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Comparative Analysis of Soft Computing Based Load Balancing Techniques in Cloud Environment: A Review

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Abstract— **Cloud computing is a computing paradigm for managing and delivering services over the internet. The fundamental guidelines of cloud computing model are computing, storage & programming as an administrator. But the size of computation & demand for higher computation is growing very rapidly which is causing an uneven and heavy workload on cloud resources. One of the core problems which cloud resources scheduling need to solve is the load balance. In the cloud resources scheduling process, if load changes suddenly, this may cause resources scheduling tilt. In this paper, we are presenting a review on the existing soft computing based techniques for the load balancing in cloud computing environment. Also a comparison is made for these existing techniques.**

Keywords— Cloud Computing, Load Balancing, Soft Computing,

I. INTRODUCTION

Now-a-days, three technological storms are, smart mobile devices, ubiquitous high-speed connectivity, and Cloud computing. Computer scientists are predicting that perhaps Cloud systems will be the next generation operating system. Prosaically, cloud computing has a strong foundation in virtualization governed by hypervisors, which are providing slices of resources. The developments in the hypervisors such as Xen, VitualBox, KVM, VMWare etc. triggering the development of the Commercial and Open source Cloud environments. The Clouds can definitely playing its role in "Hosting" part of the computations, and can be best on federation with Grids. When we plug an electric lamp into outlet socket, we do not think about how electric power is generated and how it is get through outlet socket because of that electricity is virtualized, it is readily available on wall socket that hides power generation stations and huge distribution grid [1].

Cloud computing is a new style of computing that provide flexibility of resources and services offered. Many practitioners, researchers defined cloud computing and their characteristics, **Buyya et. al (2009)** defined **—** Cloud is a parallel and distributed computing system consists of a collections of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service level agreement established through negotiation between the service provider and consumers [2].

University of California Berkeley, **Armbrust et. al (2009)** summarized characteristics of cloud computing **—**(1) illusion of infinite computing resources (2) the elimination of an up-front commitment by cloud users; and (3) the ability to pay for use as needed [3].

Common characteristics of cloud computing is defined (i) pay-as-per-use (ii) pay-as-per-go (iii) elastic capacity and illusion of infinite services (iv) self service interface (v) resources are virtualized. In addition of that cloud computing providers usually offer a wide range of software services, also include API and developments tools for an example VirtualBox with Java API provide to developers for creation cloud environment such as private cloud. In recent years several technologies have grown and radically donate to make cloud computing practicable.

Even though cloud computing is the most discussed topic and facilitates the user in performing majority of the task, still there are some bottlenecks which retards the proliferation of cloud computing. Heavy Load on cloud is one of these bigger retardation and load balancing becomes the biggest issue for the cloud computing. For efficient load balancing there must be some parameters to evaluate the load balancing techniques to get better resource distribution for the user demands. Measurement parameters allow us to see whether the given technique is good enough to balance the load of the traffic on the server or not. These parameters include throughput, fault tolerance, response time, performance, scalability and resource utilization.

Size of computation and demand for higher computation is growing very rapidly which is causing an uneven and heavy workload on cloud resources. Load balancing helps to distribute all loads among all the nodes [4]. This guarantees that each and every processing unit is dispersed well. Basically this technique helps in prevention of bottlenecks of the overall system which occurs due to load disparity [5].

In this paper we are presenting a comparative review on the existing soft computing based technique to balance the load

cloud server by proper allocation of resources. This section presents the brief introduction of the concept. Rest of the paper is organized as below.

Section II presents the Cloud Computing Model. Section III explains the concept of load balancing. Section IV gives the comparative review of soft computing based load balancing concepts. Section V concludes he paper.

II. Basic Roots of Cloud Computing

We can find the basic roots of cloud computing by monitoring the different technologies specially in hardware (virtulization, multicore chips), Internet technologies (Web services, service oriented architecture, web 2.0), distributed computing (cluster, grids) and system management (automatic computing, data center automation) as shown in Figure 1, as we discuss one by one technology.

