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Managing Load Balancing In Cloud Computing

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Abstract: ***Cloud computing is latest emerging technology for large scale distributed computing and parallel computing. Cloud computing gives large pool of shared resources, software packages, information, storage and many different applications as per user demands at any instance of time. Cloud computing is emerging quickly; a large number of users are attracted towards cloud services for more satisfaction. Balancing the load has become more interesting research area in this field. Better load balancing algorithm in cloud system increases the performance and resources utilization by dynamically distributing work load among various nodes in the system. This paper presents cloud computing, cloud computing architecture, virtualization, load balancing, challenges and various currently available load balancing algorithms.***

Index Terms: Cloud Computing, Load Balancing, Existing load balancing algorithms, parallel computing

I. INTRODUCTION

A cloud introduces an IT environment which is invented for the motive of remotely provisioning measured and scalable resources [1]. Word "Cloud" in cloud computing is also known as "Internet". So cloud computing is called as internet based computing in which many different services such as server, storage, virtualization and various application are given to the users and organization over the internet[2]. Cloud computing uses the term "pay-per-usage" instead of traditional computing in which "own and use" technique is used. There are several issues in cloud computing paradigm but balancing the load is major issue (challenge) in cloud computing environment. Load balancing is a methodology which provides methods to maximize throughput, utilization of resources and performance of system [3]. As a part of its services, it gives easy and flexible process to keep data or files and make them available for large scale of users [4]. To make the use of resources most efficiently in cloud system, there are several load balancing algorithms.

Cloud computing consist of several characteristics*:*

- ✓ On demand service- Cloud computing provide services to users on their demand.
- ✓ Users can access the services as they want.
- ✓ Broad Network Access- In cloud computing capabilities are available over the network.
- ✓ All the capabilities are accessed through different mechanisms.
- ✓ Resource Pooling- Different models are used to pooled the resources which provide by the providers
- ✓ to their consumers. All the resources dynamically assigned and reassigned according to consumer demand requirements.
- ✓ Measured Service- In cloud computing resource usage can be monitored, controlled for both the provider and consumer of the all service.
- ✓ Rapid Elasticity- Quantity of resources is increase at any time according to the customer's

A. BENEFITS OF CLOUD COMPUTING

The potential for cost saving is the major reason of cloud services adoption by many organizations. Cloud computing gives the freedom to use services as per the requirement and pay only for what you use. Due to cloud computing it has become possible to run IT operations as a outsourced unit without much in-house resources.

Following are the benefits of cloud computing:

- ✓ Lower IT infrastructure and computer costs for users

- ✓ Improved performance
- ✓ Fewer Maintenance issues
- ✓ Instant software updates
- ✓ Improved compatibility between Operating systems
- ✓ Backup and recovery
- ✓ Performance and Scalability
- ✓ Increased storage capacity
- ✓ Increase data safety

B. SERVICES OF CLOUDCLOUD COMPUTING PROVIDE MANY SERVICES TO THE END USERS

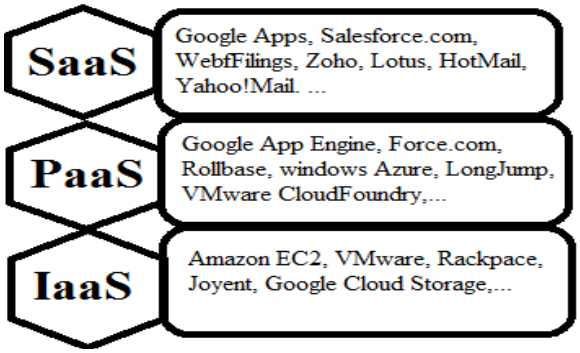

Figure 1: Cloud Service Models

a. SOFTWARE AS A SERVICE

This service model is a software conveyance model in which every single applications are gotten to through web browser. In this SaaS model the users are not concerned with the cloud structure. aaS or software as a service is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network (internet). SaaS is becoming an increasingly prevalent delivery model as underlying technologies that supports Service Oriented Architecture (SOA) or Web Services. Through internet this service is available to users anywhere in the world. aditionaly, software application needed to be purchased upfront &then installed it onto your computer. SaaS users on the other hand, instead of purchasing the software subscribes to it, usually on monthly basis via internet.

