RESEARCH ARTICLE OPEN ACCESS

Two Phase Consolidation Algorithm for Efficient Energy Consumption in Cloud Computing

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ABSTRACT

Global warming is the greatest test for environment now a days and cloud computing is one of the main motivation for an unnatural weather change as global warming. After numerous years of examination in systems administration, virtualization and distributed computing field Cloud Computing was assembled. Cloud Computing is one of the best innovation in IT field. The fundamental standard of Cloud Computing is to process on distributed PCs instead of figuring on stand alone or remote servers. The thought behind Cloud Computing is to give secured, quick and appropriate data storage and figuring administrations. As there is a positive side of any innovation there is likewise a negative side of it, so do could computing has its negative side. There is huge measure of energy wastage furthermore huge carbon dioxide discharge in cloud computing which is the most compelling motivation for a dangerous atmospheric deviation. Hence there ought to be an approach to decrease the energy utilization furthermore diminishes the discharge of perils components like carbon dioxide. Giving a green solution for cloud computing is important to diminish contamination and utilization of energy. For this we should examine the power utilization in cloud computing and examination should be done in both private and public cloud. Green Cloud Computing Solution decreases energy utilization and consequently lessens the operational coasts in cloud computing furthermore spares energy, henceforth, diminishes the negative impacts on environment. This work tries to actualize the task combination (consolidation) algorithm coordinated with job submission and scheduling algorithm and also trying to save energy by sending the unused servers to rest and migration of virtual machines in cloud computing.

Keywords:— Cloud computing, green algorithm, VirtualMachine (VM), VM migration,Physical Machine(PM), task consolidation

I. INTRODUCTION

Cloud computing is computing of various concepts where real-time communication takes place between thousands of computer systems to fulfill the user's needs, where user feels that as if he/she using a single large resource. Cloud computing provides larger numbers of computing resources, applications, storage for huge amount of data and many more. Another advantage of Cloud computing is that, the users of Cloud services need to pay only for the services they use from cloud and no other extra amount. Because of these utilities provided by the Cloud computing, numerous organizations and consumers are using cloud services and day by day as needs are increasing Cloud computing field is also growing.

The main objective of Cloud computing is to provide maximum numbers of shared resources and support for user requests in real time and on other hand the major disadvantage is its unnecessary power consumption, great amount of energy loss and higher infrastructure cost.

Why cloud needs green computing?

Global warming is becoming a biggest issue to face now days and Cloud computing is one of the biggest fields who is causing global warming in huge amount. Cloud uses thousands of storage areas which are known as data-centers and to run these data-centers and to process many processes cloud needs bulk amount of power. As there are so many numbers of data-centers each uses large amount of power and also emits huge amount of heat and hazardous elements like Carbon die-oxide.

According to the survey, [2] Power Usage Effectiveness (PUE) is used to quantify how effectively data-centers utilizes theirs energy. PUE qualities can be in the middle of 1.0 to infinity. In the event that PUE quality is 1.0 that implies full power is utilized by equipments and productivity of that data center is 100%. In past years some organizations like Google, Facebook, YouTube achieved low PUE values. For instance the PUE estimation of Google was 1.13. On the off chance that the estimation of PUE is 1.5 that implies data center is utilizing 1.5kWh of energy, 1kWh energy is devoured by the equipment and 0.5Wh is squandered in cooling of the frameworks. if such a large amount of energy is expended and wasted in one hour then there is tremendous measure of energy loss every day, every month and every year which is exceptionally unsafe for environment.

Green Solution gives a path by which we can decrease the amount of energy being devoured and amount of energy being squandered in Cloud computing.

The point of Green Cloud computing is to achieve efficient processing, as well as minimizing the energy devoured by cloud. This is required for making sure that the development later on of Cloud computing is supportable. Something else, Cloud computing with progressively broad front-end customer gadgets cooperation with back-end of

cloud will bring about a huge danger of energy use. To reduce this risk, data center should manage the resources [8] in an energy efficient way [l0] to achieve Green Cloud computing. That implies, Cloud resources ought to be apportioned to fulfill quality of service requirements by means of Service Level Agreements (SLA) furthermore to diminish energy use of cloud computing.