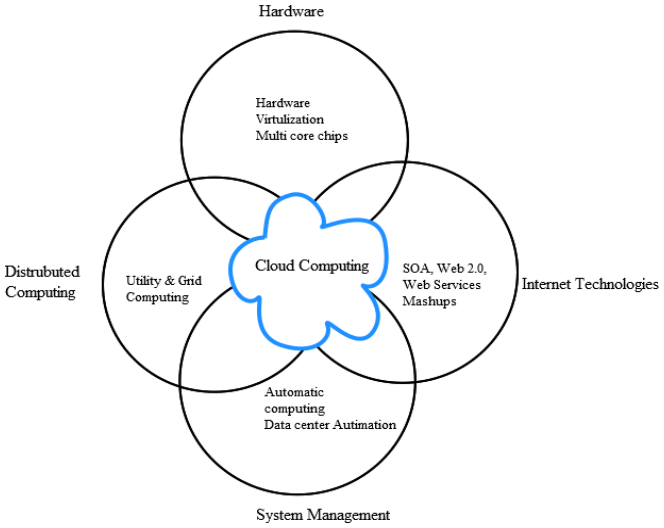

Figure 1: Basic Roots of Cloud Computing

III. Load Balancing

Load balancing is a process of reassigning the total load to the individual nodes of the collective system to improve both resource utilization and job response time. It also avoids a situation where some of the nodes are heavily loaded while other nodes are idle or doing very little work. Load balancing ensures that all nodes in the system approximately equal amount of work at any instance of time [6]**.** The objective of load balance is to achieve optimal resource utilization, maximize throughput, minimum response time, and avoid overload. The heterogeneous environment considered as a major concern [7] because the heterogeneous environment consist of heterogeneous resource, so the behavior of heterogeneous cloud different and has different attributes and different response times for any process.

Although load balancing in cloud computing is based on standard load balancing, it differs from classical load-balancing such as in parallel computing. In cloud computing the architecture and implementation of the load balancing process is different according to the use of commodity servers to perform the load balancing, which provides for new opportunities and economies of scale. Figure 1.8 presents load balancing in cloud computing.

As seen in Figure 2, the data center required a load balancing policy to process the users requests. The load balancer responsible to assigns the virtual machine to the user request. Then the data center sends the response to the users after processing the Request.

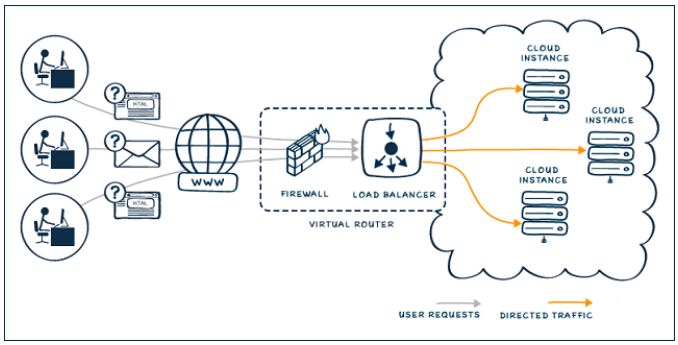

Figure 2: Load balancing in Cloud Computing

The load balancing is very important in cloud computing environment. The major goals of load balancing algorithms are:

- Achieve an overall improvement in system performance at a reasonable cost.
- To have a backup plan in case the system fails even partially.
- To accommodate future modification in the system: the distributed system can change such as applying new topology and scale up. So a load balancing algorithm must be scalable and flexible to handle these changes.

IV. Soft Computing Based Techniques to Balance the Load of Cloud Server

Wen et al. (2015) has proposed VM migration strategy based on Ant Colony Optimization for cloud computing load balancing. In this approach, local migration ants monitor the resource utilization and adapt two different traversing strategies to find the near optimal mapping between the virtual machines and physical machines. For the experimental evaluation of the load balancing, author has used the CloudSim toolkit package and shows the outperform migration results for the proposed ACO-VMM [8].

Kumar et al. (2015) has proposed a novel approach of genetic algorithm for task scheduling to minimize the energy consumption in cloud computing. Authors have compared the performance of proposed genetic approach with Random and Round Robin approach. The genetic algorithm is used the assigned the jobs to the VMs by minimizing the makespan. A number of experiments were conducted to examine the performance of genetic algorithms. This paper presents experimental results for Poisson arrived 2500 tasks were scheduled using the Genetic Algorithm, Random, and RR. The outcomes of the proposed concept shows better results as compare to other considered Random and Round Robin Approach [9].

Issawi et al. (2015) has proposed burstness-aware load balancing algorithms in cloud environment. Here, Round-Robin approach is considered in burst state, Random in non-burst state and Fuzzy logic to assign the received request to a balanced Virtual machine. Cloud Analyst is used for the

simulation of the results. Cloud Analyst is a graphical simulation tool based on Cloudsim for modeling and analyzing the behavior of a cloud computing environment, which supports visual modeling and simulation of large-scale applications that are deployed on Cloud Infrastructures. The experimental results shows the improved performance and decreased response & processing time as compare the other adaptive algorithms [10].

Singhal and Jain (2014) have proposed a load balancing algorithm using Fuzzy Logic, the algorithm focuses on a public cloud. The main idea of the algorithm is partitioning the cloud to several partitions and each partition having its own load balancer, and there is a main controller which manages all these partitions. With the idle partition status they use a fuzzy logic and in the normal partition status they use a global swarm optimization based load balancing strategy. The result shows enhancements in resource utilization and availability in cloud computing environment. The drawback of this approach is the difficulty of testing the technique in a real environment to make sure that it has achieved good results. Recently, we can find other research works done on load balancing in cloud computing using randomization such as ant colony optimization [11].