Anyone who needs an access to a particular piece of software can be subscribe as a user, whether it is one or two people or every thousands of employees in a corporation. SaaS is compatible with all internet enabled devices. Many important tasks like accounting, sales, invoicing and planning all can be performed using SaaS.

b. PAAS (PLATFORM AS A SERVICE)

Platform as a service, is referred as PaaS, it provides a platform and environment to allow developers to build applications and services. This service is hosted in the cloud and accessed by the users via internet. Example of PaaS is Aneka and Google App Engine.

c. IAAS(INFRASTRUCTURE AS A SERVICE)

It is a complete package for computing. For small scale businesses who are looking for cutting cost on IT infrastructure, IaaS is one of the solutions. Annually a lot of money is spent in maintenance and buying new components like hard-drives, network connections, external storage device etc. which a business owner could have saved for other expenses by using IaaS. This service model provides Infrastructure of servers and different software to the customer on their demand. By using this users now not have to buy any specified hardware and software. Cloud users directly use of IT infrastructure (storage, networks, processing and other computing resources). IaaS provide services like Amazons EC2.

C. VIRTUALIZATION

Cloud computing uses virtualization for provisioning services to the client. On virtualization many running systems can be keep running on the single computer so resource utilization is increased. The hardware resources are combined for enhanced the productivity of server. Computer architecture is uses software for the proper resource utilization called Hypervisor. It is too named the VMM (Virtual Machine Monitor) for running the more than one operating systems on the single host. There are two types of virtualization.[5]

- ✓ Full Virtualization: In Full Virtualization, the entire installation of one machine is done on another machine. So all the real machine functionality may too be available in virtual machine.
- ✓ Para Virtualization: In Para Virtualization, on a solitary desktop different operating systems can be run. Here entire functionalities are not fully available; services are delivered in a partial manner

D. LOAD BALANCING

Load balancing is the process of improving the performance of the system by shifting of workload among the processors. Workload of a machine means the total processing time it requires to execute all the tasks assigned to the machine. Balancing the load of virtual machines uniformly means that anyone of the available machine is not idle or partially loaded while others are heavily loaded. Load balancing is one of the important factors to heighten the working performance of the cloud service provider. The benefits of distributing the workload includes increased resource utilization ratio which further leads to enhancing the overall performance thereby achieving maximum client satisfaction [2].

In cloud computing, if users are increasing load will also be increased, the increase in the number of users will lead to poor performance in terms of resource usage, if the cloud provider is not configured with any good mechanism for load balancing and also the capacity of cloud servers would not be utilized properly. This will confiscate or seize the performance of heavy loaded node. If some good load balancing technique is implemented, it will equally divide the load (here term equally defines low load on heavy loaded node and more load on node with less load now) and thereby we can maximize resource utilization. One of the crucial issue of cloud computing is to divide the workload dynamically.

a. GOALS OF LOAD BALANCING

- ✓ Goals of load balancing as discussed by authors of [6],[7] include:
- ✓ Substantial improvement in performance
- ✓ Stability maintenance of the system
- ✓ Increase flexibility of the system so as to adapt to the modifications.
- ✓ Build a fault tolerant system by creating backups.

b. CLASSIFICATION OF LOAD BALANCING ALGORITHM

Based on process orientation they are classified

- ✓ Sender Initiated: In this sender initiates the process; the client sends request until a receiver is assigned to him to receive his workload
- ✓ Receiver Initiated: The receiver initiates the process; the receiver sends a request to acknowledge a sender who is ready to share the workload
- ✓ Symmetric: It is a combination of both sender and receiver initiated type of load balancing algorithm.

