



# **A Process Scheduling Algorithm Based on Threshold for the Cloud Computing Environment**

**Kiran Kumar Shakya<sup>1</sup>, Prof. Dr. D. Singh Karaulia<sup>2</sup>**

<sup>1</sup>Computer Technology & Applications, India

<sup>2</sup>Professor, Computer Engineering & Application, India

<sup>1</sup>kiran.shakya74@gmail.com; <sup>2</sup>dskaraulia@nitttrbpl.ac.in

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*Abstract—Cloud is a technology which supports on-demand distribution of computer resources. Resources in the cloud environment are heterogeneous in nature and geographically distributed. Demand of a cloud user cannot be predicted as it may change dynamically on runtime. Therefore, resource management and the resource scheduling, in such a large-scale distributed environment, is a challenging task. In cloud computing, there are multiple resources and large number of users that can request for same set of resources at the same time. This duly justifies need of an algorithm that optimally schedules the cloud resources for different virtual machines. This paper presents new threshold based VM scheduling approach which calculates the threshold before allocating the VM to the host.*

*Key Terms- Cloud Computing; Distributed Computing; On Demand Resources; Round Robin; Virtualization; VM scheduling*

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## **I. Introduction**

Cloud computing is close to utility computing to provide online IT services on demand using pay per use model. It is growing fast because of its attractive features such as on demand services, easy to use, cheap and pay as use scheme etc. [2, 3, 4]. In the cloud all resources (CPU, memory, network bandwidth etc) are provided as a service. Virtualization is a key technology behind the cloud computing, where all physical resources of a host are shared by multiple users. It allows multiple operating systems, termed guests, to run concurrently on a host server, which is implemented using hypervisor, also called virtual machine manager (VMM). Hypervisor creates a VM for each user, according to the user's resource requirement. Furthermore, one or multiple virtual machines can be run on a single host, as show in figure 1. Resource utilization, thus, increases effectively.

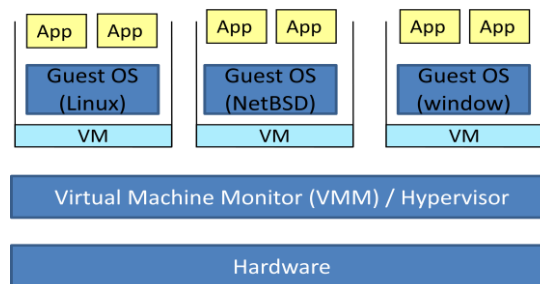


Figure1. Cloud Resource Virtualization

When any user makes a request for the cloud services, the load balancer of the cloud system then decides suitability of a host machine for fulfilling the user’s resources requirement. Since VMs are created by the hypervisor, according to user request, users pay for the resources used only. VM scheduling is a critical job in the cloud computing, which is a mechanism that maps users’ VM to the appropriate host. Resources in cloud are provided to the client through the VM via internet. Further, overall system performance can also be improved via VM scheduling.

There are numerous literatures which propose scheduling algorithms. Some of these proposed algorithms are particularly for serving jobs in a cloud computing environment and some are tailored to fit the cloud environment. For the cloud environment, many adapted scheduling algorithms [5, 6, 7, 8] are proposed in the literature to enhance the total system performance live VM migration, downtime, throughput and the cost.

In this paper, we discuss a new VM scheduling technique. The goal of this paper is to bring out the new scheduling algorithm giving its comparative analysis with other works [10]. In section 2, we discuss the background knowledge and related work of VM scheduling. Section 2 gives brief descriptions about proposed approach with algorithm. In section 4, performance evaluation is given with comparison of previous VM scheduling techniques. Section 5 concludes the work discussed in the paper.

