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An Efficient Virtual Machine Management to Achieve Energy Efficiency in Cloud Computing

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Abstract - Cloud computing has revolutionized the information technology industry by empowering versatile on-demand provisioning of computing resources. Rapid growth of demand for computational power by scientific, business and web applications has led to the creation of large scale data centers consuming enormous amounts of electrical power. How to exert energy and handle the issue concerned with energy efficiency has been the most important matter of Green Cloud Computing. This research presents the novel technique and algorithm for the Efficient Virtual Machine Management to achieve energy efficiency. Proper Virtual Machine Management is done by proper VM allocation. The overloaded host detection, VM selection, VM placement and at last under loaded host detection are four major steps carried out throughout the research. This is aimed for saving the energy and makes the virtual machine management efficient. According to the proposed work when any of the host will be shut down at the end of process the energy will not be used more and it will be saved.

Keywords - Virtual Machine Management, Virtual machine, Cloud Computing, Virtualization, Power Consumption

I. INTRODUCTION

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing assets (e.g., networks systems, servers, storage, applications, and services) that can be quickly provisioned and discharged with negligible management exertion or service provider interaction [1].

The fundamental approach of cloud computing is computing through the Web terminal operations that move workloads from clients to the server side to share hardware, software, and data or information [1]; in this way, the past excess wastage of resources on individual computers are adverted and the resource effectiveness is enormously made strides. With today's progressively high request for cloud, operation of an ordinary cloud computing such as the large-scale information processing center evolves with lot of power cons umption. Such sum of power consumption is opposite to today's accentuation on energy conservation and carbon reduction, and it is a major problem that cannot be overlooked. Not the development of cloud computing, but incorporate the efficiency of energy consumption, is the key objective of this paper. The energy demand related issues are co-circular to avoid within framework of the cloud environment. In order to achieve the efficiency of energy purpose VM management can be done such that the overloaded server can be managed and at the last the VM of under loaded host can be migrated and that can be shut down so that physical machine can be closed in order to save the energy.

In this study we propose a system for energy efficiency by VM management based on the power consumption of each host. Power consumption of each host is counted and then on base of that least power consumption host is selected as destination for migration. In that way the VM management is done.

Our solution will be helpful for the energy efficiency and VM management; through the measurement of the CPU, memory usage and power consumption. Additionally, by the means of energy saving algorithms of the cloud virtual machine management system, migration of virtual machines is carried out for energy conservation. At the final analysis, outcome of experiments indicate that the proposed algorithm under normal usage scenarios can indeed attain a certain degree of energy saving effect. The organization is cloud computing topic at Sankalchand Patel College of engineering.

II. BACKGROUND THEORY AND RELATED WORK

2.1 Cloud Computing

Cloud computing is an Internet-based computing; in this way, the shared hardware and software assets and messages can be availed on request to computers and other devices. The cloud is a metaphor for the network, or the Internet. Cloud computing permits enterprises to set up applications sooner, and diminish the intricacy of management and maintenance costs to briskly reallocate IT resources in response to business requirements [2]. Cloud computing portrays modern Internet-based services to increase IT use and easily deliver models to make avail dynamic and often a virtual expansion of the resource. Cloud computing can be thought of embracing following levels of service: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).

2.2 Virtualization

Virtualization has come into existence as heart of Cloud Computing environment on account of its ability to multiply many Virtual Machines within same Physical Machines, and within meantime provide isolated environment to each Virtual Machines. The software used to demultiplex the Physical Machine amidst numerous Virtual Machines is known as Virtual Machine Monitor/Hypervisor [3]. A Virtual Machine was originally defined by Popek and Goldberg as an efficient, isolated duplicate of a real Machine, which enables the multiplexing of the elementary Physical Machine [3]. Virtualization permits speckle allotment of resources to Virtual Machines.

Virtualization techniques authorize the accomplishment of numerous operating system instances, or Virtual Machines within same physical piece of hardware. Every single VM simulates like Physical Machines functions just like it is its personal Physical Machine with a determined Operating System and facilitated applications [3]. Each VM needs access control, some of the time different among different VMs within same Physical hardware platform. A few Virtualization platforms need an external host operating system; others are implanted straightforwardly within hardware. There are a few common approaches to Virtualization. The crucial difference among the different techniques consists in the component that has clarity and manages over the Virtual Machines. In a few designs, it is the hosting operating system and, in others, it is the privileged allotments [4].