System Architecture

System architecture is the applied configuration that characterizes the structure and behavior of a system. This Architecture depiction is sorted out in a way that backings reasoning about the structural properties of the system. It characterizes the system components or building blocks and gives an arrangement from which products can be secured, and systems built up, that will cooperate to execute the general framework.

The System architecture is:

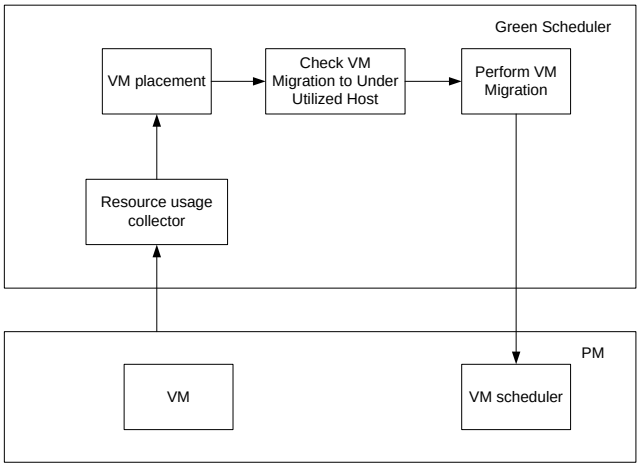

Figure1: Flow for assigning the VMs to PMs.

II. ALGORITHMIC APPROACHES

In this work two algorithms are being referred one is for consolidation of tasks and another is for submitting and scheduling the jobs.
Following are the algorithms being used as a reference:

A. **Single Task Consolidation Algorithm**.
Then based on the above algorithm following algorithm is proposed

B. Two Phase Consolidation Algorithm.

Before understanding about the algorithmic approaches we will first see the metrics which are considered for calculations of energy consumption, resource utilization and performance function.

***Following metrics are used*:**

a. Utilization function: for a specific task, if we know the processing time and processor usage then we can ascertain the energy devoured by that task. For resource at any given time, the utilization function U_i is defined as:

$$Ui = \sum_{J=1}^{n} u_{i,j}$$

Where,

n is the number for task running at that time,
$u_{i,j}$ is the resource usage of that task.

b. Energy consumed by resource r_i at any time is defined using E_i as:

$$E_i=(p_{max} - p_{min}) \times U_i + p_{min}$$

Where,

pmax, is energy consumption at peak load(100% utilization),
pmin, is minimum power consumption in the active mode(1% utilization).

c. To computes the actual energy consumption of the current task, Cost function is used which subtract the minimum energy consumption (p_{min}).The value $f_{i,j}$ of a task tj on a resource ri is obtained using:

$$f_{i,j}=((p\Delta x u_j+p_{min})xT_0\Delta-\Delta(p\Delta x u_j+p_{min})xT_1+p\Delta x u_j x T_2\Delta$$

Where,

$p\Delta$ is the difference between p_{max} and p_{min},
u_j is the utilization rate of task t_j
and T_0, T_1 and T_2 are the total processing time of t_j.

A. Single Task Consolidation Algorithm.

Task consolidation algorithm is also known as server/workload consolidation algorithm. Here we should consider that we have to consolidate the tasks without violating time constraints. The aim of consolidation is to minimize energy consumption by maximizing resource utilization.

It is the process of assigning a set "T" which has "t" tasks, which is nothing but service requests or simply services, to a set "R" which has "r" cloud resources.

Concept of Single Threshold Consolidation:

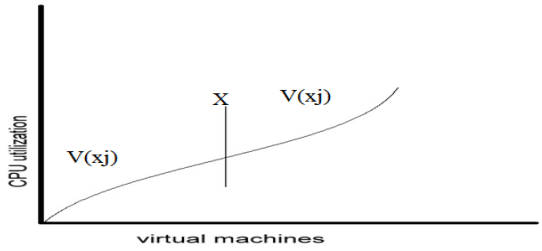

Figure2: graph showing Single Threshold algorithm

concept.

