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Energy Efficient Virtual Machine Scheduling Algorithm

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ABSTRACT

The cloud computing is the major technology used today .Energy consumption is the main concern in cloud computing .So energy preservation can be reduced in cloud computing by taking into account various factors .Without the more usage of energy maximum resource utilization is possible. The purpose of this paper is to produce an energy aware cloud data center by means of host consolidation and energy aware virtual machine migration under the different workloads characteristics. This papers proposes a Novel Power VM Allocation Policy Migration Algorithm namely Multi-dimensional Overload Detection Algorithm (MODA) to provide an energy efficient cloud data center.

Keywords :- VM Scheduling, Data center, Migration ,Allocation , Cloudsim

I. INTRODUCTION

Cloud Computing[1] is the computing model whose main goal is to access the resources in more reliable way so that to maximize the benefit and the users pay for resources they use. The data centers which are continously increasing the usage of computers so there is large utilization of energy. It also gives the negative effect to the environment .The main reason for energy consumption reason are minimizing the power consumption [2] ,increasing resource utilization and maximizing the profit. The number of users are increasing day by day so tasks are also increasing which needs to be properly scheduled by minimizing the energy consumption [3].The cloud data centers are implemented in many cloud server. The main task of the data center is to minimize the energy consumption .The inefficient use of data center [4] in servers leads to more comsumption of energy and less resource utilization.

In data centers the energy consumption in cloud can be reduced by less number of active servers kept on. There are various virtual machines operating in parallel in cloud computing some VM are kept under utilized which they run only 15 percent of their overall capacity while other VM are continuously operating more than there capacity which leads to over consumption of energy .If proper scheduling [5]is use the tasks can be scheduled to other under utilized VMs so that former overloaded VM can be kept off .In data centers there are various switches and routers which are communicating to the servers .The task are scheduled in data center by scheduling algorithm .The user send their request to data center for whatever task they want to execute such as reading file content,uploading file, downloading software This tasks are then categorized according to the suitable scheduling algorithm and then assign to one of the available servers .So various algorithms have been discussed in virtual machine scheduling algorithm like First Come First Serve(FCFS), Round Robin ,Min-Max Algorithm ,Bee algorithm[6] all of these algorithms are designed in such a way the input tasks are scheduled in an energy efficient manner. But all this algorithms have some of their pitfalls which needs to be eradicated to reduce the energy consumption in data centers. To provide an energy efficient cloud data center a novel Power VM Allocation Policy Migration Algorithm namely multi-dimensional Overload Detection Algorithm (MODA) is used. To choose this technique as the most optimal energy efficient solution, which aids in improving the overall performance of the system under consideration, by minimizing overall energy consumption.

II. DOCUMENT ORGANIZATION

The paragraph 1 of this survey paper represents the resource allocation which is performed in the server data center. The resource allocation in cloud is done by random choice performed in servers

The Paragraph 2 of this paper represents how the energy management is done in the VM by considering various parameters like Single Threshold, Load balancing and performance comparison.

The paragraph 3 of this paper represents The Multi-dimensional Overload algorithm .The main task of this algorithm is to detect the hotspot(congestion) in the algorithm andthen select the VM for migration so that it may reduce the energy consumption.
The Paragraph 4 of the paper represents the experimental analysis of various algorithms and the analysis of reduced energy consumption.

III. RELATED WORK

The T.JeniferNirubah ,Rose Rani Zone in their paper titled "**Energy efficient Task Scheduling Algorithm** "has proposed a ESF_ES algorithm which is developed by combining the hybrid algorithm and more efficient server first scheme algorithm. The set of tasks and servers as taken as input and users will request for computing various types of tasks and based on this this tasks computing time will vary.Then the energy slope is calculated according to each type of task selected with the help of processing time.Here task allocation is done to the most efficient server first so that the number of active servers is reduced in comparision to available servers .This algorithm follows the greedy approach.

Ge Lu ,Michelle Chartier,YeongJye Huang in the paper titled "**A New Virtual Machine Scheduling Algorithm in Cloud Computing "**they proposed a new virtual machine scheduling algorithm in order to maximize efficiency.This algorithm schedules the virtual machine request by the user according to their priority which is analyzed by the account level purchased by the user.Here the users who pays higher fees than others are given priority to other low payers .This algorithm is HPF_MRU (Highest Priority First and Maximum Resource Utilization).

