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An Analysis of Load Balancing Algorithms in Cloud Computing

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Abstract: Cloud computing is a term, which involves virtualization, distributed computing, networking, and software and web services. A cloud consists of several elements such as clients, datacenter and distributed servers. It includes fault tolerance, high availability, scalability, flexibility, reduced overhead for users, reduced cost of ownership, on demand services etc. Central to these issues the establishment of an effective load balancing algorithm. The load can be CPU load, memory capacity, delay or network load. Load balancing is the process of distributing the load among various nodes of a distributed system to improve both resource utilization and job response time while also avoiding 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 the processor in the system or every node in the network does approximately the equal amount of work at any instant of time. This technique can be sender initiated, receiver initiated or symmetric type. This objective is to develop an effective load balancing algorithm using maximize or minimize different performance parameters throughput, latency for example for the clouds of different sizes virtual topology depending on the application requirement.

Keywords: cloud computing, load balancing algorithms, Virtual Machine.

I. INTRODUCTION

Cloud computing is an evolving area that allows users to organize applications with enhanced scalability, availability and fault tolerance. Cloud computing provides internet based platform that is used for computer technology. It describes a diversity of computing concepts .cloud computing accumulates all the computing resources and manages them automatically. Cloud computing provides relevant hardware, software and service according to the requirement that users put forward. A cloud computing structure is categorized by its on-need self-service, access over internet, pooling of resources, and elasticity of service availability and measurement of services utilized by individual users. Cloud computing provides a collective group of resources, networks, computer processing power and specialized corporate and user application. There are four deployment models in cloud computing [1]. They are

- ✓ public
- ✓ private
- ✓ community
- ✓ hybrid

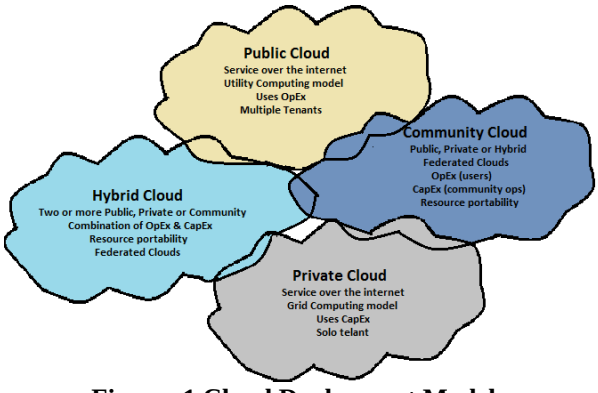

Figure: 1 Cloud Deployment Models

1) Public cloud: - this cloud is utilized by the general public users and the cloud service provider has the full responsibility for public cloud with its own qualities, policy, costing, profit, and charging model. Many popular cloud services are Google app engine, amazon ec2and salesforce.com.

2) Private cloud: - this cloud will be cloud bases worked for a solitary association and give security to its resources.

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3) Community cloud: - in community cloud, cloud infrastructure which can be used through several organizations in a private community. This cloud is shared amongst many associations that have comparative cloud prerequisites.
4) Hybrid cloud: - this cloud it utilizes a combination of no two clouds where the clouds incorporate a blend of private cloud, public cloud or community cloud [2].

II. LOAD BALANCING IN CLOUD COMPUTING

Load balancing is the process of distribution of user request on available resources to maximize the throughput of the system and utilize the resources effectively. Load balancing required to improve the performance of the system by minimize the overall completion time and avoid the situation where some resources are heavily loaded or others remains under loaded in the system[3].
The goals of load balancing are:

- improve the performance
- maintain system stability
- build fault tolerance system
- energy is saved in case of low load
- cost of using resources is reduced
- maximize throughput of the system
- minimize communication overhead
- resources are easily available on demand
- resources are efficiently utilized under condition of high/low load
- minimize overall completion time (make span)

