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A COMPARABLE STUDY OF DIFFERENT LOAD BALANCING ALGORITHM IN CLOUD COMPUTING

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ABSTRACT

In recent years cloud computing emerge as a new model as a new model for Constructing, manipulating and accessing very big scale distributed computing application over the Internet. Cloud Computing provides on-demand access to distributed resources on paid basis. Everyone wants to use these utility to reduce the cost of maintenance and infrastructure therefore the load on cloud is increasing day by day. Load balancing is necessary for competent operation in distributed computing environment. Since cloud computing is growing quickly and client require needs further services and improving the results, cloud load balancing to be a very interesting and essentials research area. The load should be distributed equally among all the nodes. Proper load balancing can reduce the energy consumption and carbon emission. There are many algorithm for load balancing in cloud computing. All these algorithms work in different techniques and some advantages and disadvantages. The most important for load balancing algorithm in cloud computing is to consider the measurement parameters throughput, response time, fault tolerance, scalability, performance, resource utilization. This paper mainly focuses on various algorithm proposed to determine the load balancing and different measurement parameters in cloud computing Environment.

KEYWORDS: Load Balancing, Cloud Computing, Static Algorithm, Dynamic Algorithm, Honey- Bee Algorithm

1. INTRODUCTION

The term “cloud”, as used in this white paper, appears to have its origins in network diagrams that represented the internet, or various parts of it, as schematic clouds. “Cloud computing” was coined for what happens when applications and services are moved into the internet “cloud.” Cloud computing is not something that suddenly appeared overnight; in some form, it may trace back to a time when computer systems remotely time-shared computing resources and applications. More currently though, cloud computing refers to the many different types of services and applications being delivered in the internet cloud, and the fact that, in many cases, the devices used to access these services and applications do not require any special applications.

Cloud computing is one of the best technology in the decade. Several companies are seeking to implement and establish clouds, because of its easy and flexible design. These end result in the growing number of users getting cloud. Even though clouds are divided in public private and hybrid models but still reliability issue may arise in these clouds. Cloud models utilize virtualization technology; this technology facilitate in slicing a single DC (Data centre) or high power server to perform as several machines.

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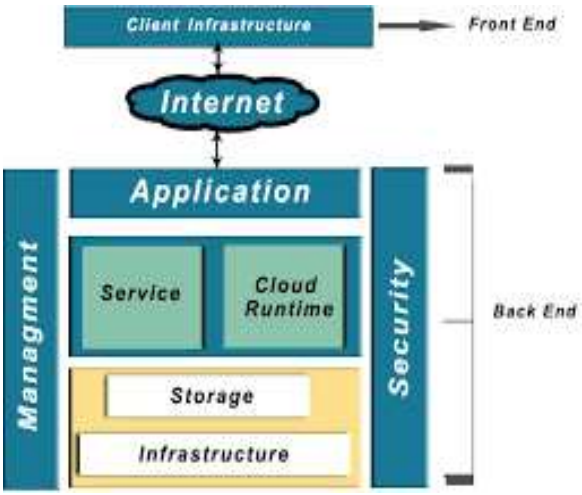

Figure 1 :Cloud Computing Architecture

A cloud deployment model represents a specific type of cloud environment, primarily distinguished by ownership, size, and access.
There are four common cloud deployment models:

- Public Clouds
- Community Clouds
- Private Clouds
- Hybrid Clouds

Cloud Computing Services: - There are three types of Cloud Computing Services.

- **Infrastructure as a service (IaaS)**The most basic category of cloud computing services. With IaaS, we rent IT infrastructure—servers and virtual machines (VMs), storage, networks, operating systems—from a cloud provider on a pay-as-you-go basis.
- **Platform as a service (PaaS)** Platform as a service refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.
- **Software as a service (SaaS)** Software as a service is a method for delivering software applications over the Internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and security patching. Users connect to the application over the Internet, usually with a web browser on their phone, tablet or PC.

2. VIRTUALIZATION

Virtualization is the creation of virtual servers, infrastructures, devices and computing resources. A great example of how it works in your daily life is the separation of your hard drive into different parts. While you may have only one hard drive, your system sees it as two, three or more different and separate segments. Similarly, this technology has been used for a long time. It started as the ability to run multiple operating systems on one hardware set and now it a vital part of testing and cloud-based computing.

Virtualization changes the hardware-software relations and is one of the foundational elements of cloud computing technology that helps utilize cloud computing capabilities to the full. Unlike virtualization, cloud computing refers to the service that results from that change.

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It describes the delivery of shared computing resources, SaaS and on-demand services through the Internet. Most of the confusion occurs because virtualization and cloud computing work together to provide different types of services, as is the case with private clouds.