## II. Related Work

- A) **Yang et al. [6]** highlighted the issue related to the job scheduling in cloud computing environment. They argued that there is no well-defined job scheduling algorithms are available in the cloud environment that considers the system state in the future. The existing job scheduling algorithms in cloud do not consider the hardware or software failure and recovery in the cloud. To tackle this issue they proposed a Reinforcement Learning (RL) based algorithm that helps the scheduler in making scheduling decision with fault tolerable while maximizing utilities attained in the long term.
- B) **Paul et al. [8]** proposed an algorithm which focuses on how to utilize resources efficiently in cloud computing and gain maximum profits. For this purpose, a credit based scheduling algorithm is proposed which evaluates the entire group of tasks in the task queue and finds the minimal completion time of all tasks. The proposed scheduling method considers the scheduling problem as an assignment problem in mathematics where the cost matrix gives the cost of a task to be assigned to a resource. Problem with this algorithm is that it only considers the probability of a resource to be free soon after executing a task so that it will be available for the next waiting, but processing time of a job are not considered.
- C) **Sindhu et al [7]** proposed two algorithms for scheduling tasks into the cloud computing. They consider the computational complexity and the computing capacity of the processing elements to schedule the task. This algorithm works in private cloud environment where the resources are limited.
- D) **Isam Azawi Mohialdeen [9]**, use a random algorithm to assign the job to the VM. In this algorithm jobs are randomly assigned to the available VM. So any process can be assigned to any VM. This method has no overhead and very less complexity.

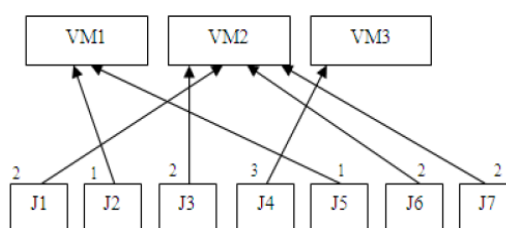


Figure2. The process of random algorithm

- E) Problem with this approach is that it does not consider the size of the process so some time it considers a machine which is overloaded.
- F) **Subramanian S. et al. [14]** proposed a Greedy algorithm for the VM scheduling in cloud. It is a default VM scheduling algorithm used in Eucalyptus. It is simple and straight forward. In this algorithm first node that it finds with suitable resources for running the VM that is to be allocated. The first node that is identified is allocated the VM. This means that the greedy algorithm exhausts a node before it goes on to the next node. The main advantage of the Greedy algorithm is its simplicity. It is also easy to implement and also the allocation of VMs does not require any complex processing. But major drawback would be the low utilization of available resources. This drawback can be overcome by the Round Robin algorithm.
- G) **Isam Azawi Mohialdeen [9]**, uses Round Robin method to assign the job to the VM. In this approach a process is selected from the job pool. Then this select process is assigned to the available VM in round robin manner, where all jobs are treated equally.
- H) **Yiqiu Fang et al.[10]** proposed a two levels task scheduling mechanism based on load balancing in cloud computing. Cloud Computing Architecture consists of three layers, viz. application layer, platform layer and infrastructure layer [11]. They are using two level scheduling, first level scheduling is from the users' application to the virtual machine, and the second is from the virtual machine to host resources. First level scheduler creates a VM description and the second level scheduler finds the appropriate host to the VM according to the task description. Problem with this approach is that they schedule the virtual machine to the host with lightest load each time. The advantage is to avoid overloading for the host holding more resources. Recent studies show that on average an idle server consumes approximately 70% of the power consumed when it is fully utilized. Only task response time and the demand for resources are considered in this paper.

### III. Proposed work

The principle of proposed threshold based technique is to efficiently allocate the cloud computing resources where user's application changes its resource requirement dynamically with respect to time.

Resource allocation policies are concerned with efficient utilization of resources for optimum use of cloud server capacity. A cloud system is a collection of data centers located in different parts of the world, in which each data-center is a collection of host servers. During the allocation of resources to a cloud service or cloud application, scheduling algorithms should be applied on the both levels viz. data center level and host server level.

At the data center level, appropriate data center is chosen where host server having enough resources to fulfill the dynamic requirement of application with respect to time exists. Whereas, at the host server level resource allocation to the application being scheduled, is considered. Here in this algorithm, as shown in figure2, two concepts of virtual machine scheduling algorithms are applied.

