An Efficient Virtual Machine Consolidation And Secure Vm Sprawl Towards Green Cloud Computing

Suprakash S, Balakannan S P

Abstract*: *The advancement in the network technology like 3G, 4G, there is a large claim of computing resources at the Data Centre which in the background is consuming a large amount of power required to maintain these systems.Also, the large demand in the virtualization environment leads to VM Sprawl where unmanaged VMs lead to security loopholes. The fundamental technology available is very difficult to give an effective system without compromising performance or power.An approach to consolidate VMs without affecting the performance, also at the mean time without affecting the VM management is studied here. A comparative study is made with Penguin search optimization algorithm (PeSOA), particle swarm optimization (PSO), and Memetic algorithm. The study resulted with Memetic algorithm with an optimal usage of VMs. Also, a managed VM environment is created due to the limited VMs.

Index Terms*: *Virtual machine, Consolidation, Cloud Computing, Green Computing, VM Sprawl.

I. INTRODUCTION

The hurried development in the Internet Technology and the fast prerequisite of computational administration over the web is scaling the Datacenters over the world. Despite the fact that there is a huge decrease in the quantity of server base with the headway in Virtualization, there is an expanding pattern in the power utilization of every server [1]. It is accounted for that about 1.1% to 1.5% of all out power use is from the worldwide Datacenters[1]. Because of the extreme interest in the VMs, an extensive number of virtual machines are made in the Datacenter and over the time it is hard to deal with every one of these machines. This tends to VM Sprawl where unused and unmanaged VMs will keep running in the Datacenter. Since these machines are unmanaged security will be a worry on these machines.[21][22]. The expanding pattern in power use, the carbon impression because of the IT framework and its supporting foundation like cooling, lighting, UPS control and so forth are serious issues in the Datacenter. Dynamic consolidation of Virtual Machines and putting the inactive hubs to rest mode or turning off the machine will enhance the power use to a more prominent degree. Power utilization of Server equipment can be straightforwardly estimated with different gear, however estimating power usage of Virtual Machines are not specifically conceivable on the grounds because there are no gadgets for estimating Virtual Machine power. These Virtual Machines are simply programmed execution of real equipment. There are many power metering techniques as acquainted in [2] [3] with measure the intensity of Virtual Machines which figures the power as the total of use of CPU, Memory and IO access. The ability of a Host machine or a Virtual Machine is given in MIPS (Million Instructions per Second) and the utilization of Virtual Machine and the power drawn can be distinguished through this [4]. Ant Colony Meta-Heuristic Algorithm [5] is utilized to relocate the virtual machines. This technique screens the present resource prerequisites and relying upon the need, artificial ants combine the Virtual Machines. This uses a most extreme edge limit of 80% for the CPU usage. [6] Characterizes four noteworthy issues on Virtual Machine consolidation, when the host is over-burden, when the host is under loaded, Virtual Machine choice from an over-burden host and dynamic Virtual Machine Migration. This uses a forecast and management algorithm to diminish the energy use, meanwhile keeping up the SLA infringement. This uses a prepared machine learning system utilizing the chronicled information to foresee the future use of Virtual Machines. [7] Concentrated on host over-burden location. Markov Chain is utilized to distinguish the interim to move Virtual Machines additionally keeping up the QoS. The commitment of this work is to diminish the Virtual Machine use by Virtual Machine consolidation with heuristic calculations. To keep up the nature of quality, the useage limit is settled at 85%. The Virtual Machine consolidation framework is tried with PeSoA, PSO and Memetic calculations on Intel Xeon processors. The energy utilization of the framework is contrasted with applying the diverse calculations. Whatever is left of the paper is composed as pursues. Area 2 Comparative study of PeSoA, PSO and Memetic Algorithms, Section 3 Securing VM Sprawl, 4 Power computation and correlations and Section 5 Conclusion.

II. STUDY OF PESOA, PSO AND MEMETIC ALGORITHMS

VM consolidation using Penguin Search Optimization Algorithm (PESOA): This reflects the prey searching behavior of penguin [8][9]. The food looking out phenomenon of penguins could be a cooperative distributed model wherever penguins move in search of their food in

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teams. The teams are going to be act with one another regarding the supply of food within the explicit region,
oxygen level and also the food taken by them. Supported this data the opposite penguins move to the high accessibility region for taking its food. The area for teams is restricted and once there's no new accommodation for a penguin in an exceedingly cluster, it'll begin moving to a bunch that may be having the most effective accessibility. The dive of penguins is random among the cluster and it's not restricted to single dive. The most effective food accessibility is known by the cluster that consumed an oversized quantity of food.
Virtual Machine consolidation is finished with relation to the penguin's behavior of choosing food resource. Here the behavior of food choice depends on the Virtual Machine's CPU and Memory accessibility as parameters. The formula for Virtual Machine consolidation is listed in Figure 2.1.1.

```
Create population of VMlist of N VMs in groups;
Initialize the VM availability with respect to CPU and RAM
While (Best solution is found) do
   For each VM ∈VMlist do
      While (utilization <=85%) do
         Consolidate VM.
      Update the current status of VM.
   End For
End while
Update the best solution.
Make VM sleep state if under utilized
End while.
```

