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EFFICIENT VIRTUAL MACHINE SELECTION ALGORITHM FOR MINIMIZING UNNECESSARY MIGRATIONS IN CLOUD DATA CENTERS

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Abstract – Load balancing is an essential task in cloud data centers that is performed for proper utilization of resources. In addition to that, load balancing also helps in enhancing overall performance of the data centers in terms of availability and reliability. Load balancing is achieved through consolidation of virtual machines in data centers. The key task of load balancing is to continuously monitor the load of physical machines and to detect the overloaded machines and under loaded machines. In case of over loaded physical machine, few virtual machines are to be removed off to mitigate service level agreement (SLA) violation. In case of under loaded physical machine, all virtual machines from it are to be migrated to other suitable hosts. The proposed work devises an algorithm that selects appropriate virtual machines that are to be migrated from over loaded hosts. The virtual machine selection algorithm is found to reduce number of migrations that are unnecessary. The implementation of proposed algorithm has been done in cloudsim and results obtained are compared with those of existing benchmark algorithms of cloudsim. The results have shown that proposed algorithm has significantly reduced energy consumption.

Keywords **- Virtual machine selection, Virtual machine consolidation, SLA violation, Load balancing**

1. INTRODUCTION

Cloud data centers are growing exponentially in size and numbers. Performance and reliability of these data centers depend on numerous factors of which optimal resource utilization is the most vital one. Proper and better utilization of resources in cloud data centers can be achieved by efficient load balancing algorithms. Efficiency of load balancing algorithms is not only measured by optimal resource utilization and performance but also by the amount of energy consumed. Virtual machine (VM) consolidation is done when over loaded physical machines are detected and virtual machine deconsolidation is done when an under loaded physical machine is detected. Migration of virtual machines is the common aspect in both cases whereas the underlying objectives are different. When it comes to overloaded physical machines, it leads to SLA violation. Few virtual machines are to be migrated from them to bring back those machines to normal load state. Selection of virtual machines for migration from over loaded physical machines plays an important role in the process of VM consolidation. This problem of VM selection finds no place in the case of under loaded physical machines since all virtual machines are to be removed off from them. Such VM deconsolidation is performed to reduce energy consumption by switching off the under loaded hosts.

The default algorithms for virtual machine placement and selection found in cloudsim toolkit[2] are presented by Belaglazov and Buyya in [1]. They defined four VM selection algorithms namely minimum migration time (MMT), random selection (RS), minimum utilization (MU) and maximum correlation (MC). Minimum migration time algorithm chooses a virtual machine that takes the shortest time to migrate. Random selection algorithm chooses a virtual machine randomly from an overloaded physical machine. Minimum utilization algorithm chooses a virtual machine which has the least resource utilization on the host. Maximum correlation algorithm chooses a virtual machine that has maximum correlation with other VMs present in the over loaded physical machines. Mashhadi Moghaddam et al. in [4] have proposed an energy aware VM selection policy that reduced the number of migrations and mitigated SLA violations. They computed virtual machines' CPU utilization on each physical machine and checked for any linear correlation between the virtual machines' CPU usage.

Mishra et al. in [5] have classified the tasks according to their resource requirements. Then they have tried to map the tasks on to appropriate virtual machines. Finally mapping of VMs to suitable physical machines is carried out. They have shown that this energy aware task based virtual machine consolidation algorithm has resulted in reduction of energy consumption. Authors in [6] have presented a VM selection policy that is based on minimum correlation coefficient. They have shown that their work has resulted in lesser energy consumption and reduced SLA violation.

Li and Cao in [12] have proposed an approach of VM consolidation based on multiple objectives that include minimized power consumption and less communication overheads. They have presented a host load detection algorithm based on ant colony optimization technique. They have concluded that their proposed method has resulted in better quality of service and less power comsumption.

We propose an efficient virtual machine selection algorithm that aims at avoiding unnecessary migrations. The proposed algorithm aims at selecting an appropriate virtual machine for migration from overloaded hosts and such selection helps in bringing back the overloaded host to its normal load state with few further virtual machines removal.