OlyinkaAdeleye in his paper "Energy **Aware Virtual Machine Scheduling Algorithm** " has proposed a energy aware scheduling algorithm.Virtualization is considered a key technique and backbone of all these approaches**.**

Yousef Tohidirad1, Siamak Abdezadeh2, ZahedSoltani aliabadi3, Abdolsalam Azizi4 and Mohammad Morad[4]in their paper "**Virtual Machine Scheduling in Cloud Computing Environment"** has mentioned a generalized priority algorithm in which clients are calssified in accordance with consumer demand .Here jobs are originally classified accordance with the bandwith ,memory and also on the size the file with largest size is given priority to other one as that file score is largest. The Virtual Machines are similarly characterized in accordance with their MIPS quality in the way the one with the highest MIPS[7] ranks the first.This allocation policy is better than FCFS and RR.

IV. RESEARCH PROBLEM

In the present situation the most of the cloud data center consume enormous amount of energy and incurs high cost. This energy wastage lies due to improper consumption of computing resources.The few existing virtual machine scheduling algorithms like HPF_MRU (Highest Priority First And Maximum Resource Utilization) and ESF_EF(Efficient Server First Scheme Algorithm)[9] provide better strategies through efficient allocation ,yet have some limitations.
The High energy consumption leads to more consumption of energy therefore this leads to less utilization of resources .The High SLA violation and performance of VmDegards due to more number of VM migration and presence of Hotspot and server overloading in the cloud data center.

V. PROPOSED METHOLOGY

In this proposed Methodology , a cloud data center with several virtual machines and hosts is considered .Each of the virtual machine is denoted as a node.
Datacenter (DC) is of the four states namely :

- ***HOT_DC :*** Runs VM with over-utilized resource and makes DC to overload with the hotThreshold value of 0.90
- ***WARM_DC***:Runs normal DC with the warm Threshold as 0.65
- ***COLD_DC:***Exists in ideal state with coldThreshold Value of 0.25
- ***GREEN_DC:***Indentifies the set of PMS which runs VMs with green computing threshold as 0.40

To stop overloading of this data center,VMs which are running in HOT_DC(overloaded DC)[11] will be migrated to either COLD_DC or GREEN_DC[12].
The main aim of using this four states that it can minimized overall energy consumption.Thus this minimized performance degradation with minimum number of VM Migration[10]. This algorithm is multidimensional nature of algorithm with energy efficient migration. This algorithm also helps to find the hotspot detection (congestion) and overload detection in cloud data center.

Algorithm:

Multidimensional overload detection algorithm(MODA) is proposed and implemented with energy efficient migration on VMS and saves considerable energy under varying workloads**.**

- Moda Technique tries to minimize skewness[8] for liot spot detection and mitigation.
- The concept of "skewness "to measure the unevenness in the multidimensional resource utilization of the server ,is used. By minimizing skewness different types of workloads can combine easily and improve the overall utilization of server resources.
- The Moda deals with multidimensional performance metric such as minimized energy consumption , less number of VM migration ,less number of host

shutdowns and minimized performance degradation,to optimize VM placement .

Multidimensional overload detection algorithm (MODA)

***Precondition*:**VM selection policy ,host list ,Threshold value of resources .

***Postcondition*:**Indicating overloaded and underloaded host ,virtual machine to be migrated .

Step 1:Select VMs.
Step 2:Select number of hosts.
Step 3: Set Data centers and initial SLA.
Step 4:Set VM selection policy for the host list,selection policies are MC,MMT,MU,RS.
Step 5:Optimize allocation of the VM according to current utilization with VM list
Step 6:Get over utilized host and initialize hotTemp== c;where c=0.90
Step 7:getVmToMigrateFromHost ;Reallocation of VMs from overutilized
list
Step 8:gets Migration map from underutilized hosts.
Step 9:switch off hosts that are overutilized .
Step 10:Finds underutilized hosts.
Step 11:if (vm to migrate from under utilizedhost=empty) then the reallocation
of VMS from the host.
Step 12:check if host is overutilized after allocation .
Step 13:find host suitable for VM and hotspot detection using skewness.