The cloud often includes virtualization products as a part of their service package. The difference is that a true cloud provides the self-service feature, elasticity, automated management, scalability and pay-as-you-go service that is not inherent to the technology.

A technology called the Virtual Machine Monitor — also called virtual manager– encapsulates the very basics of virtualization in cloud computing. It is used to separate the physical hardware from its emulated parts. This often includes the CPU's memory, I/O and network traffic. A secondary operating system that is usually interacting with the hardware is now a software emulation of that hardware, and often the guest operating system has no idea it's on the virtualized hardware. Despite the fact that performance of the virtual system is not equal to the functioning of the "true hardware" operating system, the technology still works because most secondary OSs and applications don't need the full use of the underlying hardware. This allows for greater flexibility, control and isolation by removing the dependency on a given hardware platform.

Types of virtualization in Cloud Computing

- **Network virtualization** Network virtualization in cloud computing is a method of combining the available resources in a network by splitting up the available bandwidth into different channels, each being separate and distinguished. They can be either assigned to a particular server or device or stay unassigned completely — all in real time. The idea is that the technology disguises the true complexity of the network by separating it into parts that are easy to manage, much like your segmented hard drive makes it easier for you to manage files.
- **Storage virtualization** Using this technique gives the user an ability to pool the hardware storage space from several interconnected storage devices into a simulated single storage device that is managed from one single command console. This storage technique is often used in storage area networks. Storage manipulation in the cloud is mostly used for backup, archiving, and recovering of data by hiding the real and physical complex storage architecture. Administrators can implement it with software applications or by employing hardware and software hybrid appliances.
- **Server virtualization** This technique is the masking of server resources. It simulates physical servers by changing their identity, numbers, processors and operating systems. This spares the user from continuously managing complex server resources. It also makes a lot of resources available for sharing and utilizing, while maintaining the capacity to expand them when needed.
- **Data virtualization** This kind of cloud computing virtualization technique is abstracting the technical details usually used in data management, such as location, performance or format, in favor of broader access and more resiliency that are directly related to business needs.
- **Desktop virtualization** As compared to other types of virtualization in cloud computing, this model enables you to emulate a workstation load, rather than a server. This allows the user to access the desktop remotely. Since the workstation is essentially running in a data center server, access to it can be both more secure and portable.
- **Application virtualization** Software virtualization in cloud computing abstracts the application layer, separating it from the operating system. This way the application can run in an encapsulated form without being dependent upon the operating system underneath. In addition to providing a level of isolation, an application created for one OS can run on a completely different operating system.

3. LOAD BALANCING

Cloud Load balancing is the process of distributing workloads and computing resources across one or more servers. This kind of distribution ensures maximum throughput in minimum response time. The workload is

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segregated among two or more servers, hard drives, network interfaces or other computing resources, enabling better resource utilization and system response time. Thus, for a high traffic website, effective use of cloud load balancing can ensure business continuity. The common objectives of using load balancers are:

- To maintain system firmness.
- To improve system performance.
- To protect against system failures.

3.1 How does Load balancing work

Here, load refers to not only the website traffic but also includes CPU load, network load and memory capacity of each server. A load balancing technique makes sure that each system in the network has same amount of work at any instant of time. This means neither any of them is excessively over-loaded, nor under-utilized.

The load balancer distributes data depending upon how busy each server or node is. In the absence of a load balancer, the client must wait while his process gets processed, which might be too tiring and demotivating for him.

Various information like jobs waiting in queue, CPU processing rate, job arrival rate etc. are exchanged between the processors during the load balancing process. Failure in the right application of load balancers can lead to serious consequences, data getting lost being one of them.

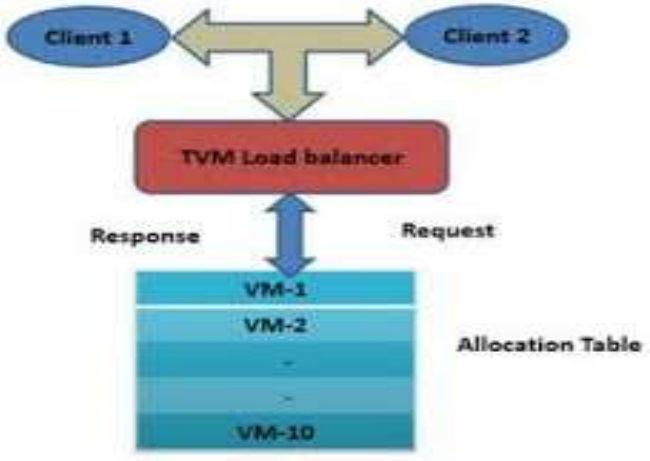

Figure2: Load Balancing

3.2 Advantages of Cloud Load Balancing

- **High Performing applications**
- **Increased scalability**
- **Ability to handle sudden traffic spikes**
- **Business continuity with complete flexibility**

Load Balancing Measurement Parameter

- **Throughput:** Throughput is a measure of how many units of information a system can process in a given amount of time.
- **Response time:** The amount of time between a single interactive user request and receipt of the response.
- **Fault tolerance:** it simply means the ability of your infrastructure to continue providing service to underlying applications even after the failure of one or more component pieces in any layer.
- **Scalability:** It is the ability of a computer application or product (hardware or software) to continue to function well when it (or its context) is changed in size or volume in order to meet a user need.

