Open access Journal International Journal of Emerging Trends in Science and Technology

Virtual Servers Allocated Dynamically With Support of Dps for Saving Energy and Reducing Operational Cost

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Abstract

Cloud computing is a model for delivering services in which resources are retrieved from the internet through web-based tools and applications, rather than a direct connection to a server. Data is stored in servers. Cloud computing structure allows access to information as long as an electronic device has access to the web. According to National institute of standards and Technology (NIST) – "the major objective of cloud computing is to maximize the shared resources and at the same time the disadvantage is its high infrastructure cost and unnecessary energy consumption." Global warming has been a big concern of late, with high power consumption and CO2 emission. With the continuously increasing popularity and usage of cloud computing, high power consumed and harmful gasses released by data centers. Cloud uses thousands of data centers to processes user queries and to run these data centers bulk amount of power is used for cooling and other processes. This power consumption increases gradually every year and green computing playing a helpful role to curb these issues. This type of system allows employees to work remotely. It enables hosting of applications from consumer, scientific and business domains. But data centers hosting cloud computing applications consume huge amounts of energy, contributing to high operational costs and carbon footprints to the environment. With energy shortages and global climate change leading our concerns these days, the power consumption of data centers has become a key issue. Therefore, green cloud computing solutions saves energy as well as reduces operational costs. The vision for energy efficient management of cloud computing environments is presented here. The proposed scheme has a two important features .These approaches (DPS(by using Dvfs technology), VM migration technology based on threshold value) have been tried out to make cloud computing environments more environmental friendly . These approaches have been tried out in the data centers under experimental conditions.

Keywords: *DPS, CloudSim, and DVFS*

1. INTRODUCTION

In cloud computing environment data center operators typically installed at least one physical server per application. When taking into account testing/development, staging, and disaster recovery 3 to 5 servers per application may have been typical. The traditional one workload, most servers run at a low "utilization rate" – the fraction of total computing resources engaged in useful work. "Server virtualization" [1][2][3]offers a way to consolidate servers by allowing you to run multiple different workloads on one physical host server. A "virtual server" is a software implementation that executes programs like a real server. Multiple virtual servers [14] can work simultaneously on one physical host server. Therefore, instead of operating many servers at low utilization, virtualization combines the processing power onto fewer servers that operate at higher Virtualization improves scalability, reduces downtime, and enables faster deployments. In addition, it speeds up disaster recovery efforts because virtual servers can restart applications much more rapidly than physical total utilization. (See Figure 1 below.)

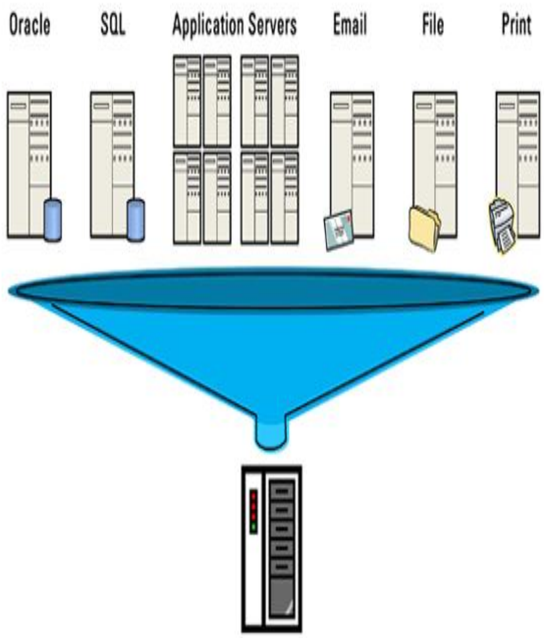


Fig1:virtual sever organization

servers[9]. With virtualization, you can move entire systems from one physical server to another in just a few seconds to optimize workloads or to perform maintenance without causing downtime. Some virtualization solutions also have built-in resiliency features, such as high availability, load balancing and failover capabilities.

- Virtualization enables you to use fewer servers, thus decreasing electricity consumption and waste heat [13][14]. One watt-hour of energy savings at the server level results in roughly 1.9 watt-hours of facility-level energy savings by nearly $150,000 in direct costs: the costs for VM Ware and SAN were offset by substantial savings in server hardware and networking [15]. reducing energy needed to cool the waste heat produced by the server[11].

2. RELATED WORK

In a 2007 study, the University of Santa Cruz used virtualization to run 54 virtual servers on 8 physical hosts, reducing peak demand by 20 kW and saving $22,000 in energy annually. In a 2010 study, Southwestern Illinois College performed a detailed 3-year total cost of ownership analysis for a 35 server upgrade with and without virtualization (see table below).10 A system with 35 virtual servers on 4 physical host servers saved over $280,000 in total savings [3][5].

3 Year Total Cost of Ownership

	Without VMware		With VMware		Savings	
Direct Costs						
VMware Services	$	-	$	17,000	$	(17,000)
VMware Software & Support	$	-	$	38,938	$	(38,938)
Third Party Software & Support	$	-	$	-	$	-
Server Hardware	$	229,500	$	27,000	$	202,500
Network Costs	$	49,500	$	18,000	$	31,500
SAN Costs	$	-	$	30,000	$	(30,000)
Total Direct Costs	$	279,000	$	130,938	$	148,063
Indirect Costs						
Data Center	$	136,823	$	16,965	$	119,858
Server Provisioning	$	11,745	$	1,980	$	9,765
Server Administration	$	50,760	$	55,080	$	(4,320)
Procurement	$	8,750	$	750	$	8,000
Total Indirect Costs	$	208,078	$	74,775	$	133,303
Total Cost of Ownership	$	487,078	$	205,712	$	281,366

Fig 2: Reducing the cost through VMware

This table shows how virtual servers reducing overall operational cost. In proposed system we introduced efficient energy reducing technologies for to overcome energy consumption and to make "Virtual Servers" as environmental friendly through saving energy[3][6][7][8].