***Step14*:**skewness=sqrt(ram+bandwidth+cpu);skewness caluation using average utilization
Step 15:define threshold values of resources as hot threshold ,cold threshold ,warm threshold, green computing thresold
Step 16:if host(hot temp of server)>=0.90 is true
Step 17:host is overutilized and returns the sorted of high temperature host
***Step 18*:**get the utilization of the cpu in MIPS for the current potential allocatedVMS.
Step 19:give ESLAV metric as ESLAV =Energy *ESLAV;Combination of
energy and SLA violation.
***Step 20*:**Adds history value to host in terms of execution time, utilization and
metric history
Step 21:Return execution time history for VM selection ,host selection ,VM reallocation
Step 22:End

VI. SYSTEMATIC METHODOLOGY

VM Selection

If the host is overloaded,then some VMs should be migrated from it and make it not generate SLA violation. There are four policies to migrate VMs from overloading hosts..

- ***Maximum Correlation Policy*:**To migrate a VM on host ,whose utilization has the maximum correlation coefficient with the sum of other VM on the host.
- ***Minimum Migration Time Policy*:** To migrate a VM which has minimum migration time among other VM on the host.The migration time is the estimated as the amount of RAM utilized by the VM divided by space network bandwidth available for the host.
- ***Minimum Utilization Policy*:**Among the various VM select the minimum utilization VM to migrate .A simple method to select the VM from overloading host.
- **Random Selection Policy:**Randomly select a VM to migrate among the all VM on the host.

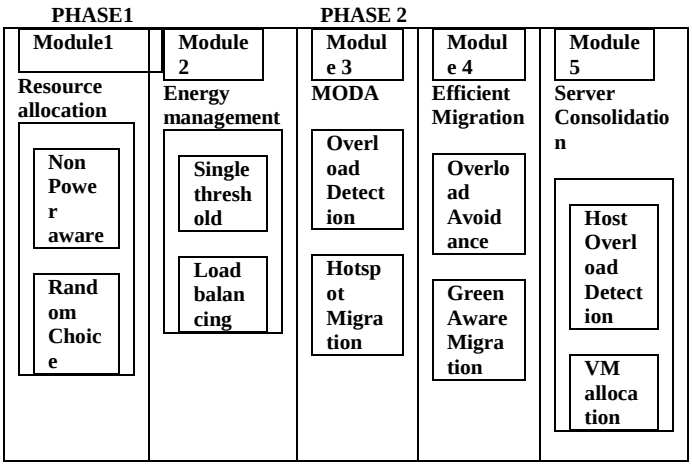
a. Module Split-up

To minimize skewness and combine different workloads ,MODA is used and measured directly based on the following two concepts:

- *Hotspot* : If the utilization of any of resource is above the hot threshold.This indicates that server is overloaded hence some of the VM running o it to be migrated away .The overloaded host is determined by
  If host(hotTempofServer)>=hotThresold ,where hot threshold=0.90
  Then the host is overloaded and returns the overloaded list of high temperature hosts.

- *Cold spot*: If the utilization of all the resources are below the threshold.This indicates that the server is mostly idle and a potential candidate to turn off to save power.The goal is to eliminate all hotspot as possible or by keeping their temperature low as possible.

Table:1



b. Server Consolidation:

1.Server consolidation is generally used when we have to indicate an approach to maximize physical resource utilization.VM migration can be used to dynamically consolidate VMS onto more suitable server physical machines .

The main task of server consolidation can be divided into four parts:

- ***Host overload detection*** :Adaptive utilization threshold based method.
- ***Host underload detection***: Switches the host to sleep mode
- **VM Selection** :The VM that is overloaded is migrated.
- ***VM allocation*** :Finding new placements of VM selected for migration.

c.Calculate Parameters :

- ❖ The temperature of hotspot p is defined as the Square of the resource utilization beyond the high temperature threshold

Temperature(p)=(r-rt)*(r-rt)

r is the set of resources that are overloaded in server p,rt is the threshold of resource r,Temperature of hotspot is to reflect the degree of overload.

- ❖ Performance Degradation due to migration is calculated as :

PDM=1/M Cdi/Cri

M represents the number of virtual machines ,Cdi refers to performance degradation caused due to VM migration.

VII. RESULT AND IMPLEMENTATION

Software tool

- The Main tool used in this moda technique is cloud sim 3.0. 3.
- For graphics Matlab is used.
- Operating system is window 7.