Here,

X- is a threshold value.

V (Xi) – are VMs which are working below threshold value.

V (Xj) – are VMs which are working beyond threshold value.

Now consider the following equations:

If V (Xj) then M [L {V (Xj)}] ⟶ V (Xi)

That means if VM is over utilised then Migration should be done from over utilised VM to under-utilised VM.

Here, **M [L {V (Xj)}]** means, Migrate the load of over-utilised VMs.

Input: A tasks tj from set T and r cloud resources from set R

Output: matching of task and resource

1. Let $r^* = \varnothing$
2. **for** $\forall r_j \in R$ **do**
3. Compute the cost function value $f_{i,j}$ of t_j on r_i
4. **if** $f_{i,j} > f^*_j$ **then**
5. Let $r^* = r_i$
6. Let $f^*_j = f_{i,j}$
7. **end if**
8. **end for**
9. Assign t_j to r^*

b. Two Phase Consolidation Algorithm.

We already have one solution for the problem, but as we know if there are some advantages of the system and it also has disadvantages. The problem in Single Threshold Consolidation is number of VM Migration and also the SLA violations because of those Migrations.

If there are more numbers of migrations then CPU cycles will be wasted in Migrations and also it will consume more energy. So we need to find a better solution than Single Threshold Consolidation.

Two-Phase Consolidation is the enhanced form of the Single Threshold Consolidation, which provide a better solution compared to existing solutions. Two phase consolidation uses less number of VM migrations so there are less numbers of SLA violations, which results in less energy consumption and less CPU utilization when compared with existing solutions. We will discuss about Two Phase Consolidation in further chapters.

This system is an attempt to reduce energy consumed in Cloud computing data centres by revising virtual machines scheduling method while keeping quality of service parameters as high as possible. The approach is implemented using CloudSim toolkit and evaluated it in compare with recent popular methods. Evaluation result demonstrates our success in reaching our aims to reduce energy consumption while keeping quality of service in acceptable range by reduction in number of virtual machines migrations.

Following tasks are required in implementation stage:

- We have to plan very carefully.
- We need to investigate the system and constraints on that system.
- To achieve the changes we need to have the design of methods.
- We need to take correct decisions to select the correct platform.
- For application development we need to select the language properly.

As we discussed in earlier chapter that the algorithms which are available, like Single Threshold Consolidation are having some drawbacks and the better solution is provided by Two-Phase Consolidation algorithm and while consolidating or migrating the VMs we also need to take care that there won't be useless migrations and also the number of migrations should be less, we also need to take care that there are minimum number of SLA violations. If we keep these things under control then surely we can get a better results compared to the existing solutions.

Simple idea behind the Two Phase Consolidation algorithm is that, check for under and over utilised VMs and prepare the Migration plan. At the beginning of the Two Phase Consolidation algorithm all hosts are checked and observed, after the observation, the hosts which are Under-Utilised and hosts which are Over-Utilised are listed. Once we determined the under and over utilised hosts, transfer the load

from the over-utilised hosts to under-utilised hosts and then turn off the over-utilised host. After this step check if there are still some under-utilised hosts, if yes then migrate the load of those VMs to the VMs which are working in energy barricade. Then at the end turn off all the hosts which are empty and run only those nodes which are working in good conditions where the CPU utilization is less. By doing this we can save lots of energy compared to other existing solutions.

Concept of Two Phase Consolidation:

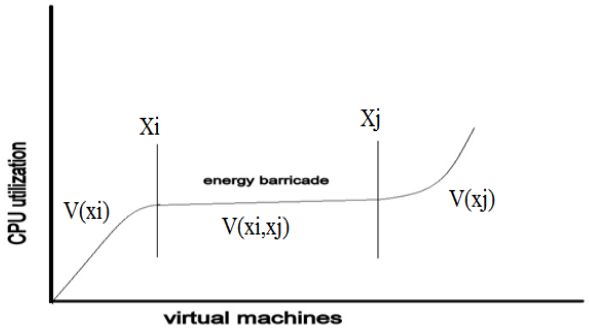

Figure3: Concept of Two phase Consolidation Here,

Xi, Xj – are upper and lower threshold value.

