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Comparative Study of Scheduling Algorithms to Enhance the Performance of Virtual Machines in Cloud Computing

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Abstract: Nowadays, Cloud computing has become buzzword in the Information Technology and is a next stage in the evolution of Internet, It provides very large amount of computing and storage services to users through the internet. The primary aim of Cloud Computing is to provide efficient access to remote and geographically distributed resources with the help of Virtualization in Infrastructure as a Service (IaaS). We need different kind of virtual machines (VM) as per the requirement and cloud provider provides these services as per the Service Level Agreement (SLA) to ensure QoS.

Keywords: Cloud Computing, Cloud Environment, Load Balancing, Virtual Machines, Resource allocation.

I. INTRODUCTION

Cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in either privately owned, or third-party data centers that may be located far from the user–ranging in distance from across a city to across the world. Cloud computing relies on sharing of resources to achieve coherence and economy of scale, similar to a utility (like the electricity grid) over an electricity network. Industry and a new delivery method for the services on pay per use basis. According to various standard definitions of cloud computing: "Cloud Computing is the delivery of application software, platform and infrastructure as a service over the Internet accessible from the web browser, as well as software and data are residing on the server on pay per use basis. Cloud computing provides services by internet.

Cloud Computing has become one of the popular technology adopted by both industry academia providing a flexible and efficient way to store and retrieve files [2]. The main problem is to schedule the incoming request in a way so with minimum response time, efficient resource utilization and at the same time resources should not be underutilized. Cloud Computing system are heavily rely on term virtualization that improves the power efficiency of datacenters and enables virtual machines to single physical server. Cloud computing is an internet based computing. It delivers all services through the internet dynamically when user demands, such as operating system, network, storage, software, hardware and resources. These services are classified into these types: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Cloud computing domain is divided into three categories such as Public, Hybrid and Private cloud. A cloud is a type of parallel and distributed system which consists of collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements that is established through negotiation between service provider and consumers. According to the requirements and preferences of users computing resources are allocated dynamically. Computing resources are shared among users based on pay as use policy as per the customer's requirements. There is significant impact of resource allocation and proper scheduling on performance of system. Scheduling plays very important role in determining the effective execution. An efficient scheduling, provisioning, load balancing and security aware infrastructure needed to manage access to different locations. various scheduling algorithms are available in this paper few of the algorithms are compared and tabulated their values. Cloud computing depicts that it has four deployment models and three service models.

II.LITERATURE REVIEW

Kavyasri M et al [1]. Scheduling is key technology in cloud computing, scheduling of tasks and resource allocation is challenging task in cloud. So we require scheduling algorithm. Primary consideration of scheduling algorithm is to provide proficiency to task and resource scheduling. They described Main objective of the paper is to given comparative analysis of existing scheduling algorithm in cloud platform where resources have varying cost and computational efficiency.

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There are also drawbacks in every scheduling algorithm, existing scheduling algorithms gives high throughput and cost effective but they do not consider reliability and availability, none of them achieves 100% efficiency, there is a need of new scheduling algorithm which takes factors like security, reliability and availability in to account.
P Kowsik et al [2]. They described especially that in cloud, there is a high communication cost that prevents well known task schedulers to be applied in large scale distributed environment. Today, researchers attempt to build job scheduling algorithms that are compatible and applicable in Cloud Computing environment Job scheduling is most important task in cloud computing environment because user have to pay for resources used based upon time. They described surveyed different types of scheduling algorithms and tabulated their various parameters, scheduling factors and so on.

Saleh Atiewi et al [3]. They described evaluation of these algorithms is based on three metrics: Total power consumption, DC load and VM load. A number of experiments with various aims are completed in this empirical comparative study. The round robin scheduler gives better VM and DC load than the green scheduler but have more energy consumption than both random and green schedulers. The experiments showed that spreading the load over multiple servers can increase power consumption more than expected. Finally, the Random algorithm performed the worst compared to the other scheduling algorithms with regard to load balancing, no single scheduling algorithm can provide superior performance with respect to various types of quality services.

