VM CONSOLIDATION USING ANT COLONY SYSTEM IN GREEN CLOUD

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ABSTRACT

In cloud computing the energy consumption of cloud data centre is a biggest problem. In this paper, we present a system that uses virtualization technology to allocate data center resources dynamically based on application demands and support green computing by optimizing the number of servers in use. The VM (Virtual Machines) consolidation approach which can be done to save energy in data centres. It is the greatest challenges in this approach, while saving the energy of the Quality of Services (QoS) at the Service Level Agreement (SLA) may not be satisfied. So we are moving to live VM migration, VMs can be consolidated so that some of the under loaded Physical Machine (PMs) can be switched off or put into a low-power mode. In the proposed work to an Ant Colony System (ACS) algorithm applied to minimize the energy consumption of data centers, while satisfying the QoS requirements. The proposed model is based on dynamic VM consolidation approach that uses a highly adaptive online optimization metaheuristic algorithm called Ant Colony System (ACS) and to optimize the VM placement.ACS based VM consolidation (ACS-VMC) approach uses artificial ants to consolidate VMs into a reduced number of active PMs according to the current resources requirements. Using the proposed approach in ACS the number of live VM migrations is less compared to the existing Non ACS methods which lead to minimum SLA violations in ACS technique.

Index Terms- Ant colony system, green computing, energy efficiency, SLA, Server Consolidation, VM Migration

1. INTRODUCTION

The advent of cloud computing is changing the way investments in computing resources are made. The characteristics of cloud computing services, including the illusion of infinite computing resources, elimination of upfront costs, and the ability to pay per use those kinds of services are popular. Different service providers are rapidly deploying new data centers to keep up with the increasing demand for cloud services. Performance was the sole concern in cloud environments, to keep up with the demand, while energy consumption did not receive much attention. However, worldwide energy usage in data centers accounted for between 1.1% and 1.5% of total electricity use in 2010[6]. As the energy costs keep increasing, focus on improving the energy efficiency in data centers is important, but it is necessary to maintain similar performance while doing so. Different approaches to improve energy efficiency may be applied on data centers, including development of applications that use resources are more efficient. Nevertheless, an efficient approach is to reduce the amount of hardware over-provisioning by the implementation of more efficient by VM (Virtual Machine). Virtualization technology allows several VMs in a single physical machine. However hardware is typically over-provisioned in order to sustain peaks of resource demand during short-periods of time, since cloud providers are bound to Service-Level Agreements (SLAs). The result of this strategy is an average low resource utilization of data centers. Therefore, improving VM placement can lead to interesting gains in energy efficiency. We can allocate more VMs using less resources, the tendency is to reduce the power consumption of the data center. This paper focuses on energy efficient for VM placement, instead of optimizing a VM consolidation. This work presents three different algorithms, one based on the First Linear Regression algorithm (LiRCUP) and two based on the Best Fit Decreasing (BFD) algorithm to solve the problem of VM placement and third based on the Ant Colony System (ACS) including modifications that allow each algorithm to suspend physical hosts and that evaluate the impact of a new VM allocation in the entire data center energy consumption. Global manager monitors the performance of multiple hosts and selects the appropriate host for requested VM migration. The method employs dynamic server consolidation by periodic VM migration. We presented an approach that first creates multiple of VMs and local search to place on the physical servers. Our approaches for virtual machines (VMs) placement consolidation aim to maximize the placed VMs on a host and minimize the number of hosts used on a cloud computing environment. The live-migration and VM consolidation, but only focus on the QoS of such an approach even in heterogeneous infrastructure containing heterogeneous VMs and the allocation to save energy consumption. However, the SLA violation and energy consumption produced by the framework has a scope of improvement. The framework selects VMs from an overload host until the host becomes underload. If the overload host does not generate SLA violation, then the migration in high energy consumption. We proposed virtual machine consolidation to finding new VMs placements. VM consolidation algorithm gets better results in both energy consolidation and SLA violations. The number of PMs used should be minimized as long as they can still satisfy the needs of all VMs. Idle PMs can be turned off to save energy.

2. RELATED WORK

The existing VM consolidation approaches[1][4] are used in data centres to reduce under-utilization of PMs and to optimize their energy efficiency .The main idea in these approaches is to use live migration[6][7] to consolidate PMs can be released for termination. Determining when it is best to reallocate VMs from an overloaded PM is an important aspect of dynamic VM consolidations that directly influences the resource utilization and QoS.