V(Xi) – are VMs which are working below threshold value.

V(Xj) – are VMs which are working beyond threshold value.

V(xi,xj) – are VMs which are working in energy barricade.

Now consider the following equations:

1. **If V(Xj) then M [L {V (Xj)}⟶ V (Xi)**

That means if VM is over utilised then Migration should be done from over utilised VM to under-utilised VM.

2. **If V (Xi) then M [L {V (Xi)}] ⟶V (xi,xj).**

That means if VM is under-utilized then Migration should be done from under-utilized VM to the VMs which are working in energy barricade.

Here, **M [L {V (Xj)}] and M [L {V (Xi)}]** means, Migrate the load of over-utilised and under-utilized VMs.

Steps in Two Phase Consolidation algorithm:

- Input: Task and Resources
- Output: Task and Resource matching.
- Advantage: very less CPU usage, resulting in less energy consumption.

***Steps*:**

1. Start.
2. Set the lower and upper threshold values after observing the behavior of the system and VMs.
3. Give tasks as input to the cloud system.
4. Check for the VMs in cloud and assign the VMs to the Jobs.
5. Assign the Physical Machines to VMs.
6. Check for the Over-Utilized VMs.
7. If VM's CPU usage is more than threshold value
   - Then migrate the load of over-utilized VM to under-utilized VM.
8. Check if there are still under-utilized hosts.
   - Then migrate the load of those VMs to the VMs which are operating in energy barricade.
9. Put all the empty Hosts to sleep mode.

RESULTS

- **Adding physical machines and assign MIPS :**

As shown in snapshot below, physical machines are created using different PM IDs and different values for MIPS. After adding the physical machine chooses the action: no consolidation or consolidation.

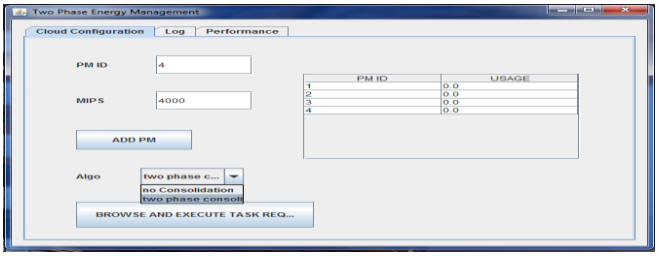

Figure4: Adding physical machines and assign MIPS.

- **Browse the file which is to be given as input load:**

Click on browse file button and choose the load for the configured system. There are different loads that we can get different values depending on the loads.

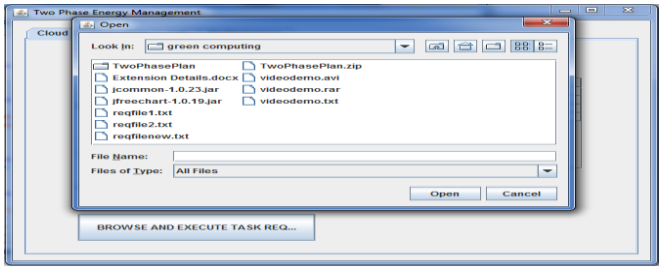

Figure5: browse the file which is to be given as input load.

- **Check the CPU utilization:**

When we choose the load then system starts working, following is the snapshot of observed CPU usage after load is provided.