Based on the current state of the system they are classified as:

Static Load Balancing

In the static load balancing algorithm the decision of shifting the load does not depend on the current state of the system. It requires knowledge about the applications and resources of the system. The performance of the virtual machines is determined at the time of job arrival. The master processor assigns the workload to other slave processors according to their performance. The assigned work is thus performed by the slave processors and the result is returned to the master processor.

Static load balancing algorithms are not preemptive and therefore each machine has at least one task assigned for itself. Its aims in minimizing the execution time of the task and limit communication overhead and delays. This algorithm has a drawback that the task is assigned to the processors or machines only after it is created and that task cannot be shifted during its execution to any other machine for balancing the load. The four different types of Static load balancing techniques are Round Robin algorithm, Central Manager algorithm, Threshold algorithm and randomized algorithm.

Dynamic Load Balancing

In this type of load balancing algorithms the current state of the system is used to make any decision for load balancing, thus the shifting of the load is depend on the current state of the system. It allows for processes to move from an over utilized machine to an under utilized machine dynamically for faster execution.

This means that it allows for process preemption which is not supported in Static load balancing approach. An important advantage of this approach is that its decision for balancing the load is based on the current state of the system which helps in improving the overall performance of the system by migrating the load dynamically.

Traditional Computing V/S Cloud Computing Environment

There are many similarities as well as differences between traditional scheduling algorithms and the scheduling of VM resources in cloud computing environment.

First of all the major difference between cloud computing environment and traditional computing environment is the target of scheduling. In traditional computing environment, it mainly schedules process or task so the granularity and the transferred data is small; whereas in cloud computing environment, the scheduling target is VM resources so the granularity is large and the transferred data is large as well. Secondly, in cloud computing environment, compared with the deployment time of VMs, the time of scheduling algorithm can almost be neglected.

Need Of Load Balancing

We can balance the load of a machine by dynamically shifting the workload local to the machine to remote nodes or machines which are less utilized. This maximizes the user satisfaction, minimizing response time, increasing resource utilization, reducing the number of job rejections and raising the performance ratio of the system.

Load balancing is also needed for achieving Green computing in clouds [5]. The factors responsible for it are:

- ✓ Limited Energy Consumption: Load balancing can reduce the amount of energy consumption by avoiding over hearting of nodes or virtual machines due to excessive workload.
- ✓ Reducing Carbon Emission: Energy consumption and carbon emission are the two sides of the same coin. Both are directly proportional to each other. Load balancing helps in reducing energy consumption which will automatically reduce carbon emission and thus achieve Green Computing.

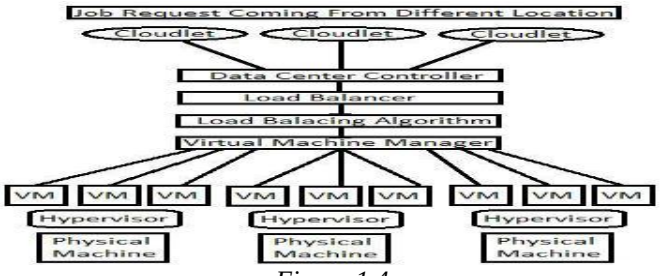

Figure 1.4

E. EXISTING ALGORITHMS OF LOAD BALANCING IN CLOUD COMPUTING

In a cloud computing atmosphere there are a lot of algorithm of load balancing which attain higher throughput, toughen the reaction time, high resource use and better efficiency [9], [10].