Dynamic VM consolidation concerns load prediction on a PM. Using a prediction of the future load enables proactive consolidation of VMs on the overloaded and under-loaded PMs[5][6][9].Therefore ,in our works[2][3]we proposed regression methods to predict CPU utilization of a PM. The method use the linear regression algorithms, respectively, to approximate a function based on the data collected during the lifetimes of the VMs. Therefore, we used the function to predict an overloaded or an under-loaded PM for reducing the SLA violations and energy consumption. Therefore, it is expensive to find an optimal solution with a large number of PMs and VMs. Since an optimization problem is associated with constraints, such as data centre capacity and SLA, these works use a heuristic to consolidate workload in a multi-dimensional bin packing problem [3]. The PMs are assumed to be the bins and the VMs are considered as the objects. The objective of bin packing is to minimize the number of bins while packing all the objects [3] .There are a number of Ant algorithms, such as Ant System(AS), Max-Min AS(MMAS) and Ant Colony System[1][4][10].ACS to improve the performance of AS and it is currently one of the best performing ant algorithms. The system architecture for dynamic VM consolidation in our approach, a local agent (LA) detects PM status is normal, overloaded, predicted overloaded, or under-loaded .We use the LiRCUP method[9] to predict an overloaded PM for avoiding SLA violations. The performance of the proposed ACS-VMC approach is evaluated by CloudSim Simulation. We compared our proposed approach with the existing dynamic VM consolidation approaches in the CloudSim toolkit and with the ACS-based VM consolidation approach in [10]. The results show that ACS-VMC outperforms existing VM consolidation approaches in terms of energy consumption, number of VM migrations, and number of SLA violations.

3. SYSTEM ARCHITECTURE

The architectural design of the VM Consolidation using Ant Colony System in Green Cloud. A cloud data center consists of number of PMs that have different resource capacities. In shown in Fig.1

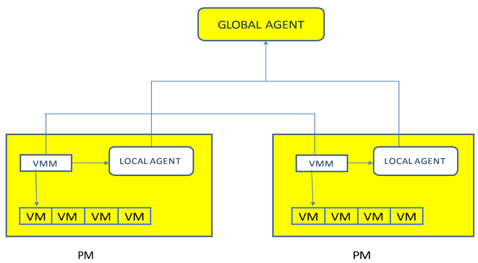

Fig.1 Architectural Design of ACS-VMC

Each PM contains a CPU which is often a multi-core. The CPU performances can be defined in terms of Millions of Instructions per Second (MIPS). PM is also characterized by the amount of memory, network, I/O and storage capacity. At any given time a cloud data center usually serves many simultaneous users .Users submit their requests for provisioning of n VMs, which are allocated to the PMs. Thus the PM selects the amount of available resources which is closest to the requested amount of resources by the VM. The local agent that resides in a PM to solve the PM status detection sub problem by observing the current resources utilizations of the PM. The global agent acts as a supervisor and optimizes the VM placement. The global agent collects the status of individual PMs from the local agents and builds a global best migration plan. The global agent sends commands to Virtual Machine Monitoring (VMM) for performing VM consolidation task. The commands determine which VMs on a source PM should be migrated to which destination PMs. The VMMs perform actual migration of VMs after receiving the commands from global agent.

3.1ACS-BASED VM CONSOLIDATION

LiRCUP-Linear Regression is used predict the short term CPU utilization based linear regression technique. LiRCUP is used to predict an under-loaded PM and migrate all VMs from overloaded PM to the under loaded PM.There are two types of algorithms Overload Prediction and Underload Prediction. In VM placement first we sorts all VMs by their utilization weights in decreasing order. BFD algorithm allocates VMs in such a way that the unused capacity in the destination PMs is minimized. It selects a PM for which the amount of available resources is closest to the requested amount of resources by the VM. ACS is a set of cooperating agents called ants cooperate to find good solutions. It is inspired by the foraging behavior of real ant colonies. While moving from their nest to a food source and back, ants deposit a chemical substance on their path called pheromone. Other ants can smell pheromone and they tend to prefer paths with a higher pheromone concentration. Thus, ants behave as agents who use a simple form of indirect communication called stigmergy to find better paths between their nest and the food source. The simple pheromone trail following behavior of ants can give rise to the emergence of the shortest paths. Each ant is capable of finding a complete solution, high quality solutions emerge only from the global cooperation among the members of the colony who concurrently build different solutions.