2. PROPOSED WORK

When an over loaded physical machine is identified, it is necessary to migrate few of its virtual machines until its load becomes normal. Selecting a virtual machine for migration is an important decision which contributes to the efficiency of the whole virtual machine consolidation process. When migrating a virtual machine (VM) from an overloaded physical machine to a new host, it is crucial to ensure that the new host does not become overloaded. The new host must have sufficient resources to accommodate the VM for an extended period. Selecting an appropriate virtual machine is just as important as choosing a suitable new host. The objective of the proposed work is to mitigate unnecessary migrations which would eventually result in saving energy consumption and improved performance. We propose an efficient virtual machine selection algorithm that is based on a metric called maximum request. Amount of Ram currently requested by virtual machine is considered in this approach. The currently requested RAM of all virtual machines that are eligible for migration are compared, and the one with the largest amount is selected. The proposed algorithm is presented below. The input of this algorithm is the list of virtual machines that are eligible for migration from an overloaded host mentioned as MIG_VmList. Output of this algorithm is expected to be an appropriate virtual machine for migration mentioned as VM_MIG. Lines from 3 to 7 selects a virtual machine with the largest amount of currently requested RAM.

2.1 Efficient Migration Reduction VM Selection Algorithm (EMRSA)

```
Input:  MIG_VmList
Output: VM_MIG
1.    VM_MIG = NULL
2.    Initialize minimum value MIN_VAL
3.    For all VM in MIG_VmLIST do
4.          size= currentRAMrequest (VM)
5.          if size > minval then
6.          minval = size
7.          VM_MIG = VM
8.          End if
9.    End for
10.   Return VM_MIG
```

This algorithm selects a virtual machine that requests for the highest amount of RAM. This approach brings down the number of virtual machines to be migrated from the overloaded hosts. Minimizing the number of migrations is beneficial for reducing energy consumption.

3. PERFORMANCE METRICS AND EVALUATION

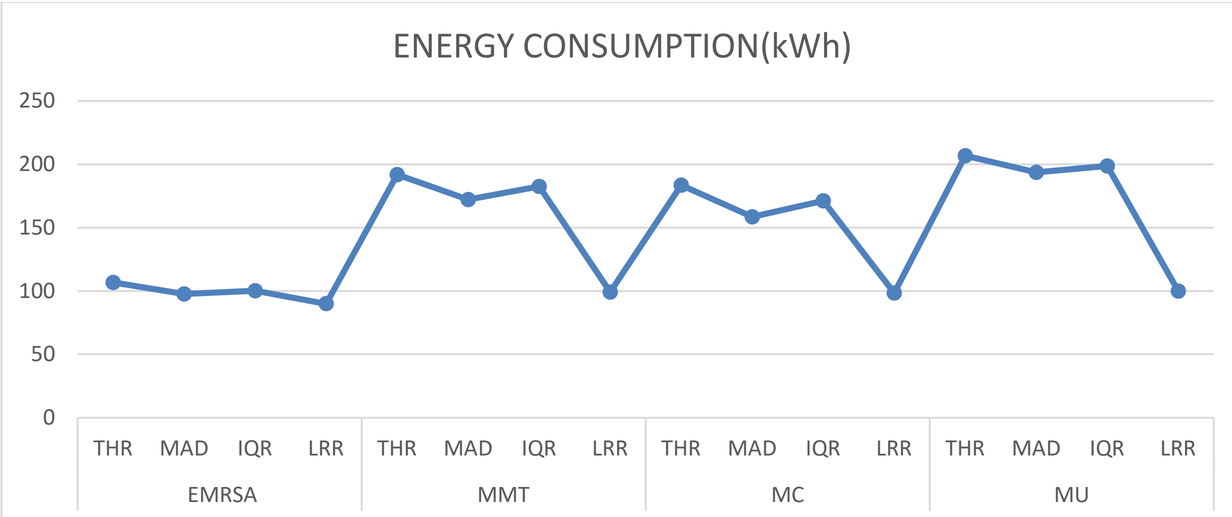
Parameters as defined in [1] that include number of migrations, energy consumption, SLA violation and performance degradation caused by migrations are to be evaluated. The proposed algorithm is implemented in cloudsim [2] and executed using planetlab [7] workload traces. Results are compared with those of default VM selection algorithms MMT, MU and MC in cloudsim. All these algorithms are run in combination with default VM overload detection algorithms namely THR, MAD, IQR, LR and LRR as described in [1,8] . THR algorithm is based on simple idea of setting CPU utilization threshold and when the current utilization of a host exceeds this threshold value, host is found to be overloaded. Median absolute deviation (MAD) algorithm collects past CPU utilization values of virtual machines and applies statistical analysis for dynamically adjusting CPU utilization threshold. Inter quartile range (IQR) algorithm sets an adaptive CPU utilization threshold value based on Interquartile range, a measure of statistical dispersion. Robust local regression (LRR) method [1] use heuristic based on Loess method for detecting overloaded hosts. These combinations have resulted in 16 experiments. Results are presented in Table 1 and Fig. 1. Energy consumption is given in kWh and PDM as percentage.