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a. TASK SCHEDULING FOUNDED ON LOAD BALANCING

This algorithm mainly consists two level task scheduling device which is in light of load balancing to meet element requirements of users. This algorithm obtains high resource utilization, and this algorithm attains load balancing via first mapping jobs to virtual machines after which all virtual machines towards host resources .This improving the task response time, also provide well useful resource utilization [10].

b. OPPORTUNISTIC LOAD BALANCING ALGORITHM (OLB)

This algorithm does not contemplate the existing workload of the Virtual machine (VM). It makes every node to be occupied. On this algorithm each and every unexecuted challenge can be finished in random order so that each task can be allotted to the node randomly. These processes slow manner because it will not calculate the existing operation time of the node.

c. ROUND-ROBIN LOAD BALANCER

Round-robin load balancer its' a static load balancing algorithm, on the time of allocating jobs which does now not remember the earlier load state of a node. This algorithm uses for allocating the jobs. In this algorithm it chooses the nodes randomly and after which jobs allot to all nodes in round robin manner. This algorithm will not be suitable for cloud computing because how much operating time of any process is not known prior to execution; there's a risk that nodes may earn heavily loaded. Then weighted round-robin algorithm used to be proposed to resolve this type problem. In this weighted round-robin algorithm, every node is appointed a specific weight. The weight assign to the nodes is helpful to control the network traffic [8].

d. MIN-MIN ALGORITHM

Min-Min Job Scheduling Algorithm it's a static scheduling algorithm. Min-Min algorithm begins with a suite of un-scheduling jobs. On this algorithm the jobs having minimum execution time first identifies and these jobs are scheduled first in this algorithm. Then it will calculate the expected completion time intended for each tasks according to available virtual machines then the resource that has the least completion time for selected task is scheduled on that resource. The resource ready time is updated and except the entire unexecuted tasks are scheduled the procedure is repeated. Main problem of this algorithm it's chooses small tasks to be finished firstly, which in turn long task delays for very long time. Min-Min algorithm is did not utilize resources competently which lead to a load imbalance [1], [9].

e. MAX-MIN ALGORITHM

Max-Min algorithm is close to equal as the min-min algorithm. The core difference among Min-Min and Max-Min algorithm is following: in this algorithm first finding out minimum execution times, then first the most extreme value is choose Then the performance time for all tasks is updated on that machine, this is done by adding the performance time of the assigned task to the performance times of other tasks on that machine. Then all assigned task is erased from the list that executed the system [9].

f. RANDOMIZED

This is a static algorithm in nature. In this randomized algorithm a procedure may also be care of by a specific node n with a likelihood p. This algorithm functions admirably when every single procedure are of equivalent loaded. Issue emerges at the point when burdens are of various computational complexities. This randomized algorithm is not keeping up deterministic methodology [9].

g. FIRST COME FIRST SERVE ALGORITHM

In this algorithm jobs are served in the direction wherein they arrive i.e. Jobs are queued and served in structure of FIFO. This algorithm is discreet and really quick but doesn't provide so much effectively to job and resource optimization [3].

h. SHORTEST RESPONSE TIME FIRST

In this algorithm every procedure is assigned a need which is permitted to run and equivalent need procedures are scheduled in FCFS demand. The SJF algorithm chooses the occupation with the most limited preparing time first. In this SJF algorithm shorter jobs are executed before long jobs. In this algorithm, it is significant to know or evaluation processing time of every job which is large SJF problem [9].

i. EQUALLY SPREAD CURRENT EXECUTION

This is an algorithm of dynamic load balancing, which handles the method with priority. It chooses the need by checking the scale of the system. This similarly spread present execution algorithm disseminates the load randomly by checking the extent of the system after then transferring load to a VM (Virtual Machine). On this algorithm load balancer spreads the load on to various nodes, so it's knows spread spectrum methodology [13].

j. RESOURCE AWARENESS SCHEDULING ALGORITHM

Resource Awareness Algorithm it's a blend of Min-Min and Max-Min algorithm and has no time consuming instruction. The time complexity of this algorithm is O (mn2) where n is number of jobs and m is number of resources [10]. Honeybee Foraging Behavior: It is a nature inspired Algorithm for self-organization. Honeybeeachieves global load balancing through local server actions. The performance of the system is enhanced with increased system diversity. The main problem is that throughput is not increased with an

increase in system size. When the diverse population of service types is required then this algorithm is best suited.