3.2 Steps for ACS-Based VM Consolidation

Step 1: Creates a set of tuples T and sets the pheromone value of each tuple to the initial pheromone level τ_0.
Step 2: The algorithm iterates over nI iterations. In each iteration, nA ants concurrently build their migration plans.
Step 3: Each ant iterates over | □ | tuples .It computes the probability of choosing the next tuple to traverse.
Step 4: Afterwards, based on the computed probabilities and the stochastic state transition rule and each ant chooses a tuple $t \in T_k$ to traverse and adds t to its temporary migration plan M_k^m.
Step 5: The local pheromone trail update the rule and is applied to t and the used capacity vectors at the source PM Upso and the

destination PM Upde in t are updated to reflect the impact of the migration .

Step 6: The function is applied on M_k^m , and its yields a score higher than the ant's best score Scrk and is added to the ant-specific migration plan M_k.

Step 7: The tuple t is removed from the temporary migration planM_k^m. Then, towards the end of iteration when all ants complete their migration plans, all ant-specific migration plans are added to the set of migration plans MS

Step 8: Each migration plan $M_k \in$ MS and the global best application migration plan M^+ is selected and the global pheromone trail update rule is applied on all tuples. Finally, when all iterations of the main outer loop complete, the algorithm outputs the global best migration plan M^+.

3.3 ALGORITHM

$M' = \emptyset , M□ = \emptyset$
$\forall □ \in □ \mid \tau_1 = \tau_0$
for i $\in$ [1 , □A]□□
for k $\in$ [1 , □A]□□
$M_k^m = \emptyset , M_k = \emptyset$, □□□$_k$ = $\emptyset$
for t $\in$ T do
generate a random variable q with a uniform distribution between 0 and 1
if $q > q_0$ then
compute p_s $\forall □ \in$ □ □y □□i□g (7)
end if
choose a tuple t $\in$ □$_k$ to traverse by using (6)
$M_k^m = M_k^m \cup \{t\}$
apply local update rule in (11) on t
update used capacity vectors U_{pso} and U_{pde}
if $f(M_k^m) > Scr_k$ then
$Scr_k = f(M_k^m)$
$M_k = M_k \cup \{t\}$
else
$M_k^m = M_k^m \setminus \{t\}$
end if
end for
$MS = MS \cup \{M_k\}$
end for
$M^+ = \arg\max_{M_k} \in MS \{f(M_k)\}$

4. EXPERIMENTAL DESIGN AND SETUP

To evaluate the efficiency of ACS-VMC technique, an experimental environment setup using the cloudsim toolkit. CloudSim is a discrete event simulator for implementation and evaluation of resources provisioning and VM consolidation techniques for different applications. Here, Data Center comprising 50 heterogeneous PMs and two server configurations in cloudsim : HP ProLiant ML110 G4 (1 x [Xeon 3040 1860 MHz, 2 cores], 4GB) and HP ProLiant ML110 G5 (1 x [Xeon 3075 2660 MHz, 2 cores], 4GB).Dual-core CPUs are sufficient to evaluate resource management methods that are designed for multi-core CPU architectures. Moreover, it is important to simulate a large number of servers for performance evaluation of VM consolidation methods.

5. PERFORMANCE METRICS

To evaluate the performance of ACS-VMC technique, the performance metrics that are used are Number of VM Migrations, SLA Violations, Energy Consumption, Energy and SLA Violations (ESV).It is shown in the Table. 5

5.1 SLA Violations

Maintaining the desired QoS is an important requirement for cloud data centers. QoS requirements are commonly formalized in the form of SLAs, which specify enterprise service-level requirements for data center in terms of minimum latency or maximum response time. It represents both the SLAVO (over utilization) and SLAVM (migration).

5.2 Energy Consumption

The energy consumption of a PM depends on the utilization of its CPU, memory, disk, and network card. The CPU consumes more power than memory, disk storage, and network interface. Therefore, the resource utilization of a PM is usually represented by its CPU utilization.

source and destination PMs, the downtime of the services on the migrating VM, and the total migration time. Therefore, one of our objectives was to minimize the number of migrations.

5.4 Energy and SLA Violations (ESV)

The objective of the proposed VM consolidation approach is to minimize both energy and SLA violations.