Ali Al-maamari et al [4]. They described task scheduling is the most significant matter in the cloud computing because the user has to pay for resource using on the basis of time, which acts to distribute the load evenly among the system resources by maximizing utilization and reducing task execution Time. Many heuristic algorithms have been existed to resolve the task scheduling problem such as a Particle Swarm Optimization algorithm (PSO), Genetic Algorithm (GA), Ant Colony Optimization (ACO) and Cuckoo search (CS) algorithms, etc. They proposed algorithm is considered an amalgamation of the Dynamic PSO (DAPSO) algorithm and the Cuckoo search (CS) algorithm; called MDAPSO. To evaluate the proposed MDAPSO task scheduling algorithm, a comparative study among the proposed MDAPSO, original PSO, DAPSO, and PSOCS algorithms has been done. According to the experimental results, it is found that MDAPSO and DAPSO algorithms outperform the original PSO algorithm. In addition, the MDAPSO and DAPSO algorithms perform better performance than the original PSO algorithm.

Kiran Kumar Shakya et al [5]. They described Cloud is a technology which supports on-demand distribution of computer resources. Resources in the cloud environment are heterogeneous in nature and geographically distributed. In cloud computing, there are multiple resources and large number of users that can request for same set of resources at the same time. They presented to new threshold based VM scheduling approach which calculates the threshold before allocating the VM to the host. VM scheduling is an important feature of the virtualization. It can also play an important role in reducing the number of migration. It is found that the uses of threshold increases resource utilization and reduces power consumption in a Cloud setup.

III. PROBLEM DESCRIPTION

In general scheduling algorithm works for the set of VMs find the appropriate Physical Machine. Scheduling in Eucalyptus determines the method by which Virtual Machines are allocated to the nodes. This is done to balance the load on all the physical machines effectively and to attain a specified quality of service. The demand for a good scheduling algorithm begins from the requirement for it to perform multitasking and multiplexing. Throughput - number of VMs that are successfully scheduled in the given time unit. Response time - Sum of time taken by the algorithm to place the first VM after a request was submitted. Load Balancing among servers - All the requests for an allocation of a physical machine should be considered in the same manner without any partiality. Resource Utilization –the amount of resource utilized by the VMs scheduled in a physical machine Energy consumption – The total power consumption of a datacenter. Number of active PMs – the total number of physical machines which are currently used for allocating set of VM requests Round Robin algorithm helps in the Fast Execution and also results into Lower Cost as the VM's are prioritized according to its Cost only. The major benefit of this algorithm is that it consumes all the resources in a balanced order. All the VMs are equally placed in physical machines to guarantee equality. This algorithm does not consider the overload or under load factor of the host machines. Since it uses more number of physical machines the datacenter utilizes more power.

IV. METHODOLOGY

A.VM SCHEDULING ALGORITHMS

In this section we describe the VM scheduling and provisioning algorithms, those are used for optimization of different factors like Time, Cost, Energy and Security. There are very less algorithms are available that provision the VMs with the perspective of the security of neighboring VMs or nodes.

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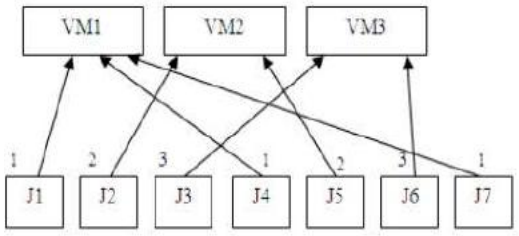
B.ROUND ROBIN ALGORITHM

The Round Robin algorithm focuses on distributing the load equally to all the nodes. Using this algorithm, the Scheduler allocates one VM to a node in a cyclic manner. The round robin scheduling for VM scheduling is similar to the round robin scheduling for process scheduling. The scheduler starts assigning VM to each node and move further for next VM to place in to next node. This algorithm is repeated for all the nodes until each node have at least on VM. After placing VMs to all nodes it will go to the first node and repeat this process for next VMs requests. Hence, in this case, the scheduler does not wait for the exhaustion of the resources of a node before moving on to the next. As an example, if there are three nodes and three VMs are to be scheduled, each node would be allocated one VM, provided all the nodes have enough available resources to run the VMs.