Dave and Maheta (2014) have proposed a new load balancing algorithm based on round robin algorithm, they made a modification on round robin algorithm by implementing a dynamic time Quantum based on algorithm execution round. The result shows an improvement in response time as compared to normal round robin algorithm. The drawback of this paper is that authors had focused only on how to decrease the response time and they ignored talking about processing cost. In addition, they need to compares their results with other algorithms such as ESCE and Throttled in order to evaluate the results [12].

Mesbahi et al. (2014) has proposed a new cloud light weight model to balance the cloud load. In this algorithm, CloudSim cloud system simulator is used for the validation of algorithm. This algorithm balances the system load among all processing nodes in a cloud datacenter. Using this algorithm in our simulation, we balanced the cloud so that all its nodes have approximately the same weight in terms of distributing system workload. The main advantage of using algorithm is that it not only balances the cloud load but also gives assurance for the Quality of Services (QoS) for end users. It also reduces the migration time during execution and number of VM (Virtual machine) migration processes [13].

Babu et al. (2013) described how to balance the load in a particular task using Honey bee behavior by proposing his new algorithm i.e. honey bee behavior inspired load balancing. The proposed technique attains fair load balance over virtual machines so that a maximum throughput is achieved. The proposed technique also deals with the priorities of tasks on machines and balanced those tasks in such a manner that waiting time of tasks is minimized. Here different scheduling algorithms are used to obtain the best performance. Using optimization algorithm response time will be better [14].

A comparison of all these algorithms of cloud computing load balancing is defined in table 1.

V. CONCLUSIONS

Load balancing is one such important issue which affects the utilization of resources and performance of the cloud system. So a lot of research work has been done to efficiently balance overall workload over available resources.

In this paper, we have compared the soft computing based load balancing techniques for the cloud server tasks. The considered algorithms for comparison are Ant Colony Optimization, Genetic Algorithm, Burstness-Aware Load Balancing Algorithm, Fuzzy Logic, Round Robin Algorithm, Cloud Light Weight Model and Honey Bee Optimization based algorithm as shown in table 1 given below. In this table, soft computing algorithms are compared with objectives & advantages in the field of cloud computing.

But the scheduling of task and balancing of load is still not much at a stage that we can say that it is efficiently balanced. So, there is the need of some more efficient algorithms that can give the optimized results.

Table I

Comparison of Soft Computing Techniques in Cloud Computing Load Balancing

Soft Computing Techniques	Authors & Year	Key Points
Ant Colony Optimization [8]	**Wen et al. (2015)**	1. In this approach, local migration ants monitor the resource utilization and adapt two different traversing strategies to find the near optimal mapping between the virtual machines and physical machines. 2. CloudSim is used for the Simulation basis.
Genetic Algorithm [9]	**Kumar et al. (2015)**	1. The genetic algorithm is used the assigned the jobs to the VMs by minimizing the makespan. 2. This paper presents experimental results for Poisson arrived 2500 tasks were scheduled using the Genetic Algorithm,

		Random, and RR..
Burstness-Aware Load Balancing Algorithm [10]	**Issawi et al. (2015)**	1. Here, Round-Robin approach is considered in burst state, Random in non-burst state and Fuzzy logic to assign the received request to a balanced Virtual machine. 2. Cloud Analyst is used for the simulation of the results.
Fuzzy Logic [11]	**Singhal and Jain (2014)**	1. With the idle partition status they use a fuzzy logic and in the normal partition status they use a global swarm optimization based load balancing strategy. 2. The result shows enhancements in resource utilization and availability in cloud computing environment. 3. The drawback of this approach is the difficulty of testing the technique in a real environment to make sure that it has achieved good results.
Round Robin algorithm [12]	**Dave and Maheta (2014)**	1. Authors made a modification on round robin algorithm by implementing a dynamic time Quantum based on algorithm execution round. 2. The drawback of this paper is that authors had focused only on how to decrease the response time and they ignored talking about processing cost.
Cloud Light Weight Model [13]	**Mesbahi et al. (2014)**	1. The main advantage of using algorithm is that it not only balances the cloud load but also gives assurance for the Quality of Services (QoS) for end users. 2. It also reduces the migration time during execution and number of VM (Virtual machine) migration processes.
Honey Bee Optimization [14]	**Babu et al. (2013)**	1. The proposed technique attains fair load balance over virtual machines so that a maximum throughput is achieved. 2. The proposed technique also deals with the priorities of tasks on machines and balanced those tasks in such a manner that waiting time of tasks is minimized.

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