Number of hosts	**50**
Number of VMs	**50**
Number of Task	**Randomly Generated**
Total simulation time	**86400.00 sec**
Energy consumption	**47.25 kWh**
No of VM migrations	**5593**
SLA	**0.02%**
SLA perf degradation due to migration	**0.25%**
SLA time per active host	**9.61%**
Overall SLA violation	**1.33%**
Avg SLA violation	**11.05%**
No host shutdown	**1618**

Table 5

6. EXPERIMENTAL RESULTS

6.1 Over Utilized Host

If the cpu utilization is above the threshold 85% then the PM will be considered as overutilized host.It is shown in the Fig 6.1

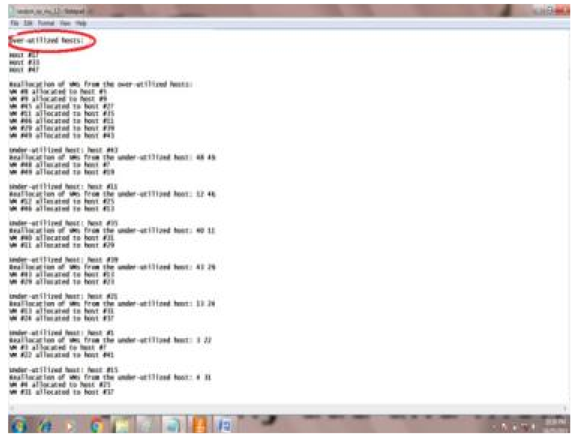

Fig6.1 Over Utilized Host

6.2 Under Utilized Host

If the cpu utilization is above the threshold 10% then the PM will be considered as underutilized host.It is shown in the Fig 6.2

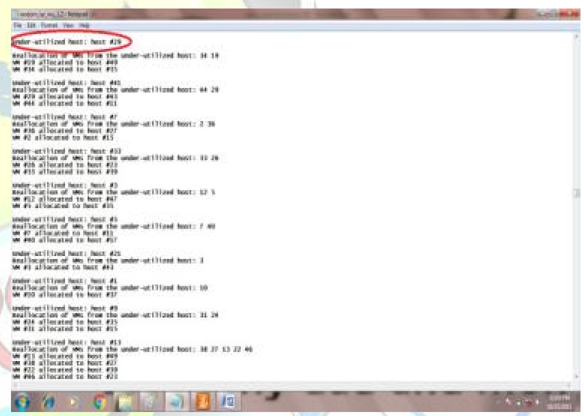

Fig 6.2 Under Utilized Host

6.3 VM Placement

Destination host for VM in overloaded host is found out. It is shown in the Fig 6.3

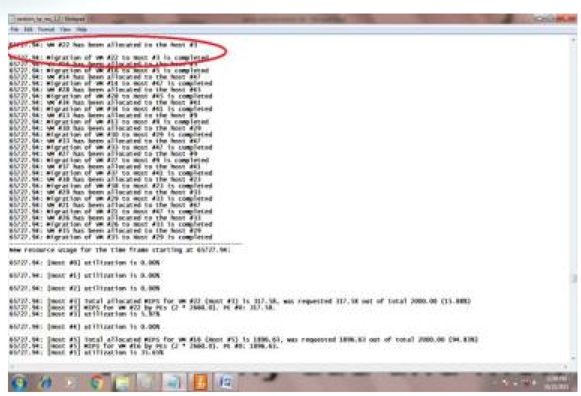

Fig 6.3 VM Placement

6.4 Server Consolidation

VMs from under loaded hosts are migrated to other host. It is shown in the Fig 6.4

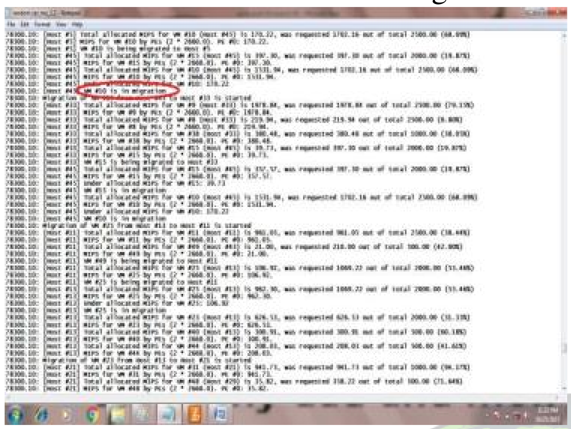

Fig 6.4 No of VM migration

6.5 Green Computing

Zero utilization host is considered as host in sleep mode.It is shown in the Fig 6.5