Figure 2.1.1. PESOA Algorithm

VM consolidation using Particle Swarm Optimization (PSO): Particle Swarm optimization (PSO) is an intelligent technique projected by Kennedy and Eberhart 1995[10]. This can be developed supported by the behaviour of flock birds. The social behaviour during a cluster and also the communication capability is impressed by this rule. The velocities and position of the swarm are updated and communicated for the simplest solution. A global neighbourhood gBest is employed to share data globally and local neighbourhood lBest is employed to share the knowledge domestically. The position of the particle updated is predicated on the present position, new position, and best position.

$$Velocity_{new} = Velocity_{current} + (Position_{best} - Position_{current}) + (Position_{neighbour} - Position_{new}) \quad (2.2.1)$$

$$Position_{new} = Position_{current} + Velocity_{new} \quad (2.2.2)$$

The algorithm for PSO is given in Figure 2.2.1.

```
Initialize array of VMlist
   For each VM in VMlist evaluate fitness function with
respect to CPU and RAM   availability
   Check the VM fitness with pBest.
   Assign the best value to pBest
   Check the fitness with the gBest
   Assign the best value to gBest
   Change the positions based on (I) and (II)
Iterate the steps till best solution is reached.
```

Figure 2.2.1. PSO Algorithm

Memetic Optimization: Memetic Algorithms [11] are a hybrid of biological process algorithms with a local search to accelerate the findings of fine solutions. With the assistance of this, a more in-depth resolution may be replaced with the best resolution. Memetic Algorithms uses meme that unendingly checks for individual improvement similarly as global improvement. This rule is additionally pretty much well-liked as a result of it'll create use of all obtainable data concerning the matter underneath study. The initial population of Memetic rule is taken randomly. The well-featured people from the population are designated for ensuing generation. an area search like hill climbing technique can enhance the generation. The algorithm used is given in Figure 2.3.1.

```
Initialize the population_size and Maximum_size
Initialize the Virtual Machines(Population)
While(!Best solution)
   Extract the best Virtual Machines
   Perform LocalSearch
End While
Apply the best solution as the global solution
LocalSearch:
While(!Best Solution)
   New_solution=neighbors(Best_solution)
   If New_solution is best
      Best_solution=New_solution(local best)
   End If
End While
```

Figure 2.3.1 MEMETIC Algorithm

III. SECURING VM SPRAWL

Virtual Machine Sprawl happens where there is a large snapshot of VMs created and later on they were not properly closed or updated. Since these machines were untouched for a long time and later when they are taken up, these VMs are vulnerable to attacks because there will not be any patches or security updates. This loophole helps the attackers to take control of the machines and attack from there. The best way to avoid such kind of attacks is to keep track of all the VMs and maintain it by updating the patches and security updates. If the number of virtual machines in the datacenter is limited, this process will be much easier. The consolidation algorithms discussed will help in maintaining limited and active virtual machines in the datacenter. Further, it is a best practice to use only most recently used virtual machines and take snapshots from the same to create new VMs. This will help in maintaining updated VMs live all the time. Also, the least used VMs can be deleted from the snapshots because these are vulnerable to attacks. The policy used is described in Figure 3.1.1.

```
Initialize the Virtual Machines
Extract the Most Recently Uses VMs
Delete Least used Snapshots
While(VMs)
If(VM consolidation results in idle VM list)
    Delete Snapshot
If(VM consolidation results in new VM)
    Create VM from most recently used Snapshot
Update VMs
End While
```

Figure 3.1.1VM Snapshot Securing Policy

IV. POWER USAGE CALCULATION

The power utilization at the datacenter is estimated in PUE (Power Usage Effectiveness) this gives out how successfully the power use is done on the datacenters. The power use viability of a server farm is determined utilizing the equation (4.1)

$$PUE = \frac{Total\ Facility\ Power}{IT\ Equipment\ Energy} \quad (4.1)$$

If PUE results in the range 1 to 1.8, the Datacenter is viewed as power effective.

The absolute power is equivalent to the power devoured by the IT equipment and the other hardware supporting the IT foundation. This incorporates the intensity of cooling, lighting, UPS charging power and so on.

IT Infrastructure power utilization predominantly incorporates the power utilization by the CPUs, Memory Storage Devices, and Network gadgets. The cooling framework expends the greater part of the power in the Datacenter. In the event that the heat created at the datacenter is diminished, the real piece of electric utilization (for cooling) can be decreased. This requires a productive method for using the Datacenter Virtual Machines.