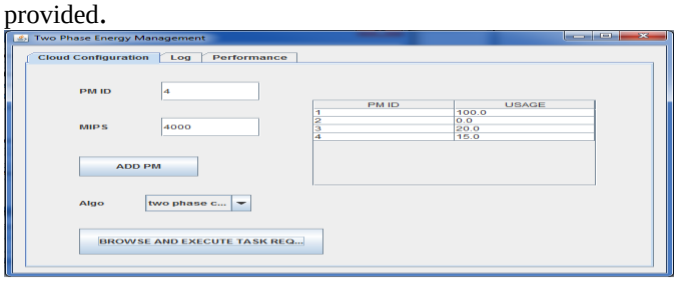

Figure6: check the CPU utilization.

- **graph for number of Migrations:**

Observation shows that there are no migrations of VMs when no consolidation option is selected, because it is the normal operation in cloud without using any algorithm. Whereas for two phase consolidation algorithm there are maximum numbers of VM migrations compared to single threshold algorithm.

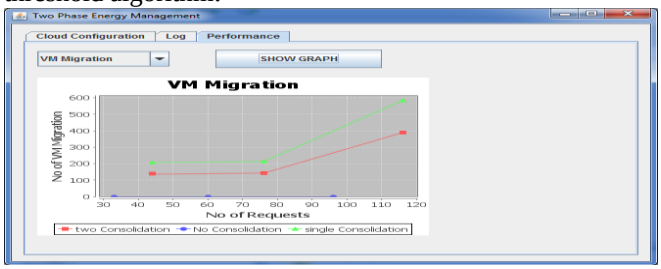

Figure7: graph for number of Migrations

- **Graph for number of SLA Violations:**

SLA violations are taken cared in two phase consolidation algorithm so there are less number of SLA violations in Two phase consolidation compared to Single threshold and no consolidation options.

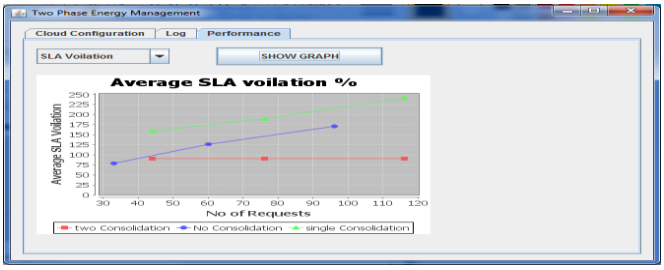

Figure8: graph for number of SLA Violations

- **Graph for number of Energy Consumption:**

Following are the observations for the energy consumptions by VMs when experiments are carried out for different loads and different methods. Observations clearly shows that energy consumption is more when there is no consolidation algorithm is used in cloud and there is less energy consumed when Single threshold algorithm is used and even lesser when Two phase consolidation algorithm is used.

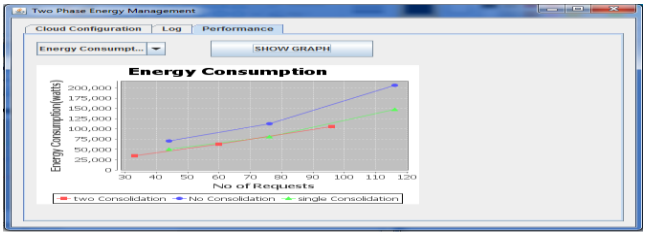

Figure9: graph for number of Energy Consumption

III. CONCLUSION & FUTURE SCOPE

The work carried out here mainly addressed a problem in many of scheduling algorithms and these algorithms can be used as a base for overcoming the problems in old methods. In experiments conducted here, approach together with old Migration methods and VM selection method, two phase consolidation method performed better than other algorithms in terms of SLA Violation and Number of Migrations and also showed better level of CPU energy consumption.

Two Phase Consolidation algorithm method migrates VMs to optimize overall parameters, despite of user's behaviour and their SLA Violation and sometimes cause starvation for servicing an extreme SLA violations for some users with specific VM configuration. Concentration of this subject is to try to make value of maximum SLA Violation that happens for a user to average SLA Violation value while trying to reduce both VM migrations and energy consumption. Future work can be a method by which we can further reduces the VM migrations in case of Two Phase Consolidation algorithm to achieve much more better results.

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