

# Energy Efficient VM Migration in Cloud for Load Balancing

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**Abstract:** Cloud computing has brought a revolution in high performance computing these days. In cloud Computing energy and load balancing is been a concerned domain for all the researchers. In this paper a Max-Min ACS based approach is applied for load balancing is cloud. The results show considerable reduction in VM Migration and energy consumption.

**Keywords:** Ant colony system (ACS), Cloud, Energy in cloud, VM Migration.

## I. INTRODUCTION

Some decades ago when Internet was not introduced, companies ran e-mail as an application where data was stored in the hardware or in a secure place only. All the files, documents, messages and other important information were stored in a protection on the company's premises only [1]. However, it was not possible to store the huge amount of data due to lack of storage space. By moving forward into the 20th century, when companies like Google started showing up and email system has been started [1]. Then it became easy, it would have been a great invention of Google, that cause more subscribers, however these companies choose to open their own servers to store e-mail information for customers. However, to access that data, user has to adopt their applications like Gmail, Yahoo Mail and so many others. Further to open own servers and access all these applications to store the information of customers, Internet arrived. Moving further, if describe practically about cloud computing, adopting other people's servers to run applications for the organization, remotely is called as cloud computing system. For example, with cloud

computing, different applications and services can be accessed without ever buying an extra piece of hardware or software. Whenever user required any changes to the cloud data, there needs an Internet connection [1]. The cloud computing nature is shared resource, identity management, privacy and access control; these all parameters are the area of concern in cloud computing. Organizations are increasing day by day for computation of applications in the cloud, this is necessary to deal with cloud computing security issues.

## II. RELATED WORK

In [12] an admission control and scheduling mechanism proposes which not only maximizes the resource utilization and profit, but also ensures that the QoS requirement is proposed. Mixed Workload Aware Policy (MWAP) is implemented to consider the workload of different types of application such transactional and non-interactive batch jobs. The proposed mechanism provides substantial improvement over static server consolidation and reduces SLA violations. In [13] VM consolidation problem which is a NP Hard problem is solved by applying meta-heuristic algorithm ACO. The objective is to lower down the energy consumption of the overall algorithm. And the algorithm also reduces VM migrations. In [6] a novel allocation and selection policy for the dynamic virtual machine (VM) consolidation in virtualized data centers to reduce energy consumption and SLA violation. Firstly, it detects overloading hosts in virtual environments and then applies a method to select VMs from those overloading hosts for migration. VM Provisioning Method to Improve the Profit and SLA Violation of Cloud Service Providers. In [2]

authors proposed a Threshold based algorithm for VM provisioning among multiple service providers that reduces SLA Violation. It uses two threshold values and two type of VMs (on-demand and reserved), These threshold values will be decided by the cloud federation depending on the environmental conditions like current workload, idle capacity of each cloud provider, etc. In [11] a power friendly algorithm is proposed. This paper compared live and non live VM migration in terms of power consumption. In [16] authors developed an objective method to facilitate the comparison of different virtual machine placement algorithms in the cloud. In [17] stable matching framework to decouple policies from mechanisms when mapping virtual machines to physical servers are presented and a general resource management architecture called Anchor is proposed. In [18] the resource allocation problem to be a convex optimization problem and proposed a self-organizing cloud architecture is discussed. Speitkamp and Bichler [20] studied the static consolidation problem with a mathematical programming approach. In [19] they modeled the consolidation as a modified bin-packing problem. These works focus on the initial VM deployment or static consolidation problem based on resource utilization and do not consider VM migration overhead.

### III. MAX-MIN APPROACH

Consider each physical machine is represented by a node in graph and each edge defines VM migration from one physical machine (PM) to another. The generated graph will be directed and completely connected having positive edge weights. Consider 3 physical machines having one, two, three VMs respectively.

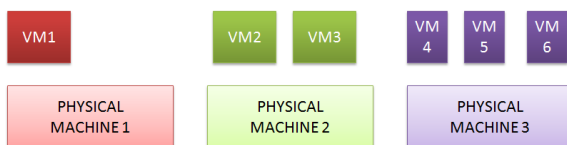


Figure 1 virtual machine

The above situation can be converted into graph as shown below. In AS ants concurrently build the solution for the Cloud VM. Initially ants are put on randomly chosen nodes which represent PM. In each iteration construction step, ant  $k$  applies probabilistic action choice rule, called random proportional rule, to decide to which PM given VM should be migrated.  $P_{ij}$  is the probability of migrating VM to  $j$  which is currently at  $i$  is:

$$P_{ij}^k = \frac{[\tau_{ij}]^\alpha [\eta_{ij}]^\beta}{\sum_{l \in N_i^k} [\tau_{il}]^\alpha [\eta_{il}]^\beta} \quad \text{if } j \in N_i^k$$

Where  $\eta_{ij} = 1/d_{ij}$  is a heuristic. There are two ( $\alpha, \beta$ ) parameters which determine the relative influence of the pheromone trail and the heuristic information, and where  $N_i^k$  is the nodes which are available.