First concept is related to selection of a data center that is having some of the host server with free resources to assign to the new cloud application or cloud service. Second concept is to apply the threshold based comparison of data center limit and host server limit.

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#### Algorithm 1: Cloud VM Scheduling ()

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Initialize Number of Data Center= $m$ ,  
Number of Host[ $j$ ] in DataCenter[ $i$ ]= $n$ ,  
Host\_Limit, H\_UTD, H\_LTD, VM\_List.

- [1] Arrange all hosts into the decreasing order of their capacity
- [2] **for** each VM from the VM\_List
- [3] **for** each Host [ $j$ ] on current Data\_Center [ $i$ ] **do**
- [4] **if** the host is having sufficient resources then

- [5] Host\_load=  $\sum$  all VM available in that host
- [6] **if** Host\_Load<=H\_UTD && Host\_Load>=H\_LTD
- [7] **then** allocate VM to the host
- [8] **else** goto step 3.
- [9] **end if**
- [10] **end for**

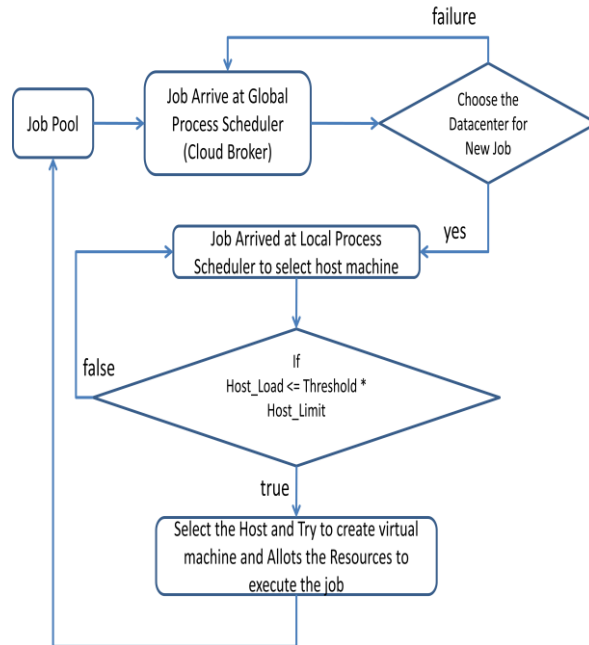


Figure3. Virtual machine scheduling model

Here a threshold based process scheduling system is designed. This environment is composed of one data center and a physical host server. Where each data-center is a collection of the physical host servers connected by a communication network. Here two threshold values are used to compare the load and these threshold values are calculated using total capacity of the server’s CPU power and RAM multiplied by respective weight coefficients.

$$H\_TD = \text{Host\_Limit} * \alpha$$

(Where H\_TD is Threshold value of the host and  $\alpha$  is a constant for host server set by cloud provider on the basis of dynamic behavior of applications and services).

The cloud computing environment is established using CloudSim simulator to implement this system. CloudSim simulator is based on java technology. The flow chart of the proposed algorithm is given in above figure 3.

#### IV. Performance Evaluation

We have verified the accuracy and feasibility of the proposed approach using the CloudSim simulator which creates the cloud-computing environment. CloudSim is a, generalized, and extensible simulation framework that allows seamless modeling, simulation, and experimentation of emerging cloud computing infrastructures and application services.

The simulation of this work is performed using CloudSim toolkit by developing a cloud environment where load balancing and server consolidation algorithms can be applied in various levels. In this work both have been applied on host server level in cloud environment. At host level, the host server provides its resources to virtual machine up to upper threshold as demand comes. In the CloudSim simulator, VmScheduler is used in virtual machine level which works on

two policies namely TimeShared and SpaceShared. In the VM level, each virtual machine divides the resources among Cloudlets running on it using cloudletScheduler which also uses two policies namely TimeShared and SpaceShared.