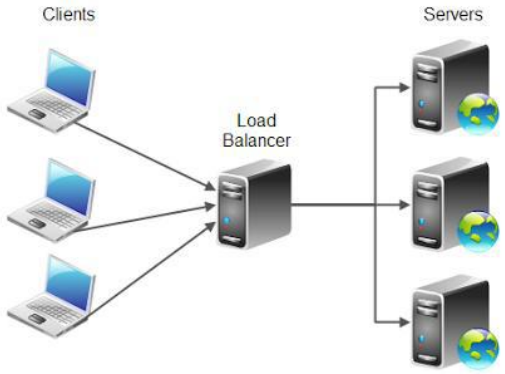

Figure: 2 Example of Load Balancing

Load balancing in cloud is a method, which distributes the overloaded, active local workloads uniformly, across all the nodes. It achieves good utilization of resources and better user satisfaction, efficiently improving the overall performance of the system. When the tasks are arrived from different locations the load balancer receives them and distributes to data center for appropriate load distribution. Vendors in cloud are usually based on automatic load balancing service, which allows entities to add the number of CPU for their resources to scale with the increased demands.

III.LOAD BALANCING ALGORITHMS

Following load balancing algorithms are currently prevalent in clouds
Round-Robin algorithm [4]
It is the static load balancing algorithm which uses the round robin scheme for allocating job. It selects the first node randomly and then, allocates jobs to all other nodes in a round robin fashion. Without any sort of priority the tasks are assigned to the processors in circular order. Because of the non-uniform distribution of workload, this algorithm is not suitable for cloud computing .some nodes get heavily loaded and some nodes get lightly loaded because the running time of any process is not known in advance. On the basis of assignment of weight to the node it would receive appropriate number of requests .if there are equal assignment of weight, each node receive some traffic. This algorithm is not preferred because prior prediction of execution time is not possible.
Throttled load balancing algorithm [5]
This algorithm is a static load balancing algorithm. Here first check the index values of all the virtual machine in the system. The request is sent where load balancer parses a table for the allocation of the resources in the system. It

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assigns the request to a particular load balancer which passes or responds reverse the request to the requester and updates the allocation policy. After the successful allocation of the system the whole process for the de-allocation of the system also starts. This mechanism provides a higher amount of resource sharing and allocation in the system resulting in the higher performance and utilization. The throttling threshold maintained generally is 1. It could be modified easily to make the threshold a configurable value.

Ant colony optimization based load balancing algorithm [6]

Aim of the ant colony optimization to search an optimal path between the source of food and colony of ant on the basis of their behavior. This approach aims efficient distribution of work load among the node. When request is initialized the ant starts movement towards the source of food from the head node. Regional load balancing node (RLBN) is chosen in cloud computing service provider (CCSP) as a head node. Ants keep records the every node they visits ant record their data for future decision making .ant deposits the pheromones during their movement for other ants to select next node the intensity of pheromones can vary on the bases Of certain factors like distance of food, quality of food etc. When the job gets successful the pheromones is updated. Each ant build their own individual result set and it is later on built into a complete solution. The ant continuously updates a single result set rather than updating their own result set.

Honeybee foraging load balancing algorithm [7]

It is a nature inspired decentralized load balancing technique which helps to achieve load balancing across heterogeneous virtual machine of cloud computing environment through local server action and maximize the throughput. The current workload of the VM is calculated then it decides the VM states whether it is over loaded ,under loaded or balanced. according to the current load of VM they are grouped. The priority of the task is taken into consideration after removed from the overload VM which are waiting for the VM .then the task is schedule to the lightly loaded VM. The earlier removed task are helpful for the finding the lightly loaded VM. These tasks are known as scout bee in the next step. Honey bee behavior inspired load balancing technique reduces the response time of VM and also reduces the waiting time of task.

IV. PERFORMANCE ANALYSIS

Cloud computing used the cloud analytical tool to evaluate the algorithms round robin , throttled algorithm, ant colony optimization algorithm and honey foraging behavior algorithm for four cases closest data center, optimize response time &reconfigure dynamically lb by using user base(1-6) with different regions & data centers (1-6) with different virtual machine monitor.

A. User base

The design model use the user base to represent the single user but ideally a user base should be used to represent a large numbers of users for efficiency of simulation

USER BASE	REGION
UB1	0
UB2	1
UB3	2
UB4	3
UB5	4
UB6	5

Table: 2 User Base

B. Datacenter

Datacenter manages the data management activities virtual machines creation and destruction and does the routing of user requests received from user base via the internet to virtual machines.