2.3 VM management

With the intention of establishing an orthodox cloud service, we necessitate a virtual machine. When a huge number of virtual machines are set to be executed through virtualization technology, it gets to be exceptionally awkward to oversee them with native instructions; thus a virtual machine management platform is needed [5]. The virtual machine management platform consolidates a virtual machine to create, edit, delete, switch, pause, reply, and may carry through live migration operations. Next, a few prevalent open source virtualization management platforms can be used as the network interface to provide a virtual building process with many benefits, for illustration, a more favorable and appropriate interface is given for observing states of a large number of virtual machines, and the account consents are also simpler to manage.

2.4 Related work

Rakesh Kumar vishwarkarma et al. [6] represented that in order to efficiently manage the power consumption of these data centers, Green computing offers schemes like load balancing across physical machines, live migration of virtual machines and Sever Consolidation which aims at minimizing the number of Active Physical Machines (APM). Server consolidation is a result of Virtual Machine (VM) scheduling which involves— *VM selection*, *VM placement* and *VM placement re-optimization.* He presented the VM placement optimization techniques used in green cloud, particularly based on the classical problem of Bin Packing. Bin packing is inspired by the NP-Hard knapsack problem and reduces the total number of Active Physical Machines (APM). Further these arrangements are optimized using Rank based VM scheduling algorithm. The proposed approach hence decreases the energy utilization and gives improved server integration.

Jia-Lia Yen et al. [7] represented that as the era of information technology get into the cloud computing technology, applications are delivered as services over the Internet and the hardware and systems software within data centers give those services. Cloud technology might hold guarantee in decreasing energy consumption and greenhouse effect. At the same time, the cumulative depletion of energy for the need of cloud operation is huge, especially in the large computational and data center. These servers ought to be controlled and utilized effectively for saving energy. Therefore, he presents an energy management strategy of cloud. Using proposed calculation model of developed method to reduce the numbers of wake up server, they may find the way to allocate or focus on the workload of server in higher operating efficiency. And that will achieve better energy saving.

Adeleye et al. [8] represented that energy consumption of cloud's data centers remains the major challenge confronting cloud operations and its sustainability. Proficient utilization of cloud resources using diverse virtual infrastructure management techniques remains one of the strategic implies of realizing energy efficiency in cloud. Lots of research works on cloud efficient energy consumption exist, with a few concentrating on the infrastructure layer and some on the virtualization layer of the cloud architecture.

An effort has been put by him to analyze different procedures deployed to organize virtual machine in an energy efficient way. In spite of the fact that, the focus is on the virtualization layer, cardinal aspects such as the architectures, supporting technologies, methods, and overall cloud performances for each strategy will be considered.

Beloglazov et al. [9] proposed an energy efficient resource management system for virtualized Cloud data centers that reduces operational costs and provides required Quality of Service QoS. Energy savings are attained by continuous consolidation of VMs according to current utilization of resources, virtual network topologies established between VMs and thermal state of computing nodes. They present first results of simulation-driven evaluation of heuristics for dynamic reallocation of VMs using live migration according to current requirements for CPU performance. The results show that the proposed technique brings substantial energy savings, while ensuring reliable QoS. This justifies further investigation and development of the proposed resource management system.

Yang et al. [10] proposed a novel method for managing green power of a virtual machine cluster in cloud computing environments. A green power management scheme puts forward number of physical machines that are ought to be run or turned off based on the gross occupies resource weight ratio of the virtual machine cluster. When the gross engrossed resource weight ratio is higher than a supreme tolerant occupied resource weight ratio, a substitute physical machine in the non-running physical machines is elected and waken up to unite as either of the running physical machines. A source allotment procedure is also put to use at dispense loads of the running physical machines such a manner that overall number of the running physical. Machines can be adaptably dispatched to gain the intention of green power management.

