network congestion, bandwidth usage etc, there were problems are occurred. These problems were solved by some of the existing techniques. A load balancing algorithm which is dynamic in nature does not consider the previous state or behaviour of the system, that is, it depends on the current behaviour of the system. There were various goals that related to the load balancing such as to improve the performance substantially, to maintain the system stability etc. Depending on the current state of the system, load balancing algorithms can be categorized into two types they are static and dynamic algorithms. In the static algorithm there was prior knowledge of the system is needed and not depend on the current system. In the case of dynamic algorithm it is based on the current system and it is better performance than the static algorithm.

In this survey paper there were various load balancing techniques are discussed. The paper is organized as follows. Section 2 describes the literature review of various load balancing papers and section 3 describes the conclusion.

## 2. EXISTING LOAD BALANCING TECHNIQUES IN DISTRIBUTED SYSTEMS

*2.1 A fast adaptive load balancing method:* D. Zhang et al.[1] proposed a binary tree structure that is used to partition the simulation region into sub-domains. The characteristics of this fast adaptive balancing method are to be adjusted the workload between the processors from

local areas to global areas. According to the difference of workload, the arrangements of the cells are obtained. But the main workload

concentrates on certain cells so that the procedure of adjusting the vertices of the grid can be very long because of the local workload can be considered. This problem can be avoided by the fast load balancing adaptive method.

Here the region should be partitioned by using the binary tree mode, so that it contains leaf nodes, child nodes, parent nodes etc. There were partition line between the binary tree and the indexes of the cells on the left are smaller that of right and the indexes on the top are smaller than the bottom. Calculate the workload based on the balancing algorithm. This algorithm has a faster balancing speed, less elapsed time and less communication time cost of the simulation procedure. Advantages are Relative smaller communication overhead relative smaller communication overhead, faster balancing speed, and high efficiency and the disadvantage is it cannot maintain the topology that is neighbouring cells cannot be maintained.

*2.2 Honey Bee Behavior Inspired Load Balancing:* Dhinesh et al. [2] proposed an algorithm named honeybee behavior inspired load balancing algorithm. Here in this session well load balance across the virtual machines for maximizing the throughput. The load balancing cloud computing can be achieved by modeling the foraging behavior of honey bees. This algorithm is derived from the behavior of honey bees that uses the method to find and reap food. In bee hives, there is a class of bees called the scout bees and the another type was forager bees. The scout bee which forage for food sources, when they find the food, they come back to the beehive to advertise this news by using a dance called waggle/tremble/vibration dance. The purpose of this dance, gives the idea of the quality and/or quantity of food



and also its distance from the beehive. Forager bees then follow the Scout Bees to the location that they found food and then begin to reap it. After that they return to the beehive and do a tremble or vibration dance to other bees in the hive giving an idea of how much food is left. The tasks removed from the overloaded VMs act as Honey Bees. Upon submission to the under load VM, it will update the number of various priority tasks and load of tasks assigned to that VM. This information will be helpful for other tasks, i.e., whenever a high priority has to be submitted to VMs, it should consider the VM that has a minimum number of high priority tasks so that the particular task will be executed earlier. Since all VMs are sorted in an ascending order, the task removed will be submitted to under loaded VMs. Current workload of all available VMs can be calculated based on the information received from the data center. Advantages are maximizing the throughput; waiting time on task is minimum and overhead become minimum. The disadvantage is if more priority based queues are there then the lower priority load can be stay continuously in the queue.

**2.3 A Dynamic and Adaptive Load Balancing Strategy For Parallel File System:** B. Dong et al.[3] proposed a dynamic file migration load balancing algorithm based on distributed architecture. Considered the large file system there were various problems like dynamic file migration, algorithm based only on centralized system etc. So these problems are to be avoided by the introduction of the algorithm called self acting load balancing algorithm (SALB). In the parallel file system the data are transferred between the memory and the storage devices so that the data management is an important role of the parallel file system. There were various challenges that are faced during load balancing in the parallel file system. They are scalability and the availability of the system, network transmission and the load migration. Considered the dynamic load balancing algorithms, the load in each I/O servers are different because the workload becomes varies continuously. So there were some decision making algorithms are needed.

In this decision making system, there were firstly central decision maker, by which the central node is the decision maker so that if the central node becomes fail, then the whole system performance becomes down and the reliability becomes less. Secondly group decision maker in which the total system should be divided in to groups so that the communication cost becomes reduced. But taking decision without considered the whole system load so that global optimization explored a major problem. Finally the distributed decision maker in which each I/O server can take their own decision so that they provide better scalability and availability. This proposed SALB addressed the load prediction algorithm, efficient load collection mechanism, effective distributed decision maker, migration selection model and dynamic file

migration algorithm for a better load balancing. The disadvantage is degradation of the whole system due to the migration side effect.