k. ACTIVE CLUSTERING

In this algorithm same type nodes of the system are grouped together and they work together in groups. It works like as self-aggregation load balancing technique where a network is rewired to balance the load of the system. Systems optimize using similar job assignments by connecting similar services. System Performance improved with improved resources. The throughput is improved by using all these resources effectively.

l. COMPARE AND BALANCE

This algorithm is uses to reach an equilibrium condition and manage unbalanced systems load. In this algorithm on the basis of probability (no. of virtual machine running on the current host and whole cloud system), current host randomly select a host and compare their load. If load of current host is more than the selected host, it transfers extra load to that particular node. Then each host of the system performs the same procedure. This load balancing algorithm is also designed and implemented to reduce virtual machines. migration time. Shared storage memory is used to reduce virtual machines migration time.

m. LOCK-FREE MULTIPROCESSING SOLUTION FOR LB

It proposed a lock-free multiprocessing load balancing solution that avoids the use of shared memory in contrast to other multiprocessing load balancing solutions which use shared memory and lock to maintain a user session. It is achieved by modifying kernel. This solution helps in improving the overall performance of load balancer in a multicore environment by running multiple load-balancing processes in one load balancer.

n. ANT COLONY OPTIMIZATION:

Ant algorithms is a multi-agent approach to difficult combinatorial Optimization problems. Example of this approach is travelling salesman problem (TSP) and the quadratic assignment problem (QAP). These algorithms were inspired by the observation of real ant colonies. Ant's behaviour is directed more to the survival of the colonies. They not think for individual.

F. DYNAMIC LOAD BALANCING POLICIES AND STRATEGIES

The different policies as described in [2], [3] are as follows:

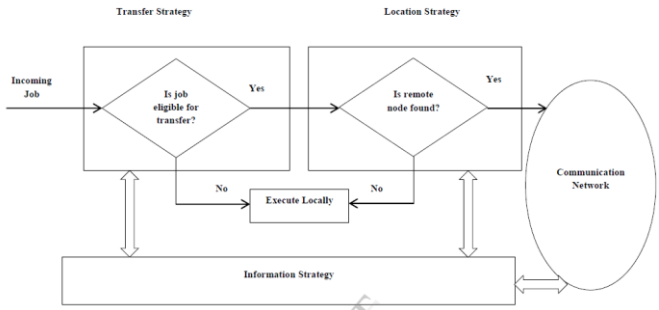

Figure 1.6: Interaction between different components of Dynamic Load Balancing Algorithm

- ✓ Location Policy: The policy used by a processor or machine for sharing the task transferred by an over loaded machine is termed as Location policy.
- ✓ Transfer Policy: The policy used for selecting a task or process from a local machine for transfer to a remote machine is termed as Transfer policy.
- ✓ Selection Policy: The policy used for identifying the processors or machines that take part in load balancing is termed as Selection Policy.
- ✓ Information Policy: The policy that is accountable for gathering all the information on which the decision of load balancing is based id referred as Information policy.
- ✓ Load estimation Policy: The policy which is used for deciding the method for approximating the total work load of a processor or machine is termed as Load estimation policy.
- ✓ Process Transfer Policy: The policy which is used for deciding the execution of a task that is it is to be done locally or remotely is termed as Process Transfer policy.
- ✓ Priority Assignment Policy: The policy that is used to assign priority for execution of both local and remote processes and tasks is termed as Priority Assignment Policy.
- ✓ Migration Limiting Policy: The policy that is used to set a limit on the maximum number of times a task can migrate from one machine to another machine

II. LITERATURE REVIEW

In this section, discussion is focused on the most preferred researches in the literature for load balancing in cloud computing. We are going to discuss these techniques year wise to evaluate the fixed parameters. This will help us to compare these techniques and conclude an optimized one

- ✓ Patel et al [1] provided a study on special mission scheduling algorithms and modification of min-min load balancing algorithm. The altered algorithm is founded on min-min process and venture rescheduling to use unutilized assets. It selects challenge with minimal completion time and assigns it to right assets for utilizing assets easily.
- ✓ Srinivas Sethi et al [2] proposed an algorithm of load balancing creation fuzzy good judgment use in a cloud computing atmosphere. This presented a new fuzzy logic centered load balancing algorithm with additional parameters- memory usage, bandwidth utilization, disk house utilization and digital computer device position and

named it as Fuzzy Active Monitoring Load Balancer (FAMLB).