The main advantage of this algorithm is that it utilizes all the resources in a balanced order. An equal number of VMs are allocated to all the nodes which ensure fairness. However, the major drawback of using this algorithm is that the power consumption will be high as many nodes will be kept turned on for a long time. If three resources can be run on a single node, all the three nodes will be turned on when Round Robin is used which will consume a significant amount of power. The CloudSim [9] toolkit supports RR scheduling strategy for internal scheduling of jobs.



b. Process of round robin algorithm

The mechanism of the Round Robin (RR) job scheduling algorithm. The algorithm does not require any preprocessing, overhead or scanning of the VMs to nominate the job's executor. The detailed steps of Round Rubin job scheduling algorithm. The index of the selected VM for the current job is computed by a round robin fashion using Equation:

$$\text{Index} \leftarrow (\text{index}+1) \bmod \text{NoVM} \qquad (2)$$

Where: index = the index to the selected VM

C.**MINIMUM TIME COMPLETION ALGORITHMS**

The Minimum Completion Time job scheduling algorithm attempts to allocate the selected job to the avail-able VM that can offer the minimum completion time taking into account its current load. The main criterion to determine the VM in the minimum completion time scheduling algorithm is the processor speed and the cur-rent load on each VM. The algorithm first scans the available VMs in order to determine the most appropriate machine to perform the job. Subsequently, it dispatches the job to the most suitable VM and starts execution. The process of job scheduling using the minimum completion time algorithm. Notice that all the available VMs (VM1, VM2 and VM3) are able to run the set of jobs but with different response time. For that reason, job J1 is send to VM1 as it is the fastest machine that can run the job and return the results within a short time, which is 2 sec. VM2 and VM3 can also run J1 but with longer time consumption, namely 5 sec for VM2 and 8 sec for VM3. The detailed steps of the minimum completion time scheduling algorithm are presented and are repeated for each job. Formally, the index for the selected VM that will execute the current cloudlet cl is computed using formula.

$$\text{Index} \leftarrow \text{Min}\ \{v.\text{getready}\ () + cl.\text{length}/v.\text{speed}\ \forall \in \mid v\ \text{VML}\}$$

D.OPPORTUNISTIC LOAD BALANCING ALGORITHM

It is also one of the static load balancing algorithms, which do not consider the present workload of the VM. It usually keeps each and every node busy. This deals with the unexecuted tasks quickly and in random order to the current node, where each one of task is assigned to the node randomly. This algorithm provides a load balancing schedule but does not produce a good result. The tasks are processed in a slow manner, where the current execution time of the node is not calculated.

V. EXPERIMENTAL RESULTS

Cloud computing is the dynamic provisioning of IT capabilities (hardware, software, or services) from third parties over a networkload balancing mechanisms can be broadly categorized as centralized or decentralized, dynamic or

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static, and periodic or non-periodic. Physical resources can be split into a number of logical slices called Virtual Machines (VMs). All VM load balancing methods are designed to determine which Virtual Machine assigned to the next cloudlet [11]. This document introduce a new VM load balancing algorithm and compare the performance of this algorithms with the already existing algorithms like throttled and active monitoring VM load balancer.

A. Round Robin VM Load Balancer

Virtual machine enables the abstraction of an OS and Application running on it from the hardware. The interior hardware infrastructure services interrelated to the Clouds are modelled in the simulator by a Datacenter element for handling service requests. These requests are application elements sandboxed within VMs, which need to be allocated a share of processing power on Datacenter's host components. DataCenter object manages the data center management activities such as VM creation and destruction and does the routing of user requests received from User Bases via the Internet to the VMs The Data Center Controller [11], uses a VmLoadBalancer to determine which VM should be assigned the next request for processing. Most common Vmloadbalancer are throttled and active monitoring load balancing algorithms.

B. Throttled Load Balancer

It maintain a record of the state of each virtual machine (busy/ ideal), if a request arrive concerning the allocation of virtual machine, throttled load balancer send the ID of ideal virtual machine to the data center controller and data center controller allocates the ideal virtual machine.