**2.4 Heat Diffusion Based Dynamic Load Balancing:** Yunhua et al.[4] proposed an efficient cell selection scheme and two heat diffusion based algorithm called global and local diffusion. Considered the distributed virtual environments there were various number of users and the load accessing by the concurrent users can cause problem. This can be avoided by this algorithm. According to the heat diffusion algorithm, the virtual environment is divided in to large number of square cells and each square cells having objects. The working of the heat diffusion algorithm is in such a way that every nodes in the cell sends load to its neighbouring nodes in every iteration and the transfer was the difference between the current node to that of neighbouring node. So it was related to heat diffusion process. That is the transfer of heat from high to low object, when they were placed adjacently

In local diffusion algorithm, there were local decision making and efficient cell selection schemes are used. Here they simply compared the neighbouring node loads to the adjacent node loads. If load is small then the transfer of load becomes possible. When global diffusion algorithm considered, it has two stages that is global scheduling stage and local load migration stage. From various experimental results the global diffusion algorithm becomes the better one. Advantages are communication overhead is less, high speed and require little amount of calculations. Disadvantages are network delay is high and several iterations are taken so there was a waste of time.

**2.5 Decentralized Scale-Free Network Construction and Load Balancing in Massive Multiuser Virtual Environments:** Markus et al.[5] addressed the concept of overlay networks for the interconnection of machines that makes the backbone of an online environment. Virtual online world that makes the opportunities to the world for better technological advancements and developments. So the proposed network that makes better feasibility and load balancing to the dynamic virtual environments. This proposed system developed Hyper verse architecture, that can be responsible for the proper hosting of the virtual world. There were self organized load balancing method by which the world surface is subdivided in to small cells, and it is managed by a public server. In this cells various hotspots so that the absolute mass of the object in the cell can be calculated by the public server. Hotspot accuracy is better when increasing the network load. The proposed algorithm cannot avoid the overloaded nodes but find out the number of links that assigned to each node while joining the network. The advantages are the network becomes reliable, the network becomes resilience, efficient routing, and fault tolerant. The disadvantage is the overload ratio at the beginning is higher so that public



servers are initially placed randomly so some time is used for balancing the load.

**2.6 Load Balancing in Dynamic Structured P2P Systems:** Brighten et al. [6] proposed an algorithm for load balancing in dynamic peer-to-peer system and other hybrid environments. In most peer-to-peer system the non uniform of objects in the space and also the load of the node can be changed continuously due to the insertion, deletion and other various operations. This will leads to decrease the performance of the system. So the concept of virtual server can be introduced. In this proposed load balancing algorithm, the load information of the peer nodes are stored in different directories. These directories

help to schedule reassignment of the virtual servers to develop a better balance. Greedy heuristic algorithm used to find out a better solution for the proper utilization of the nodes. The huge number of virtual servers in the system helps to increase the utilization. The various load information in to the corresponding pool and then the virtual server assignments are to be done. This proposed algorithm should be applied to different types of resources like storage, bandwidth etc, It was designed to handle the various situations like varying load of the node, node capacity, entering and leaving of nodes and also insertion and deletion of the nodes. Advantages are high node utilization and increasing scalability. Disadvantage is the reassignment of the virtual server is difficult.

TABLE I  
 COMPARISON TABLE OF LOAD BALANCING TECHNIQUES

Load Balancing Methods	Parameters	Merits	Demerits
Fast Adaptive Load Balancing Method [1]	Efficiency Communication Cost	Faster Balancing Speed High Efficiency Low Communication Overhead	Cannot Maintain the Topology of Cells
Honey Bee Inspired Load Balancing Method [2]	Makespan Task Migration Execution Time	Maximizing the Throughput Waiting Time of Task is Minimum Low Overhead	Low Priority Load Become Stay Continuously on the Queue
Dynamic and Adaptive Load Balancing for Parallel File System [3]	Throughput Response Time	High Scalability Reduce the Decision Delay Better Resource Utilization	Degradation of the Whole System due to Migration Effect
Heat Diffusion Based Dynamic Load Balancing Method [4]	Number of Migrated Users Number of Overload Servers	Require Very Little Amount of Calculation High Speed	Wastage of Time Network Delay is High
Load Balancing in Massive Multiuser Virtual Environment [5]	Clustering Coefficient Number of Links Shortest Path Length	Network Becomes Reliable Efficient Routing Fault Tolerant Network Becomes Resilience	More Time is Used for Balancing the Load.
Load Balancing in Dynamic Structured P2P Systems [6]	Node Utilization Load Movement Factor	Increasing Scalability High Node Utilization	Assignment of Virtual Server is Difficult

### III. CONCLUSION

The load balancing of the current system is one of the greatest issues. Various techniques and algorithms are used to solve the problem. In this paper we survey various existing load balancing methods in different environments. A large number of parameters and different types of soft computing techniques can be included in the future for the better utilization and needs of the user. The various load balancing techniques are also being compared here.

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