Beloglazov et al. [11] proposed Dynamic consolidation of virtual machines (VMs) employing live migration and permuting idle nodes to the suspended mode permits Cloud providers to amend resource practice and lessen energy consumption. However, the liability of supplying premium quality of service to customer's inductees to the necessity in dealing with the energy-performance trade-off, as aggressive consolidation may lead to performance degradation. By the virtue of changeability of workloads proficied by modern applications, the VM placement should be optimized unremittingly in an online manner. To comprehend the insinuation of the online nature of the problem, we undertake rival analysis and prove rival ratios of optimal online deterministic algorithms for the single VM migration and dynamic VM consolidation problems. Getting around to, they propound novel adaptive heuristics for dynamic consolidation of VMs based on an anatomy of historical data from the resource custom by VMs. The proposed algorithms substantially trim energy consumption, while asserting a high proportion of adhesion to the Service Level Agreements (SLA). In order to dynamically provisioning resources for virtualized multi-tier application execution environments (VAEEs) of different customers, the most common approaches are based on self-managing techniques , such as Monitor, Analyze, Plan, and Execute (MAPE) control loops architecture is needed. The goal is to meet the virtualized application requirements while adapting IT architecture to workload variations. Usually, each request requires the execution of virtualized application allocated on the VM of each physical tier. They presented survey with the various mechanisms for effectively VM migration [12].

III. PROPOSED METHODOLOGY

Accordingly, the objective of this study is to provide a technique to achieve efficient energy consumption. With a view to reach our intend, we implemented a virtual machine cluster consisting of physical machines put to use as host. An efficient virtual machine management comprises the following steps:

Step 1: Calculate the all claimed resource weight of the virtual machine cluster, which is the sum of resource weight of overall the virtual machine over the sum of all obtainable resource weight running on the host or the physical machine. The total acquired resource weight is calculated with the given equation (1):

$$\text{HOSTjrate} = \sum_{i=1}^{v} VMjirate \quad \ldots\ldots(1)$$

$$\text{VMjirate} = \frac{(\text{VMjiCPUuse} \times \text{VMjiRAMallocate})}{\sum_{i=1}^{v} VMjiCPUuse \times VMjiRAMallocate}$$

Where j is sequent number of the particular physical machine, i is the serial number of the virtual machines, N is total number of virtual machines, VMjiCPUuse is processor load rate of virtual machine, VMjiRAMallocate is memory allocation of virtual machine in host

Step 2: After counting the resource weight of the host or physical machine select the surcharged host, the host with highest resource allocation.

Step 3: From the surcharged host, note and select the VM on the basis of its migration time. The VM which consumes the minimum time to migrate select that VM for migration.

Step 4: Now seek for the VM placement, on which host should the VM be relocated. For that count the power consumption done by each host. Now select the host with the minimum power consumption. The host on which there is the least difference of power consumption between before migration power consumption and after migration power consumption. The host with least gap selects that host for VM relocation. Place the selected VM on the particular host.

Now in order to fulfill our aim we have to empty the under loaded host than only the host can be suspended and shutdown.

Step 5: So now find the under loaded host with minimum resource weight.
Step 6: Now select all the VM of the under loaded host.
Step 7: According to the above mentioned VM placement technique place the selected VM
Step 8: Now the under loaded host is free with empty pipeline. So turn off the host in order to save the energy.

3.1 Proposed Algorithm

```
For each host in hostlist            Input: Hostlist,Vmlist
Calculate (HOSTjrate-α):             Output: Allocation of VM
 if isHostOverloaded(host) then
     VMsToMigrate.add(get VM with minimum migration
      time)
  Fromoverloadedhost(host))

     migrationMap.add(getNewVmPlacement(vmsToMigrate)
  For each host in hostlist do
     minPower←MAX
     allocatedHost←NULL
For each host in hostList do
  if host has enough resource for VM
     if host does not get overloaded after VM migration
       power←estimatePower (host, vm)
     if power < minpower then
       allocated host←host
       minpower←power
  if allocated host≠ NULL then
     allocation. Add(vm,allocatedhost)
return allocation
For each host in hostlist do
    if ishostunderloadedhostthen
      VMstomigrate. Add (host.getvmlist)
            migrationmap.Add(getnew vm placement(VMstomigrate))
return migrationmap
end if
```

IV. DISCUSSION AND EXAMPLE

In this research four stages are important: (1) Finding overloaded host (2) VM Selection (3) VM Placement (4) Finding under loaded host.

(1) Finding overloaded host: For managing VM and getting energy efficiency in VM management to begin with the step is to find overloaded host. It is predicted on the indication of setting upper and lower resource utilization for hosts and keeping the overall utilization of the CPU by all the VMs between these resources. If the CPU utilization shortfalls the lower resource utilization, all VMs have to be resettled from this host and the host has to be put to the sleep mode in order to carry off the idle power consumption. If the utilization surpasses the upper threshold, some VMs have to be migrated from the host to reduce the utilization in order to prevent a potential SLA violation. The host with the most in resource utilization value is called to be overloaded host. Greater the value of resource utilization, the value of CPU utilization will get higher.