DATA CENTER	VMM1	VMM2	VMM3	VMM4	VMM5	VMM6
DC1	1	1O	25	5O	75	1OO
DC2	1	1O	25	5O	75	1OO
DC3	1	1O	25	5O	75	1OO
DC4	1	1O	25	5O	75	1OO
DC5	1	1O	25	5O	75	1OO
DC6	1	1O	25	5O	75	1OO

Table: 2 Data Center

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After performing the simulation the result computed by cloud analyst is shown in following below figures. We have used the above defined configuration for each load balancing policy one by one and depending upon that result calculated for table like response time and cost in fulfilling the request.

1).Round Robin algorithm for reconfigures dynamically LB

Round Robin Algorithm With Vmm	Reconfigure Dynamically Lb	
	Time	Cost
R1	50.37	16.09
R10	50.45	20.81
R25	78.90	28.36
R50	50.90	40.70
R75	67.47	49.91
R100	50.73	53.45

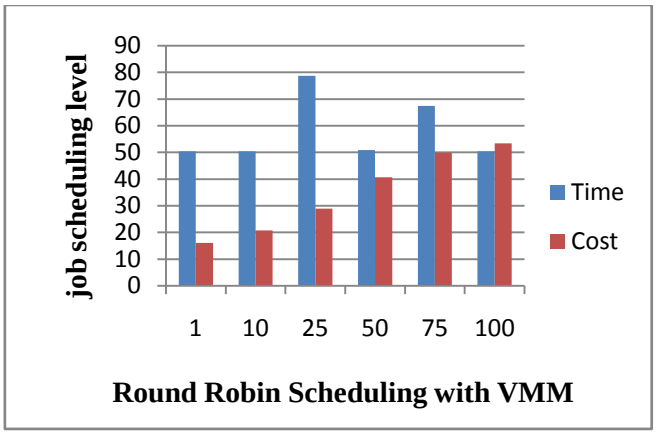

Figure: 3 Graph Of Round Robin Algorithm

2). Throttled algorithm for reconfigure dynamically LB

Throttled Algorithm With Vmm	Reconfigure dynamically lb	
	time	cost
T1	50.10	0.99
T10	50.09	5.50
T25	50.19	13.03
T50	50.35	25.58
T75	50.51	38.12
T100	50.68	50.67

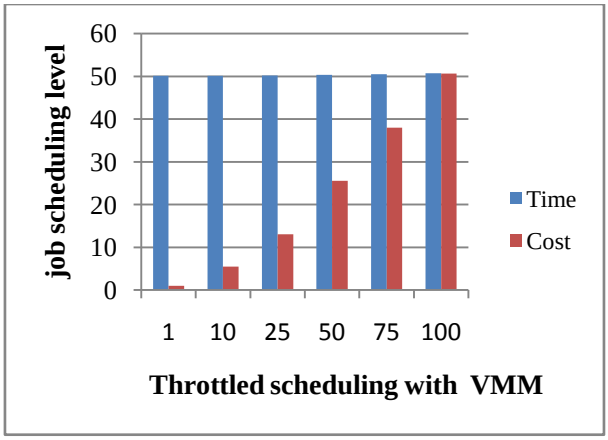

Figure: 4 Graph Of Throttled Algorithm

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3). Ant colony optimization algorithm for reconfigure dynamically LB

ant colony algorithm with vmm	reconfigure dynamically lb	
	time	cost
AC1	50.09	16.99
AC10	50.07	10.50
AC25	45.17	13.03
AC50	50.33	25.58
AC75	60.49	38.12
AC100	70.66	50.67