The power expended at each Virtual Machine can be determined with the formula given underneath [11]

$$EVM = \propto_{cpu} U_{cpu} + \propto_{mem} U_{mem} + \propto_{disk} U_{disk} + \gamma - 1 \quad (4.2)$$

Where α and γ are the model specific constant.
Ucpu is the power utilization at CPU
Umem is the power utilization of Memory
Udisk is the power utilization of Storage Device

V. RESULTS AND DISCUSSION

The calculations are tried with Cloud Sim which is a Library for Simulation of Cloud Computing Scenarios. The component for help in modelling and simulation of extensive scale distributed computing framework, including data centres is the motivation to pick the apparatus. It gives fundamental classes to portraying data centres, virtual machines, applications, clients, computational assets, and arrangements. The Cloud Setup was finished with X86 - 2 core processor with 1860 Mhz and varying RAM. The exhibitions of the calculations are analysed here. The framework is simulated with differing workloads and the examination of the equivalent is outlined beneath. The power usage model of the machine at various use level is accessible at [13].

Table 5.1: Virtual Machine Utilization by PESOA, PSO,and MEMETIC

Total Virtual Machines allocated in the system	VM usage with PESOA	VM usage with PSO	VM usage with MEMETIC
30	28	24	18
50	48	42	28
80	78	62	40

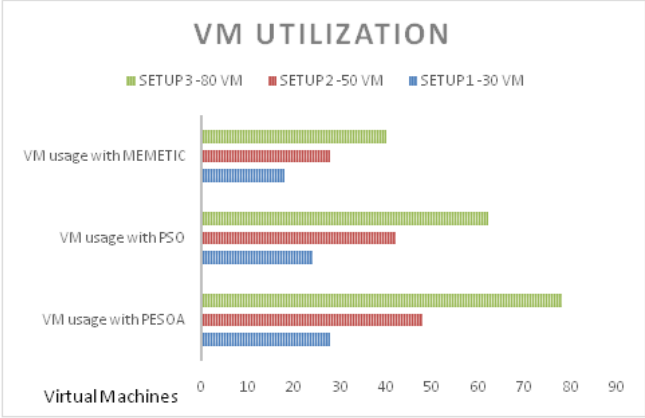


Figure 5.1. Virtual Machine Utilization by PESOA, PSO,and MEMETIC

The outcomes demonstrate the quantity of Virtual Machines utilized on various loads. On looking at the three algorithms the Memeticalgorithm performs superior to the PeSoA and PSO regarding the Virtual Machine utilization.

The power estimation of the virtual machines is determined as given beneath. The usage level is settled to 80% so as to maintain performance. Taking the case here with most extreme virtual machine task, the greatest total power required by the machine without calculations at 80% load will be

Evm = 157 W, as per [13]

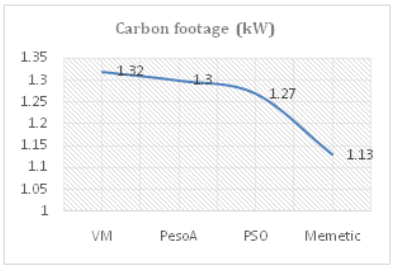
Presently the rate decrease in the usage of the calculations PESOA, PSO and MEMETIC is 2.5, 22.5 and 50 rates separately. The Carbon emission per kWh based on coal-based power generation system is 0.87 [12]. Carbon Footprint is calculated with the below formulae Cf.

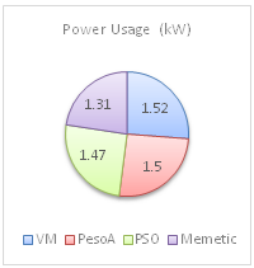
$$C_f = P_{used}(kW) * C_{emitted}(kg/kW) \quad (5.3)$$

$$P_s = P_{actual} - P_{used} \quad (5.4)$$

Table 5.2: Power usage in KVA and Carbon Footprint in Kgs

Algorithm Vs Power Usage	Power Usage (kW)	Carbon footage (Kgs)
VM	1.52	1.32
PesoA	1.50	1.30
PSO	1.47	1.27
Memetic	1.31	1.13





VI. CONCLUSION

The excessive usage of cloud platform is indirectly intense massive power at the datacenter that is resulting in a good share within the carbon footprint. a close study on the virtual machine consolidation to scale back the VM usage at the datacenter is studied and tested with PeSoA, PSO, and Memetic Algorithms. The study resulted in Memetic algorithmic program because the higher choice for saving unused virtual machines. This prevents the over usage of Datacenter infrastructure leading to low power consumption. Also, this helps during a managed datacenter with restricted VMs those is updated often and VM Sprawl attacks is avoided. The study are going to be extended more considering the opposite parameters moving the VM consolidation and QOS.

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