- ✓ Shridhar G. Domanal and G. Ram Mohana Reddy et al. [16] have been proposed a neighborhood enhanced load balancing methodology for distributing incoming job request uniformly between the servers or digital machines. They analyzed the performance of their algorithm making utilizing the Cloud Analyst simulator.
- ✓ N. J. Kansalet al. [4] have mentioned a number of the prevailing approaches which can be geared toward reducing the related overhead, provider response time and bettering efficiency of the method. The paper additionally presents important points about quite a lot of parameters, used to estimate the prevailing approaches. Soumya Ray and A. D. Sarkar et al. [18] have mentioned particularly lots algorithms to load balancing like circular robin algorithm, imperative queuing algorithm and Randomized algorithm, their analysis is applied on MIPS vs. VM and MIPS vs. HOST groundwork. Their outcome show that these algorithms can in all likelihood reinforce the response time in order of magnitude, with admire to quantity of VMs in Datacenter. Execution judgment of the imitation indicates that the change of MIPS will have an effect on the response time. Increasing MIPS vs. VM reducing the response time. With the intention to control the random selection established load distribution main issue, the algorithm may also be carried out as the future course of labor to evaluate quite a lot of parameters.
- ✓ Ankush P. Deshmukh and Prof. KumarswamyPamu et al. [19] discussed on one-of-a-kind load balancing strategies, algorithms and approaches. The research additionally suggests that the dynamic LB is more efficient than other static LB approaches. AlexandruIosup et al. [20] Analyzed the effectively of cloud computing facilities for scientific computing workloads and evaluated the vicinity in real experimental computing workloads of Many-assignment Computing (MTC) users, that's, of customers who rent loosely coupled functions includes many tasks to gain their scientific ambitions. In addition they perform an empirical evaluation of the performance of four business cloud computing offerings.
- ✓ Seyed Mohssen Ghafari et al. proposed a load balancing algorithm for power consumption management in cloud computing and named this algorithm Bee-MMT (artificial bee colony algorithm-Minimal Migration Time) [2]. This algorithm use Artificial Bee Colony algorithm (ABC) to detect over-weighted hosts. Then it use MMT algorithm to transfer one or more virtual machines from those over weighted hosts to decrease their load. In the meantime it can detect under-weighted hosts and if possible transfer all virtual machines allocated to these hosts and then toggle them to the sleep mode.