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- **Performance: Cloud computing** makes **computer** system resources, especially storage and **computing** power, available on demand without direct active management by the user.
- **Resource allocation :** New generation technology that allows the users to share **resources** over any communication network by using virtualization technique

4. STATIC LOAD BALANCING ALGORITHM

In this approach load balancing is achieved by providing priori information about the system. The performance of the node is determined at the commencement of execution. Nodes calculate their allotted work and submit the result to remote node. Then depending on the performance work load is distributed in start without considering the current load. Static load balancing methods are non-preemptive i.e. once the load is allocated to the node it cannot be transferred to another node. This method requires less communication hence reduces the execution time. The main drawback of this approach is that it does not take current state of the system while making allocation decisions. This has the major impact on the overall performance of the system due to load fluctuation in distributed system.

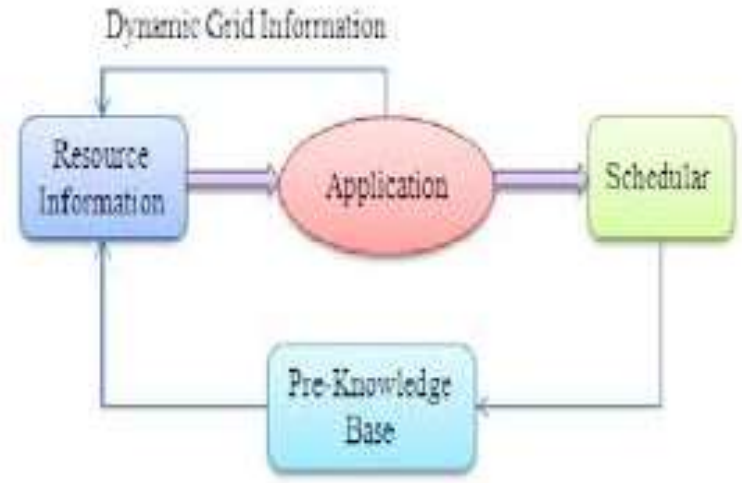

Figure: - Static load Balancing

Static Load Balancing (min_sup, D)
A= {parent Class A_i = [x_i]};
Sort-on-weight (A);
For all A_i ε A do //Create work Queue
P_j= Process–with-Min-weight ();
QP_j= QP_j U A_i
For all Processors P_j
For All Classes A_i ε QP_j do Enumerate-frequent-Sequence(A_i);

Static load Balancing Algorithm are

- Round Robin
- OLB (opportunistic Load balancing)
- Map reduce
- Min-Min
- Max- Min

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5. DYNAMIC LOAD BALANCING ALGORITHM

These algorithms monitor changes on the system work load and redistribute the work accordingly. This algorithm usually composed of three strategies: transfer strategy, location strategy and information strategy. Transfer strategy decides on which tasks are eligible for transfer to other nodes for processing. Location strategy nominates a remote node to execute a transferred task. Information strategy is the information center for load balancing algorithm. It is responsible for providing location and transfer strategies to each node. Dynamic algorithms can take three different controlling forms: centralized, distributed, or semi-distributed. In centralized load distribution, a single (central node) node in the network is nominated to be responsible for all load distribution in the network. In distributed the responsibility is divided among all nodes equally. In a semi-distributed the network is segmented into clusters where each cluster is centralized. Load balancing of whole system is achieved through the cooperation of central nodes of all clusters.

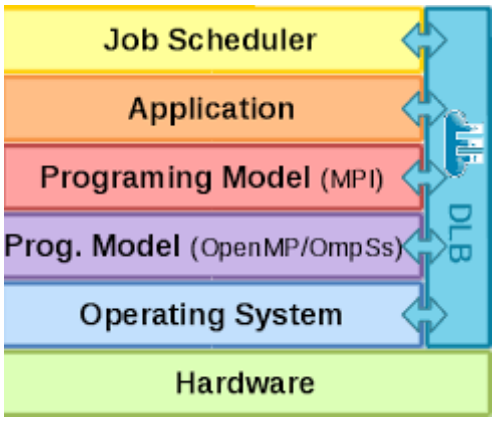

Figure :- Dynamic Load Balancing

Dynamic cloud Load Balancing (min_sup, D)
A= {parent Class $A_i = [x_i]$};
Sort-on-weight (A);
Shared int Classid=0;
For each Processor P_j do in parallel
For(i=0;i<=A;i++)
If (Compare_and_swap(Classid, i, i+1))
Enumerate-frequent-Sequence(A_i);