C. Active Monitoring Load Balancer

Active Vm Load Balancer maintains an information about each VMs and the number of requests currently allocated to which VM. When a request to allocate a new VM arrives, it identifies the least loaded VM. If there are more than one, the first identified is selected. ActiveVmLoadBalancer returns the VM id to the Data Center Controller The data Center Controller sends the request to the VM identified by that id. DataCenterController notifies the ActiveVmLoadBalancer of the new allocation

D. Proposed VM Load Balancing Algorithm

The Proposed Load balancing algorithm is divided into three parts. The first phase is the initialization phase. In the first phase, The expected response time of each VM is to be find. In second Phase find the efficient VM, in Last Phase return the ID of efficient VM.

1. Efficient algorithms find expected
response time of each Virtual machine. // expected response time find with the help of resource info program
2. When a request to allocate a new VM from the Data Center Controller arrives, Algorithms find the most efficient VM (efficient VM having least loaded, minimum expected response time) for allocation.
3. Efficient algorithms return the id of the efficient VM to the Datacenter Controller.
4. Datacenter Controller notifies the new allocation
5. Propose algorithm updates the allocation table increasing the allocations count for That VM.
6. When the VM finishes processing the request, and the Data Cener Controller receives the Response. Data center controller notifies the efficient algorithm for the VM de-allocation. Continue From Step 2

The purpose algorithm find the expected Response Time of each Virtual Machine because virtual machine are of heterogeneous platform, the expected response time can be find with the help of the following formulas

$$\text{Response Time} = \text{Fint} - \text{Arrt} + \text{TDelay} \quad (1)$$

Where, Arrt is the arrival time of user request and Fint is the finish time of user request and the transmission delay can be determined using the following formulas

$$\text{TDelay} = \text{Tlatency} + \text{Ttransfer} \quad (2)$$

Where, TDelayis the transmission delay T latency is the network latency and T transfer is the time taken to transfer the size of data ofa single request (D) from source location to destination.

$$\text{Ttransfer} = \text{D} / \text{Bwperuser} \quad (3)$$

$$\text{Bwperuser} = \text{Bwtotal} / \text{Nr} \quad (4)$$

Where, Bwtotal is the total available bandwidth and Nr is the number of user requests currently in transmission. The Internet Characteristics also keeps track of the number of user requests in-flight between two regions for the value of Nr.

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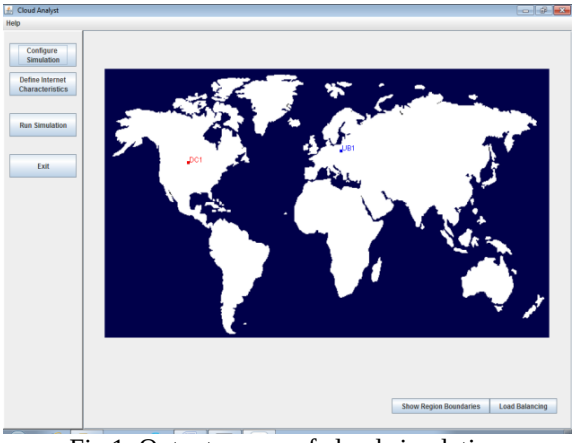