PROPOSED WORK

The goal of the proposed work is to design an efficient scheduling algorithm that uniformly distribute workload among the available virtual machines in a data center and at the same time, decrease the overall response time and data center processing time. The proposed approach is a combination of Throttled (TVLB) and ESCE (AVLB) algorithm. TVLB algorithm makes use of states of VMs. A virtual machine state may be either AVAILABLE or BUSY. AVAILABLE state indicates that the virtual machine is idle/free and ready for cloudlet allotment, where BUSY state indicates that the current virtual machine is busy in execution of previous cloudlets and is not available to handle any new cloudlet request. This current load state of a VM helps in taking decision whether to allocate cloudlets to virtual machines or not. Active VM Load Balancing algorithms continuously monitor the job queue for new cloudlets and allot them to the bunch of idle/free VMs. It also maintains the list of cloudlets allocated to each virtual machine. This allocated cloudlet list helps in determining whether a VM is overloaded or under loaded at particular moment of time. On the basis of this information, VM load Balancer moves some load from overloaded VMs to the VM having minimum number of cloudlets, so as to maintain a high degree of balance among virtual machines. Knowledge of VM States and allocated cloudlets are the two main features of Throttled and Active VM Load Balancer Scheduling algorithms respectively. These features combined together, make the proposed scheduling algorithm more efficient & effective and help in fair distribution of the load. Hybrid VM Load Balancing Algorithm Input- Userbases/Cloudlets UB1, UB2,... UBn. - Available VMs VM1, VM2, VM3,…,VMn within data center. Step1: Hybrid VM Load Balancer maintains a list of VMs, their states (AVAILABLE/BUSY) and allocated cloudlets list. Initially state of every VM is AVAILABLE and allocated cloudlet list is empty. Step 2: Data Center Controller gets cloudlet requests from cloud clients. Step 3: Data Center Controller asks the Hybrid VM load Balancer for available VM. Step 4: Hybrid VM load Balancer do a) Find the next available VM using VM State List. b) Check if present allocation count is less than maximum VM list length and length of virtual machine list is greater than zero, then allocate the VM. c) Determine the current cloudlet load on every VM. d) Return vmId of those VM which have minimum load. Step 5: Hybrid VM Load Balancer allocates the cloudlet over available VM. Step 6: If a VM get overloaded then hybrid VM Load balancer moves some workload on VM that have minimum workload Step 7: The DCC get the reply of sent cloudlet & then allots a waiting request from job pool to hybrid VM Load Balancer. Step 8: continue with step 4. Output- Userbases/cloulets are allocated on the available VMs and completed with minimum response time and processing time at DC.

EXPERIMENTAL SETUP

In this study, the proposed VM Load Balancing algorithm is implemented using the following softwares and tools: windows7 operating system, NetBeans IDE 8.1, JDK 1.8 and cloud analyst tool. This algorithm is implemented for IaaS (Infrastructures as a Service) model in a simulated cloud environment. Cloud Analyst Cloud Analyst is an extension to cloudsim oriented simulator used for modeling and simulation of real cloud environment [10]. Some key elements of Cloud Analyst simulator are as follow: Region: World is split into six regions in Cloud Analyst, that symbolize the six continents

(Asia, Australia, Africa, North America, South America and Europe). User base and datacenter which are very essential components of cloud analyst, resides in these regions. UserBase: A group of users are modeled using this component which is taken as a single unit. Traffic generation is the major responsibility of this component.

Simulation Parameters In addition to existing load balancing policies such as round robin, throttled and ESCE, a new policy named as Least Response Time VM Load Balancing is added to cloud analyst tool as shown in figure 1. For algorithm simulation, six user bases named as UB1, UB2, UB3, UB4, UB5, UB6 and four data centers named as D1, D2, D3, D4 are created. Data centers D1, D2, D3 and D4 are created in region R0, R4, R2 and R3 respectively. User Bases UB1, UB2, UB3, UB4, UB5 and UB6 are created in R0, R1, R2, R3, R4 and R5 regions respectively as shown in figure 2. User base configurations such as their regions, requests per user per hr, data size of each request, average peak users and so on, are shown in figure 3. Each data center is constructed with 15 physical machines, each have following configuration: 8086 architecture, linux operating system, Xen virtual machine manager, 204800 RAM (MB), 100TB storage space, 1000000 available bandwidth, 4 processors, 1000 MIPS, TIME_SHARED VM scheduling policy as shown in figure 4 & 5. Each physical machine is consolidated with 10 virtual machines as shown in figure 6. Each virtual machine is configured as follow: 1000 MB Image size, 512 MB memory, 1000 MB bandwidth.

III. CONCLUSION

The load balancing of the system is one of the greatest concern which should be worked and improved upon. Various techniques and algorithms are used to solve the problem. In this paper we survey various existing load balancing methods in different environments and have also mentioned their advantages, disadvantages and many other details which can be used by the researcher to develop more precise and efficient algorithms. 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 which can be used for more improvements and research in future.

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