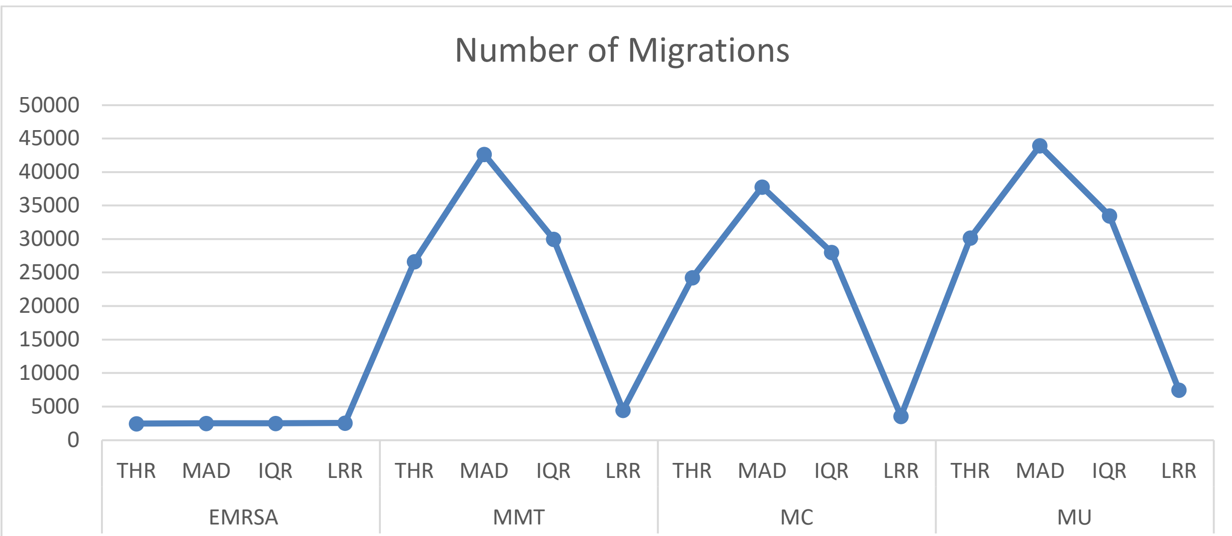
TABLE 1. RESULTS

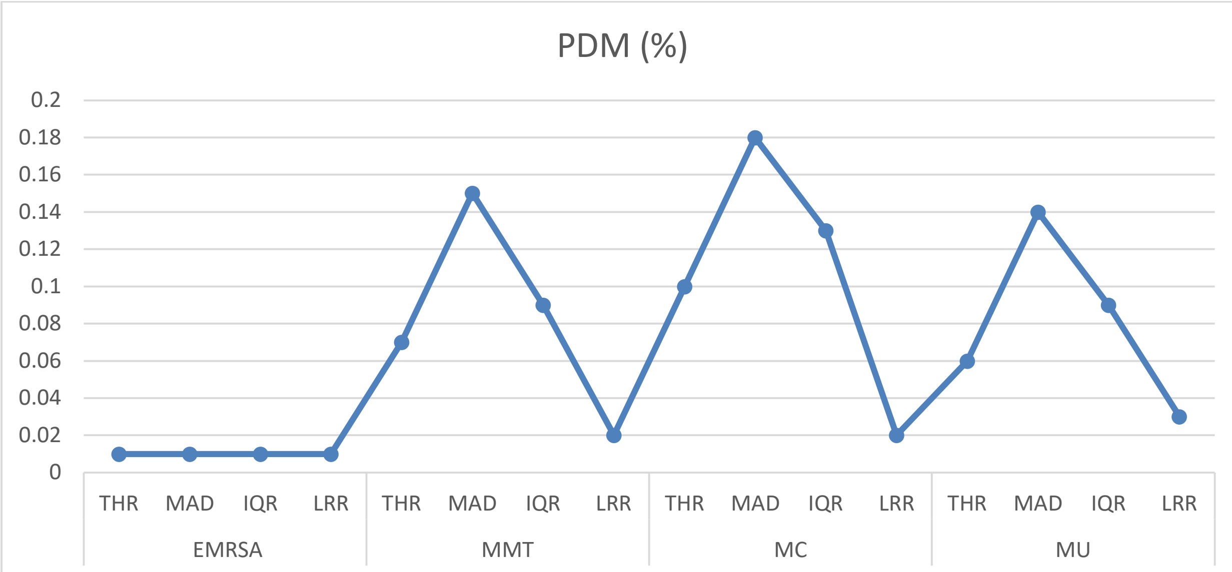
VM Selection Algorithm	Overload Detection Algorithm	Energy Consumption (EC)	Number of Migrations (N)	Performance Degradation due to Migration (PDM)
PROPOSED ALGORITHM EMRSA	THR	106.8	2458	0.01
	MAD	97.63	2515	0.01
	IQR	100.12	2519	0.01
	LRR	89.94	2548	0.01
MMT	THR	191.73	26634	0.07
	MAD	172.11	42681	0.15
	IQR	182.37	29988	0.09
	LRR	99.01	4477	0.02
MC	THR	183.61	24235	0.1
	MAD	158.53	37780	0.18
	IQR	171.15	28041	0.13
	LRR	98.47	3580	0.02
MU	THR	206.73	30188	0.06
	MAD	193.58	43933	0.14
	IQR	198.68	33476	0.09
	LRR	99.82	7474	0.03

It is evident from Fig. 1 that the proposed algorithm EMRSA has performed better than the baseline placement algorithms MMT, MC and MU. Combinations of MMT, MC and MU with LRR algorithm are found to be equally good in terms of energy consumption and number of migrations but performance degradation is higher when compared with that of the proposed algorithm. It is also understood from the results that energy consumption is increased by increase in number of migrations. Degree of consolidation of virtual machines is to be considered so that unnecessary VM migrations could be avoided.

Figure 1. Energy Consumption, No. of Migrations, PDM







4. CONCLUSION AND FUTURE WORK

The decrease in number of virtual machine migrations during VM consolidation leads to improved performance and reduced energy consumption. The proposed approach has succeeded in achieving the same. Excessive virtual machine consolidation may lead to more number of frequent migrations of virtual machines. This in turn will increase energy consumption and will definitely violate service level agreement. One factor that contributes to energy saving is the minimum number of virtual machine migrations. The proposed work has considered only one metric which is the amount of RAM currently requested by VM. To achieve better results, the work can be extended by taking few more resource metrics into account for selecting virtual machines for migration from an over loaded host.

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