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Energy Efficient Policies in Cloud Computing

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Abstract: **-** Energy efficient processing is known as Green Cloud Computing. It is getting popular with the demand of time and become important to reduce the energy consumption of the Cloud datacenters in order to create a more nature friendly Cloud environment. In this paper, two policies are proposed i.e. minimum CPU utilization policy and low utilization host selection policy. These two policies are deciding which VM will be picked for migration and which host will be selected to reallocate that VM. The Min-Min scheduling algorithm is used to schedule the tasks at Cloud datacenter. The load balancing concept is proposed that further helps in reducing the energy consumption. The results of proposed energy efficient Cloud scenario is compared with power aware and non-power aware Clouds.

Keywords*: - Cloud Computing, Energy Efficient, Power Aware Cloud.*

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I. Introduction

Cloud Computing is a technology in which resources are provided to user in terms of services. There are three types of services provided by Cloud service provider i.e. software as a service, platform as a service and infrastructure as a service. The main motive of Cloud service provider is to offer quality of service to its customer. The SLA (service level agreement) is a document in which QoS constraints are defined and signed between Cloud service provider and Cloud user. The Cloud service provider offer services from Cloud datacenter and try to optimize the energy consumption of datacenter. These Cloud data centers need electric power for its working so, to reduce the operation cost. The Cloud service provider makes the data centre energy efficient.

Energy efficient cloud computing also known as Green Cloud Computing is the demand of the time. As cloud computing is getting popular, it is becoming important to reduce the energy consumption of the cloud data centers in order to create a more nature friendly cloud environment which is also called Green Cloud. Moreover creating a cloud that is low in energy consumption will increase ROI (return on investment).

The rest of the paper is structured as follow: The related work is presented in section 2. The proposed approach is presented in section 3. Experimental results and comparison are presented in section 4 and Section 5 concludes the work carried out.

II. Related Work

The scheduling is performed [1] using genetic algorithm to allocate reliable virtual machines to workflow tasks. Genetic algorithm results into highly power utilization at Cloud datacenter. In [2] there is needs to make a policy that reduce the energy consumption at datacenters. In [3] propose power aware policy which results into saving in energy consumption at datacenter. The power aware policy switch off the idle nodes and transfer there load to some underutilized virtual machines. The results are evaluated on the basis of energy consumption, SLA violation and number of virtual machines migrated. In [4] proposed a policy in which live virtual machines are rearranged to reduce the overall energy consumption of datacenter. Cloud global optimization algorithm is proposed that results into high energy saving and provides infrastructure as a service. In [5] present a review on various energy efficient methods. From the literature review we feel that there is a need to make the datacenter energy efficient when scheduling the task on it.

III. Proposed Approach

In the proposed work, there are two policies on the basis of which the energy consumption is reduced at Cloud datacenter. The proposed work finds a better selection policy for the virtual machine to be migrated and find a policy to decide which host will be selected for reallocation of the virtual machine. The minimum CPU utilization policy and low utilization host selection policy decide which virtual machine will be picked for migration and which host will be selected to reallocate that virtual machine.

A. Energy Efficient Policies

1. Selection Policy

In our research we are proposing a minimum CPU utilization selection policy. According to our approach Vm whose CPU utilization is less than 10%, should be picked for migration so that underutilized host should be shut down. We will migrates virtual machine of the underutilized host to the other hosts, we are proposing that Vm should be

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migrated to other hosts whose CPU utilization is minimum in this way chance of overloading the other host will be less.
Minimum CPU utilization Algorithm:-

a. Analyze virtual machines on the host.
b. Find if the virtual machine on the host needs migration. If there are no need for migration returns null.
c. Find the CPU utilization of the Vm on the host.
d. If CPU utilization < 10 (threshold) Select virtual machine for migration.
e. Repeat step c until all virtual machines is analyzed.

2. Low Utilization Host Policy

After selecting the virtual machines to be migrated next step is to find the host on which virtual machines can be migrated. According to our research it is better idea to migrate virtual machines on the hosts that has low CPU utilization because if we will migrates virtual machines over a host that has high CPU utilization there are chances that we may overload the host and host may crash. Migrating virtual machines over low utilization host will reduce the chanced of host overloading. The following algorithm is to find low utilization host.

Lowest Host utilization algorithm:-

a. Get the list of host to which virtual machine can be migrated.
b. Find the total utilization of the host.
c. If it is the first host in the list, store its utilization information, this information will be used as reference to compare with other hosts.
d. Compare the utilization of the hosts with the previous host; if the utilization of host is less than previously stored utilization info replace the utilization information.
e. Compare utilization of each host. In the end we will have host with lowest utilization.
f. Return host, this host will be selected for Vm migration.

3. Scheduling Policies

The min-min scheduling algorithm is heuristic based scheduling algorithm. It schedules the task iteratively. It computes ECT (Earliest Completion Time) of each task on every available resource and obtains MCT (Minimum Completion Time) for each task. It pick the task which is having minimum completion time than other tasks and schedule the task on resource that execute the task at earliest time. After every iteration, it updates the completion time of resource at which the task is scheduled and then schedule the next task. The figure 1 shows min-min algorithm.