Fig 6.5 Green Computing

6.6 Performance Metrics Values

The performance metrics values are Energy consumption, Number of VM migration, SLA violation and Number of shutdowns. It is shown in the Fig 6.6

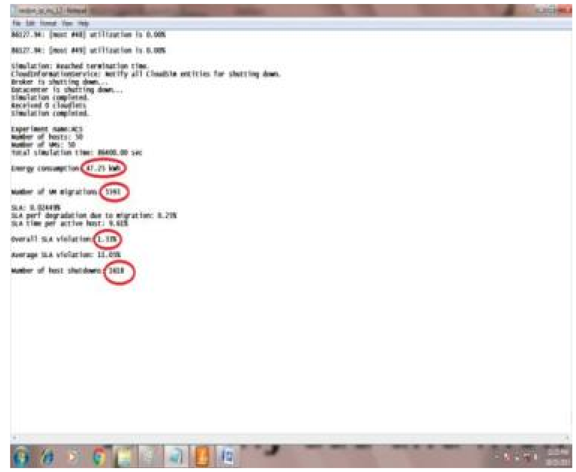

Fig6.6 SLA Violation, Energy Consumption

7.CONCLUSION AND FUTURE WORK

VM consolidation is achieved by using living migration of VMs, in that process the under loaded PMs are switched off and put into a low power mode according to their current resources requirements. ACS based VM Consolidation also reduce the energy consumption of data centers by consolidating VMs into a reduced number of active Physical Machines while preserving Quality of Service requirements. In this work number of PM are reduced and VM are migrated based on the requirement of process. Thus the ACS-VMC not only reduced the energy consumption, but also improves the quality of service without violated the SLA. This work can be improved by clustering PMs and assigning them to the respective consolidation managers. Live migration can impose severe performances degradation for the VM application and cause VM performances degradation .The penalties for VM migration can be reduced by carefully choose a VM's for migration.

8.REFERENCES

[1] Ajiro Y and Tanaka A (2007), 'Improving packing Algorithm for sever consolidation', Proc. Int. Conf. Comput .Mea. Group, pp. 399-407.

[2] Chen G, Wenbo H, Liu J, Nath S, Rigas S, Xiao L, and Zhao F (2008), 'Energy-Aware Server Provisioning and Load Dispatching for Connections-Intensive Internet Services', Proc.

USENIX Symp.Networked Systems Design and Implementation.

[3] Clark C, Fraser K, Hand S, Hansen J G, Jul E, Limpach, Pratt I and Warfield A (2005),' Live migration of virtual machines', Proc. 2nd Conf. Symp. Netw. Syst. Design Implementation vol.2, pp. 273-286.

[4] Fahimeh Farahnakian, Pasi Liljeberg, and Juha Plosila (2013),' LiRCUP: Linear Regression based CPU Usage Prediction Algorithm for Live Migration of Virtual Machines in Data Centers', Proc.39th EUROMICRO Conf. Softw. Eng.Adv.Appl,pp.357-364.

[5] Feredaus M, Murshed M, Calheiros R and Buyya R (2014),'Virtual Machine Consolidation in cloud data centers using ACO metaheurisic',Proc.20th Int. Eur. Conf. Parallel Process,vol.8632,pp.306-317.

[6] Gouda K C, Radhika T V, Akshatha M (2013),' Priority based resource allocation model for cloud computing', International Journal of Science, Engineering and Technology Research (IJSETR) Vol 2,Issue 1.

[7] Meng Wang , Xiaoqiao Meng, and Li Zhang (2011) ,'Consolidating virtual machines with dynamic bandwidth demand in data centers', Proc.Conf. Comput, pp71-75.

[8] Moreno Marzolla ,Ozalp Babaoglu, Fabio Panzieri(2011),'Server Consolidation in Clouds through Gossiping', Proc.IEEE Int, Symp.World Wireless, Mobile Multimedia Netw.,pp.1-6.

[9] Tsepo M and Suchithra R(2009),'Heuristic Based Resources Allocation Using VM Migration',Proc.ACM European conf.Computer System.

[10] Xiao Z, Song W and Qi Chen(2013),'Dynamic Resource Allocation Using Virtual Machines for Cloud Computing Environment',IEEE Trans.VOL24.