(2) VM Selection: After probing overloaded host next move is to find the host for relocating the VM. Once it has been concluded that a host is overloaded, the following step is to choose particular VMs to migrate from this host. After a selection of a VM to migrate, the host is checked once more for being overloaded. On the off chance that it is still considered as being overloaded, the VM selection approach is connected again to select another VM to migrate from the host. Usually rehashed until, the host is considered as being not overloaded. VM selection is done considering numerous base like considerably low utilization, least migration time, a few are selected on premise of random choice, on premise of low CPU utilization etc.

(3) VM placement: Following step after VM selection is VM placement. After selecting the VM for migration the place is to be chosen that where to place the VM that is VM placement. For VM placement numerous approaches are taken according to the different parameters. On what premise on a parameter to decide the VM placement place is done in VM placement. Parameters like power consumption, host utilization, cost, and best fit place for VM placement. For power consumption the host where there is minimum Power consumption is chosen for VM placement.

(4) Finding under loaded host: Pinpointing under loaded hosts we propose a simple technique. First, all the overloaded hosts are set up applying the selected overloading detection algorithm, and the VMs selected for migration are allocated to the destination hosts. Then, the system encounters the host with the minimum utilization compared with the other hosts, and attempts to put the VMs from this host on other hosts keeping them not overloaded. If this can be skilled, the VMs are set for migration to the determined target hosts, and the source host is switched to the sleep mode after all the migrations have been completed. If all the VMs from the source host cannot be placed on other hosts, the host is kept active. This process is iteratively repeated for all hosts that have not been considered as being overloaded Given below Table 1: VM occupying resource weight after migration is the existing theory example in which the overloaded PM is found and then the VM from that PM is migrated to the host with least host rate. The table specifies the current theory which works based on the host rate ratio. The Physical machine which is overloaded is taken as the machine from which VM is to be migrated to the machine to the Physical machine where the host rate is least. In this way the

migration is done in the existing theory as illustrated in table 2. We have done the migration based on the Power consumption of each Physical machine. From this table we conclude that table no.1 migration is done on the basis of host rate and the VM from the overloaded host is migrated to PM with least load, and in table no.2 migration is done on Power consumption basis. Power consumption is considered main for migration more the Power consumption high chances of migration from that PM are more. Now the example according to proposed work is given in Table 2: VM migration considering the power consumption.

Table 1: VM occupying resource weight after migration

	VM	VMjicpuuse	VMjiramallocate	VMjirate	HOSTjirate
11	VM01 VM03 VM04 VM05	95 40 10 30	512 2048 512 1024	0.08 0.14 0.01 0.05	0.28
12	VM06 VM07	70 60	1024 512	0.12 0.05	0.17
13	VM02 VM08 VM09 VM10	100 10 15 20	1024 1024 512 512	0.17 0.02 0.01 0.02	0.22
14	VM11 VM12 VM13 VM14	45 60 30 100	1024 1024 512 512	0.08 0.05 0.03 0.17	0.33

Table 2: VM migration considering the power consumption

PM	VM	VMjirate	HOSTjirate	Power Consumption
11	VM01 VM03 VM04 VM05	0.08 0.14 0.01 0.05	0.28	100.75
12	VM06 VM07	0.12 0.05	0.17	9.31
13	VM02 VM08 VM09 VM10	0.17 0.02 0.01 0.02	0.22	87.7
14	VM11 VM12 VM13 VM14	0.08 0.05 0.03 0.17	0.33	106.5

V. CONCLUSION

Substantial amount of energy can be spared by the decision in VM management which will give rise in less power consumption, more benefit to cloud service providers.in our proposed work we have taken the power consumption as mainframe. Currently theory exists but in that theory migration is done on the host rate basis and in our work we use power consumption for the migration of VM for VM placement in migration we use Power consumption of that particular machine. The PM with lowest Power consumption we will place the VM at that machine after migration. We expect to improve energy efficiency because our goal is to attain the minimum power consumption. Finally, compared to other research this will lead to a significant contribution towards all the humankinds. A lot of energy can be saved by VM management according to the algorithm proposed which will result in reduced energy consumption, more profit to cloud service providers, consequently lower price to customers and most importantly leading to Green Cloud computing environment. The proposed work is yet to be implemented and tested.

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