CloudSim simulation tool of cloud computing is java based tool to create cloud environment with data center and host server. Entire functionality of CloudSim toolkit is implemented in java classes to perform cloud operation. Java classes of datacenter, datacenterBroker, datacenterCharacteristics, host, vm,vmAllocationPolicy, vmScheduler, cloudlet and cloudletScheduler are the main classes of the CloudSim simulator. In the first step of establishing cloud environment, datacenters are created using the host server having its characteristics and physical host server and its resources description.

The proposed approach is implemented using threshold values. If load or utilization of any host system is more than threshold value then user requests are transferred to another host machine to fulfill the resource requirement. Probability of VM migrations are increased with the load, which affect the efficiency of the cloud system. The proposed work is simulated using various threshold values from 0.5 to 1.0.

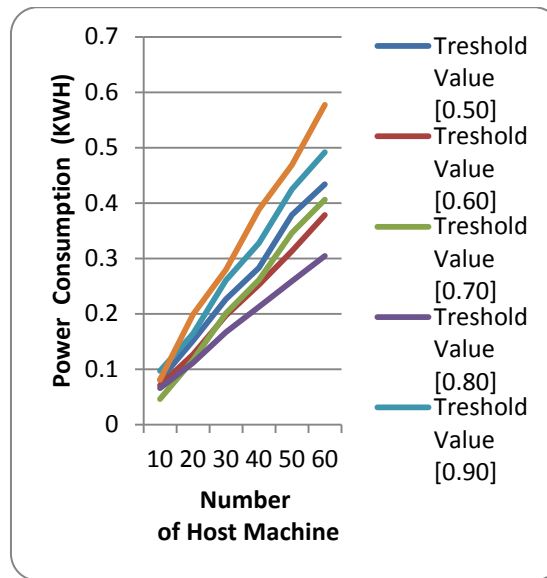


Figure4.1. Simulation Result for threshold

The graph presented in figure 4.1, represents the comparative analysis of scheduling algorithm using threshold values in terms of power consumption by cloud system for different number of cloudlet execution time. As shown in the above graph, the threshold based algorithm presents better result when the threshold value is equal to 0.8. It is, thus, the optimum threshold value for cloud server with efficiency.

Figure 4.2, represents the comparative study of threshold based algorithm and general scheduling algorithm. As shown in figure, the proposed algorithm is power efficient compared to general scheduling algorithm [10]. Proposed algorithm uses the concept of threshold value to allocate resources to the virtual machine. The threshold value restricts the virtual machine to occupy all resources of the host machine. Due to this, in the approach, dynamic requirement of resources can be handled without migration of virtual machine.

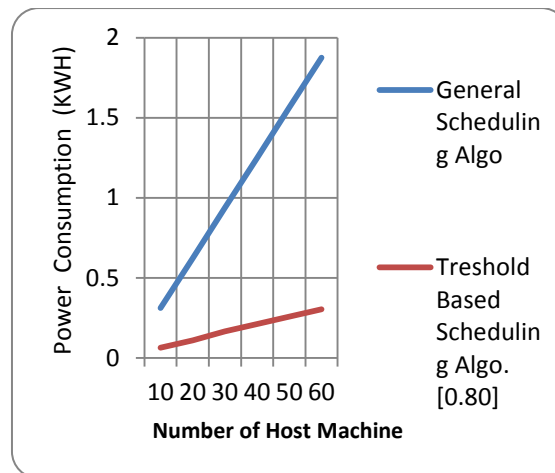


Figure4.2. Comparative Simulation Result

### Conclusion

VM scheduling is an important feature of the virtualization. Resource utilization can be increased by the proper VM scheduling. It can also play an important role in reducing the number of migration. A threshold based virtual machine scheduling algorithm, proposed in this paper, is able to allocate VMs to the host till the upper threshold is reached. It is found that the uses of threshold increases resource utilization and reduces power consumption in a Cloud setup.

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