Hardware tool

- Development IDE is NetBeans.
- Ram should be of 4 Gb.

MODA Algorithm with Multi Dimensional Parameters
Table: 2

Parameters	VM 1	VM 2	VM 3	VM 4
No. of VMs	1052	898	1061	1516
Energy	87.48	66.68	67.11	78.64
No of VM Migration	1296	1206	1662	2075
Performance Degradation	0.00	0.00	0.0001	0.0001

Comparative result of different VM allocation Algorithms for same data size of result

Table:3

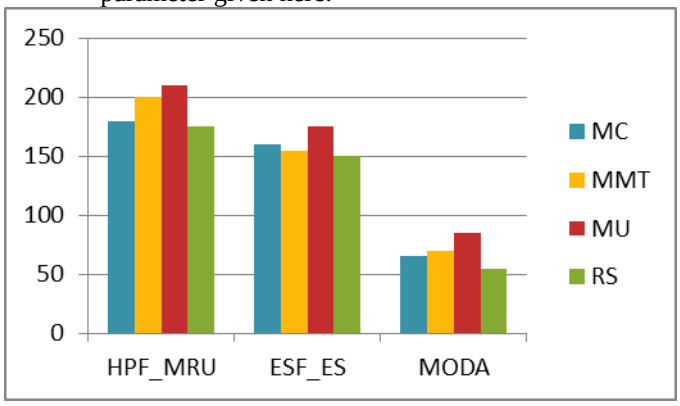
VM allocation policies	Energy(KWH)	No. of host shutdown	No. of VM Migration	SLA perf. Degradation(%)
HPF_MRU	142.56	4628	19587	0.0011
ESF_ES	120.55	3455	18046	0.0010
MODA	66.68	781	1206	0.00

Table:4

VM allocation policies	Energy(KWH)	No. of host shutdown	No. of VM migration	SLA perf. Degradation(%)
HPF_MRU	188.55	5769	24735	0.0010
ESF_ES	159.65	4415	24212	0.0010
MODA	87.48	776	1296	0.00

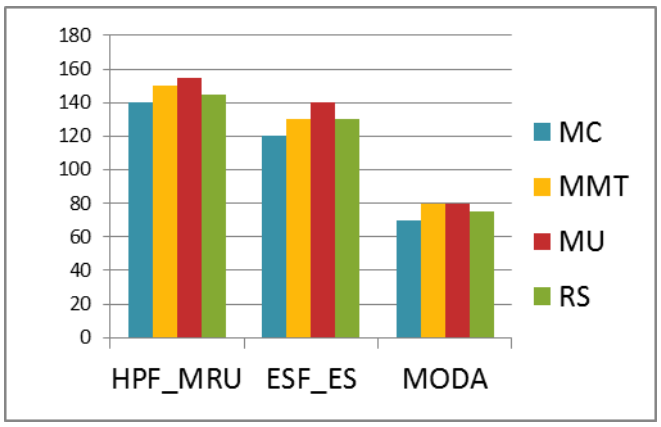
Algorithm	Security aware	Power Aware	Cost Effective	Memory Bandwidth aware
FCFS Algorithm	✓	–	–	–
Genetic Algorithm	-	✓	✓	–
HPF_MRU Algorithm		–	–	✓
ESF_ES Algorithm	✓	–	–	✓
MODA Algorithm	✓	✓	✓	✓

- Here in this section the comparision between various algorithms with the various parameters are shown.
- We found out Moda is the best among them which means it is most efficient algorithm regarding all the parameter given here.



7.1 Comparision of VM allocation policies with 800 host and 1052 VMs

Performance comparison using MATLAB



7.2 Comparision of VM allocation policies with 800 hosts and 898 VMs

In the above figures we tried to compare many hosts and various vm machine with the following parameters :-
1.mc=maximum callation.
2.mmt = minimum migration time .
3.mu= minimum utilization .
4.rs= random selection

VIII. CONCLUSION

The most challenging problem today in cloud data center is conservation of energy. The various energy efficient scheduling algorithms have been used in servers to minimize the consumption with maximum utilization of resources.

Thus Multidimensional Overload Detection Algorithm has been proposed which helps to minimize the energy by hotspot detection and mitigation.

In future the performance can be improved by using other algorithms.The above work can be enhanced by using the combination of other algorithms.

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