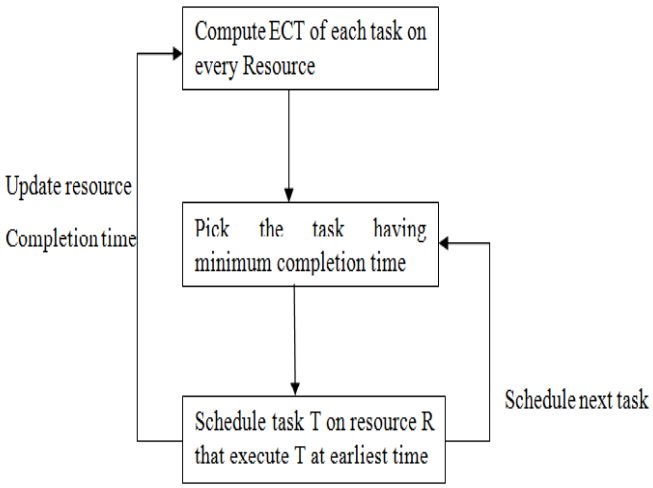

Figure. 1 Min-Min Scheduling Algorithm

In our proposed work, we are proposing a concept that scheduling tasks or better load management optimizes energy efficiency of the cloud, the min- min scheduling algorithm is used to schedule the tasks on the virtual machines.

Min-Min Scheduling Algorithm:

1. Provide list of virtual machines and tasks to the scheduling algorithm.
2. Min-Min picks that task with minimum execution time first from the list of tasks. The tasks are sorted in ascending order according to their size. The task with smallest size will take minimum time for executions.
3. Find expected execution time of the task on each Vm. The expected time is calculated by dividing the size of task with MIPS rate (processing power) of the virtual machine.
4. Pick the virtual machine that will execute task with in minimum expected execution time.
5. Bind task to the virtual machine, so at the simulation start up simulator will assign task to the selected virtual machine.
6. The following flow chart in figure 2 shows the proposed flow of energy efficient Cloud.

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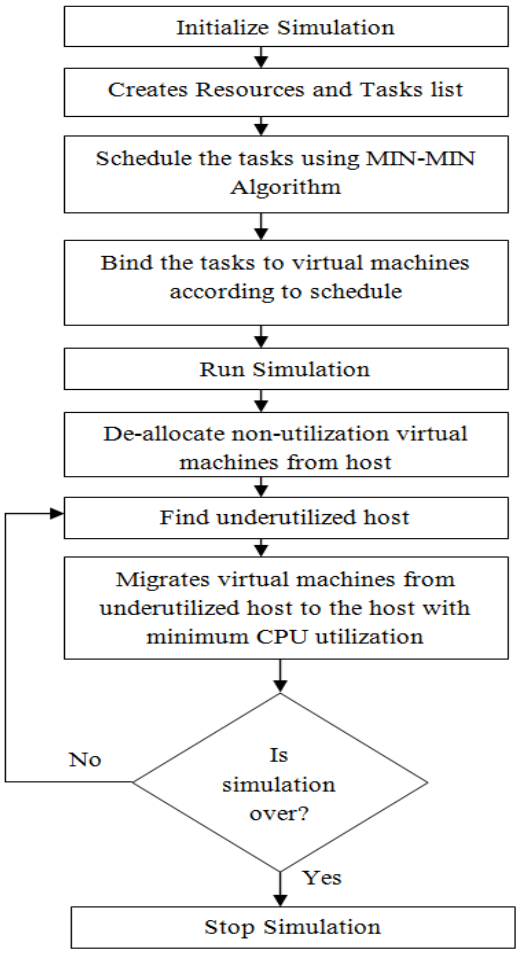

Figure. 2 Flow diagram of proposed work

IV. Experimental Results

The proposed work is implemented using CloudSim that allows simulate an energy aware Cloud model, that keep the track of its energy utilization. This is a java based simulator to simulate data-centres, hosts and virtual machines. In the experiment results, three scenarios are compares i.e. Energy Efficient Cloud, Power Aware Cloud and Non Power Aware Cloud. The table 1 show parameter on the basis of which comparison is done.

Parameters	**Energy-Efficient cloud**	**Power-Aware Cloud**	**Non-Power-Aware Cloud**
Number Of Hosts	5	5	5
Number of Virtual Machines	10	10	10
Total Simulation Time	1440	1440	1440
Energy Consumption (in KWh)	0.03	0.05	0.17
Number of Vm Migrations	2	13	13
SLA Degradation (Service Level Agreement %)	0.00531	0.01074	0.24716
SLA Time per Active Host (%)	2.91	7.07	30.68
Number of Hosts Shutdown (%)	4	4	4
StDevtime before a host shutdown	16.07	287.23	287.23

Table 1 Comparison of Energy Efficient Cloud with Others

From the results it is clear the energy aware Cloud results into reduction of energy consumption (.03 KWh) as compare with power aware Cloud and non-power aware Cloud. It also perform well in optimizing other parameters like energy consumption, virtual machine migration, SLA degradation (%), SLA time per active host (%), Standard deviation time before the a host shut down.

V. Conclusion

In this paper we propose two policies which results into optimizing the various parameters to make the Cloud energy efficient. The proposed work is implemented in java based simulator CloudSim. The experimental results shows that the proposed policies i.e. Selection Policy and low utilization host policy results into highly optimizing various parameters as such energy consumption, virtual machine migration, SLA degradation (%), SLA time per active host (%), Standard deviation time before the a host shut down as compare with other scenarios i.e. power aware Cloud and non-power aware Cloud.

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