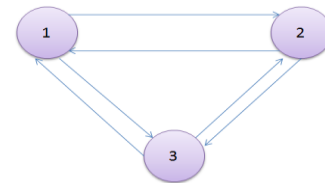


Figure 2 graphical presentation of VM

#### Update of Pheromone Trail

When ants have constructed their tours, pheromone trails are updated. This is done by first lowering the pheromone value on all the edges by a constant factor called  $\rho$ . And then adding the pheromone content on the edges visited by the ants in their tours. Pheromone evaporation is done as:

$$\tau_{ij} \leftarrow (1 - \rho)\tau_{ij} \quad , \quad \text{for all } (i, j) \in L.$$

Where  $\rho$  is the pheromone evaporation rate lies between  $0 < \rho \leq 1$ . The parameter  $\rho$  is used to avoid unlimited pheromone deposition and it enables the algorithm to not to choose the bad path that were chosen by earlier ants. The pheromone evaporation decreases the pheromone content exponentially with the number of iterations. In first iteration pheromone is  $\rho$  times the initial pheromone

available but in second iteration pheromone available is  $\rho^2$  times the pheromone available initially. After evaporation, all ants deposit pheromone in their tour constructed in tour construction phase. Pheromone is updated as:

$$\tau_{ij} \leftarrow \tau_{ij} + \Delta\tau_{ij}^i$$

Where  $\Delta\tau_{ij}^i$  is the amount of pheromone deposited by ant  $k$  on the arcs it has visited. It is defined as:

$$\Delta\tau_{ij}^i = \begin{cases} 1/n^k, & \text{if arc}(i, j) \text{ belongs} \\ & \text{to the tour of the ant } k \\ 0 & \text{otherwise} \end{cases}$$

Where  $n^k$  is the number of VMs running on  $k$ th PM. With this less the number of VMs on PM more is the amount of the pheromone deposit on the edges of its tour. Therefore more likely they will be chosen by ants in their future iterations of the algorithm and relatively less difference in pheromone trail levels.

#### IV. RESULTS & ANALYSIS

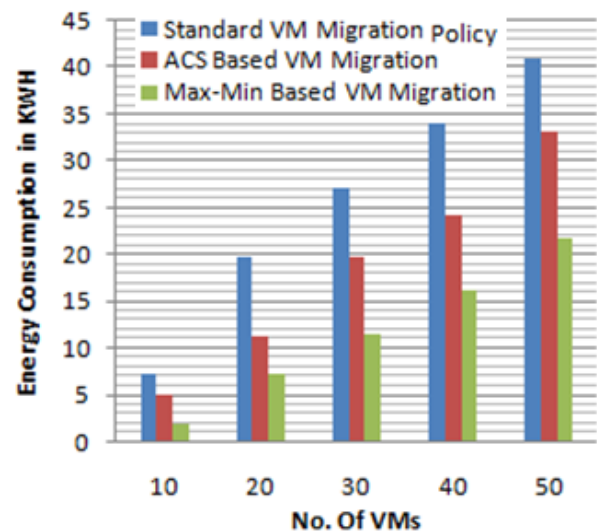
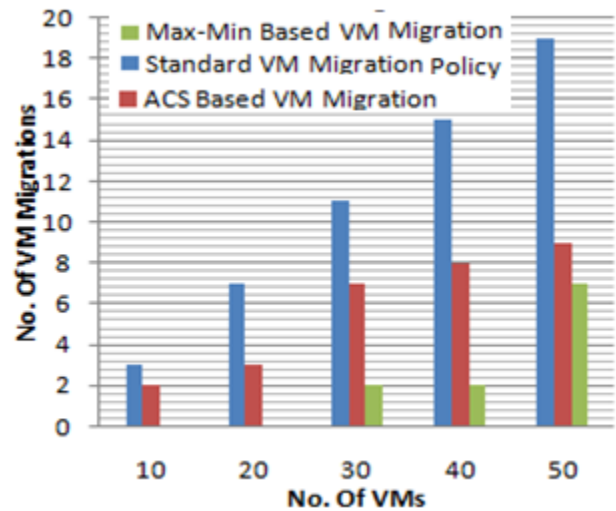
In this paper standard VM migration approach using ant colony optimization as done in the base paper is simulated using CloudSim and the proposed algorithm based on Max-Min ant system is also simulated for same environment. And the results are as follows:

No. of VM Migrations				
VMs	PMs	SVMMP	AVMMP	MMABP
10	5	3	2	NIL
20	10	7	3	NIL
30	15	11	7	2
40	20	15	8	2
50	25	19	9	7

Here all the VMs are created on the basis of MIPS which is as follows: {250, 500, 750, 1000} And PMs are created on the basis of: {1000, 1500, 2000}

Where	SVMMP	Standard VM Migration policy
	AVMMP	ACO based VM Migration policy
	MMABP	Max-Min Ant based policy

Energy consumption in Kwh				
VMs	PMs	SVMMP	AVMMP	MMABP
10	5	7.20	4.88	1.87
20	10	19.64	11.29	7.19
30	15	27.14	19.74	11.33
40	20	33.99	24.13	16.19
50	25	41.01	33.20	21.78



## V. CONCLUSION

Cloud computing is getting attention of the researchers these days. Large number of users are attached with cloud computing. But as there are several merits of cloud computing some demerits are also there. The one of the greatest issue in cloud computing is energy consumption and VM Migration problem. In this paper an Ant colony approach is proposed for VM migration in cloud. As described VM Migration is a NP-Hard problem and this problem can be solved in less time using some meta-heuristic algorithm. All such implementations can be effectively simulated using a tool called CloudSim. In future the algorithm proposed in this paper can be implemented. And ACO has many variants; different variants may be applied on VM migration problem. Performance of all these variants may be compared with each other in terms of No. of VM Migrations, Energy consumption and SLA Violations.

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