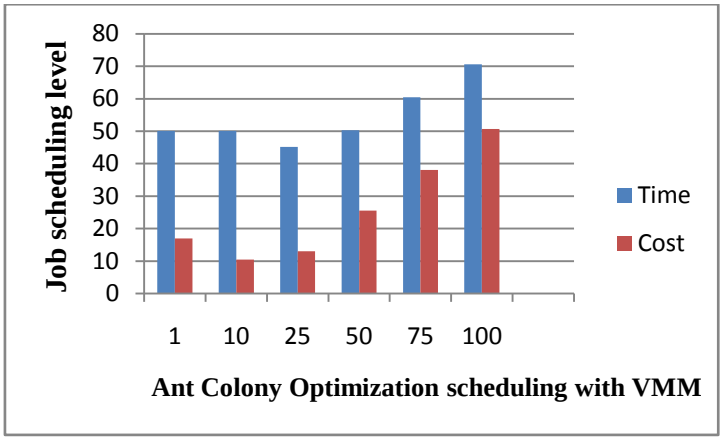

Figure: 5 Graph Of Ant Colony Optimization Algorithm

4). Honey bee behavior algorithm for reconfigure dynamically LB

honey bee behavior algorithm with vmm	reconfigure dynamically lb	
	time	cost
HBB1	50.67	27.09
HBB10	60.45	20.81
HBB25	78.90	38.36
HBB50	60.90	40.70
HBB75	67.47	52.91
HBB100	50.89	53.45

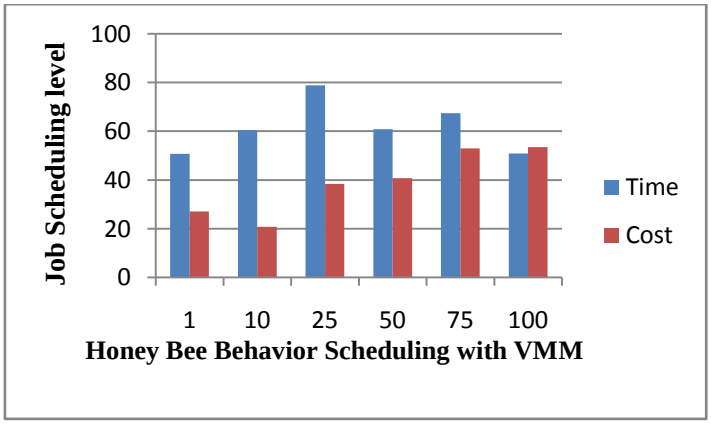

Figure: 6 Graph Of Honey Bee Behavior Algorithm

RESULT

Comparing with the table and graph, overall response time and data center processing time is improved. It is also seen that the virtual machine time and data transfer time in ant colony optimization algorithm the and throttled algorithm is

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much better when compared to round robin algorithm and honeybee behavior algorithm. The results strongly shows that around 50%-60% gain has achieved using ant colony optimization algorithm and throttled algorithm.

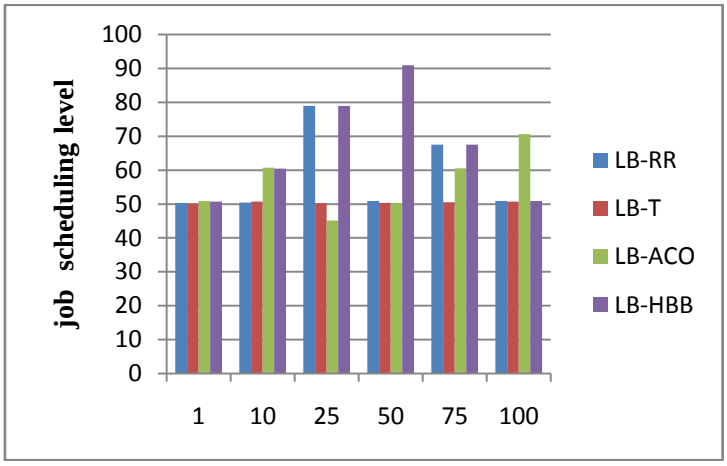

Figure: 7 Graph Of Time Estimation

CONCLUSION

The response time and data transfer cost is a challenge of every engineer to develop the products that can increase the business performance in the cloud based sector. The several strategies lack efficient scheduling and load balancing resource allocation techniques leading to increased operational cost and give customer satisfaction. This process aims to development of enhanced strategies through improved job and load balancing resource allocation techniques. Ant colony optimization algorithm and throttled algorithm dynamically allocates the resource to the job in a queue leading reduced cost in data transfer and virtual machine formation. The simulation result shows the reduction up to 50-60%in the cost and time.

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