Fig 1: Output screen of cloud simulation

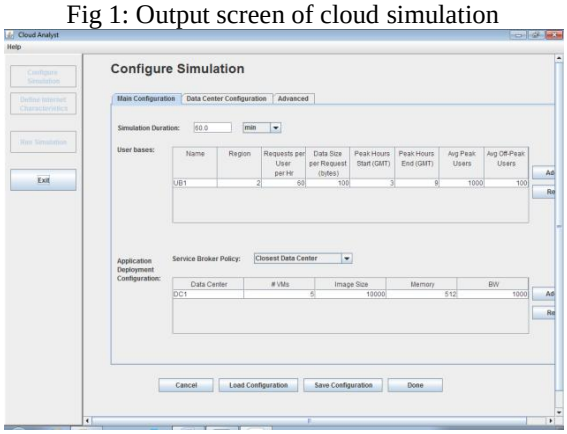

Fig 2: Configure simulation

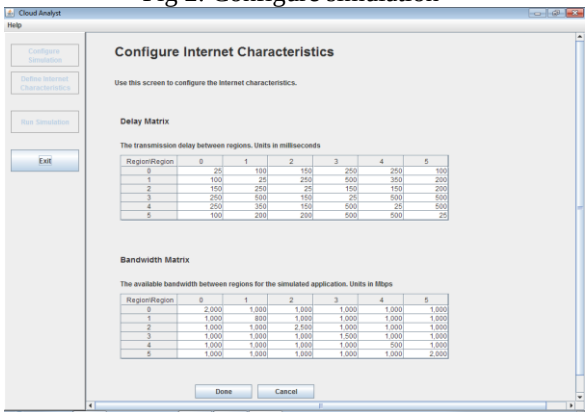

Fig 3: Configure internet characteristics

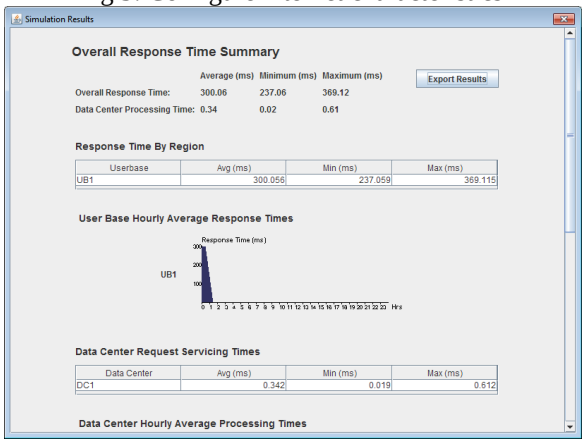

Fig 4: Overall Response Time

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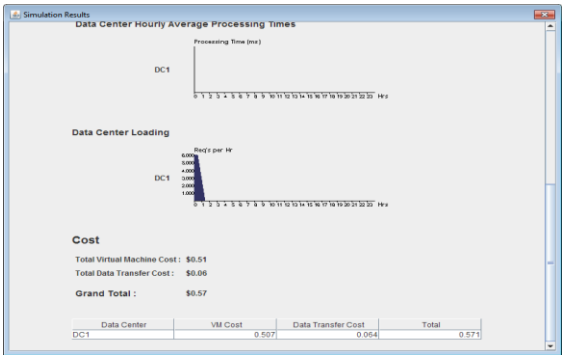

Fig:5 Data Centre Hourly Average Process Time

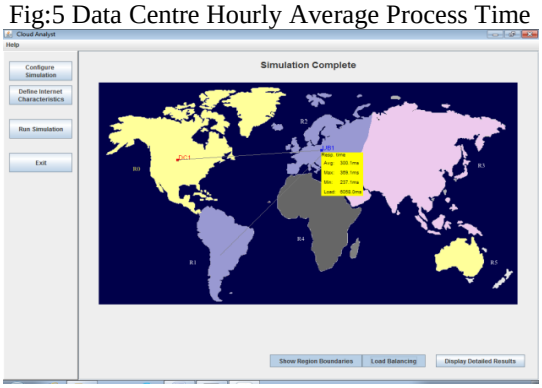

Fig 6: simulation Complete

VII. CONCLUSION

Nowadays Cost and Time are key challenges for every IT engineer to develop products that can enhance the performance of business in the cloud. Various scheduling algorithms with the perspective of Least Response Time, Load Balancing among servers, Reasonable Resource Utilization, Least energy consumption, Minimum number of active PMs and Higher profit are studied. To solve the resource scheduling problem various scheduling algorithms based on various factors have been tried by various researchers. VM deployment requests to which the cloud infrastructure is subject over time Moreover, different algorithms woks well and satisfies some of the above discussed factors but the cloud providers need a dynamic algorithm which will perform well in all situations and satisfies all the factors so as future work we plan to develop such a dynamic algorithm which will consider various factors for VM placement to avoid SLA violations and manages QOS constraints.

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