Dynamic Load balancing Algorithm are

- Ant Colony optimization
- Honey bee Foraging
- Biased random Sampling
- Active Clustering

6. DIFFERENCE BETWEEN LOAD BALANCING ALGORITHMS

Load Balancing Algorithm	Advantages	Disadvantages
Round Robin Load Balancing Algorithm	• It utilizes all the resources in a balanced order. • An equal number of VMs (virtual Machine) are allocated to all the nodes which ensure fairness.	• It considers current load on each virtual machine. • the non-uniform distribution of workload, this algorithm is not suitable for cloud computing • Some nodes get heavily loaded and

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		some nodes get lightly loaded because the running time of any process is not known in advance.
Opportunistic Load Balancing Algorithm (OLB)	• OLB algorithm deals quickly with the unexecuted tasks in random order to the currently available node. • Every task is assigned to the node randomly.	• It provides load balance schedule without good results. • The task will process in slow in manner because it does not calculate the current execution time of the node.
Min-Min Load Balancing Algorithm	• Min-Min Load balancing algorithm performs betters when the numbers of jobs having small execution time is more than the jobs having large execution time. • It is easy and fast algorithm. • It works effective for the smaller task.	• The main drawback it can lead to starvation. • Bad Load balancing • Choose the task having minimum completion time.
Max-Min Load Balancing Algorithm	• Max-min algorithm resolves the difficulty of Min-min, by giving Priority to large tasks. • The Max-min algorithm selects the task with the Maximum completion time and assigns it to the resource on which achieves minimum execution time. • The Max-min seems better choice. • The number of small tasks is much more than large ones.	• The Max-min strategy is that chooses large tasks to be executed firstly, which in turn small task delays for long time. • Bad load balancing • Choose the task having Maximum Completion time.

Ant Colony optimization Load Balancing Algorithm	• This algorithm uses small-world and scale-free characteristics of a complex network to achieve good load balancing. • This technique is adaptive to dynamic environments, • This Technique is excellent in fault tolerance and has good scalability. • Improve the performance of the system. • Excellent in fault tolerance. • Good scalability.	• This Algorithm Throughput is less. • Delay in moving in backward and forward. • Network overhead.
Honey bee Foraging Load Balancing Algorithm	• This algorithms Performs well as system diversity increases. • This algorithm Achieves global load balancing through local serve actions. • This algorithm is useful for heterogeneous environment.	• This algorithm does not show any significant improvement in throughput, which is due to the additional queue and the computation overhead. • This algorithm will not improve the throughput.

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Biased random Sampling load balancing Algorithm	• Performs better with high and similar population of resources. • Achieves load balancing across all system nodes using random sampling of the system domain. • Best in Big network.	• The performance is degraded as the number of servers increase due to additional overhead for computing the walk length. • Degrades as population diversity increases.

Comparison Chart Load Balancing Measurement Parameters:-

Comparison on Different Measurement Parameters						
Technique	**Through-put**	**Response time**	**Fault tolerance**	**Scalability**	**Performance**	**Resource allocation**
OLB	×	×	×	×	✓	✓
Round Robin	✓	✓	×	✓	✓	✓
Min-Min	✓	✓	×	×	✓	✓
Max-Min	✓	✓	×	×	✓	✓
Ant Colony	×	×	✓	✓	✓	✓
Honey bee Foraging	×	×	×	×	✓	✓
Biased random Sampling	✓	×	×	×	✓	✓

7. CONCLUSION

Load Balancing is the important task in cloud computing environment to obtain greatest use of the resources. Load balancing is one of the prime challenges in cloud computing. It is demand to issue the dynamic local workload evenly across all the nodes to reach a high user fulfillment and re-source usage balance by making sure that every computing re-source is distributed efficiently and fairly. With proper load balancing, ruse consumption can be kept to a lowest that will further minimize energy utilization and carbon discharge rate that is a grim need of cloud computing. Current load balancing approach that has been discussed mainly focus on lowest related overhead, service response time and better performance etc. Cloud computing allows maximum area of users to access distributed, scalable, virtualized, hardware and software resources over the Internet. Load balancing is one of the most important technique of cloud computing. It is a device that circulation workload evenly crosswise all the nodes in the whole cloud. Through appropriate load balancing, we can successfully a high user satisfaction and resource utilization. Hence, this will better the overall performance and resource utility of the system. With proper load balancing, resource consumption can be kept to a minimum which will further minimum energy consumption and carbon emission rate. Hence static load balancing and dynamic load balancing algorithm provide improved performance in cloud computing.

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