3. PROPOSED SCHEMES

Dynamic Performance Scaling (DPS)

DPS [11][12]includes different techniques that can be applied to computer components supporting dynamic adjustment of their performance proportionally to the power consumption. Instead of complete deactivations, some components, such as CPU, allow gradual reductions or increases of the clock frequency along with the adjustment of the supply voltage in cases when the resource is not utilized for the full capacity. This idea lies in the roots of the widely adopted Dynamic Voltage and Frequency Scaling (DVFS) [4][13]technique.

Dynamic Performance Scaling(by using DVFs technology):-

Dynamic voltage frequency scaling is a hardware technology that can dynamically adjust the voltage and frequency of the processor in execution time. By applying DVFS technology, without having to restart the power supply, system voltage and frequency can be adjusted in accordance with the specification of the original CPU design into a different working voltage. While CPU works in lower voltage, the energy consumption can effectively be saved. The power consumption of the CPU is measured by multiplying the voltage square with the system frequency. Where V is the voltage, F is the frequency, and C is the capacitive load of the system. The DVFS is the power saving technology by reducing the voltage supply. The reduction of CPU frequency means that the voltage can also be dropped, though it will result in the degradation of the system performance and lead to prolong the execution time. In addition, the overhead of the voltage adjusting should also be considered. The purpose of the DVFS is to allow the filth of the execution speed of task by decreasing the CPU frequency and voltage to reduce the power burning up. This technology is often used in real-time systems [4].

$$P=V*V*F*C$$

Here P=power
V=voltage
F=frequency
C=capacitive load of the system

As mentioned above, by applying the DVFS technology, CPU voltage can be lowered, but the execution speed of the task will be reduced. From Equation, we can see that if only reducing the frequency, energy cannot be saved effectively. In the system, C is the capacitive load of the system, only in lowering the frequency and also reducing the voltage, the power consumption can be saved effectively.

As implemented CloudSim MIPS and frequency are directly related together. They presented three schemes result in reduce energy consumption, Lowest DVFS, Advanced DVFS and Adaptive DVFS, to allocate appropriate MIPS (million instructions per second) rate to real-time service.

DVFS adjustment mechanism

A mechanism by applying CloudSim to simulate a large scale cloud data center for energy saving has been proposed in this chapter. The system consists of three parts: the CPU utilization monitoring, DVFS adjustment, and real-time migration. [4] CPU utilization on each host is monitored in the system. According to the measured CPU utilization, an appropriate process will be performed for saving energy consumption.

$$Vcpui = (vm/host) *(MIPSi/MIPSi) \quad (1)$$

$$CPU\ utilization= Vcpui/host.MIPS \quad (2)$$

Cloud Sim MIPS (million instructions per second) is used to present the capacity of the host machine, the capacity of VM, and the workload requested by the user. Each workload will be distributed to VMs on different hosts. VM MIPS is the amount of MIPS required for the VM and Host MIPS presents the amount of MIPS the host can support. The utilization of the virtual CPU of a virtual machine, Vcpu , can be calculated by **(1)**, and the average utilization of CPUs can be calculated by **(2)** To reduce energy consumption, we can lower the frequency but inappropriate frequency assigned to virtual machine may result in performance degradation and missing application deadline. implemented CloudSim to show that MIPS and frequency are directly relate presented three schemes result in reduce en Lowest-DVFS, ∂-Advanced-DVFS and Adaptive DVFS, to allocate appropriate MIPS rate to real-time services. Apart from controlling energy consumption by load balancing or voltage adjustment at current executed job, process live migration technique when host is more overload than dynamic threshold of current time.

VM migration based on threshold method:

In a cloud computing environment, every physical machine hosts a number of virtual machines upon which the applications are run. These virtual machines can be transferred across the hosts according to the varying needs and available resources. The VM migration method focusses on transferring VMs in such a way that the power increase is least. The most power efficient nodes are selected and the VMs are transferred across to them.

The problem of VM allocation can be divided in two: the first part is admission of new requests for VM provisioning and placing the VMs on hosts, whereas the second part is optimization of current allocation of VMs.

Optimization of current allocation of VMs is carried out in two steps: at the first step we select VMs that need to be migrated, at the second step chosen VMs are placed on hosts using MBFD algorithm. We propose four heuristics for choosing VMs to migrate. The first heuristic, Single Threshold (ST) [1][2], is based on the idea of setting upper utilization threshold for hosts and placing VMs while keeping the total utilization of CPU below this threshold. The aim is to preserve free resources to prevent SLA(Service Level Agreements) violation due to consolidation in cases when utilization by VMs increases. At each time frame all VMs (Virtual machines) are reallocated using MBFD algorithm with additional condition of keeping the upper utilization threshold not violated. The new placement is achieved by live migration of VMs.

The other three heuristics are based on the idea of setting upper and lower utilization thresholds for hosts and keeping total utilization of CPU by all VMs between these thresholds. If the utilization of CPU for a host goes below the lower threshold, all VMs have to be migrated from this host and the host has to be switched off in order to eliminate the idle power consumption. If the utilization goes over the upper threshold, some VMs have to be migrated from the host to reduce utilization in order to prevent potential SLA violation. We propose three policies for choosing VMs that have to be migrated from the host [2][9][10].

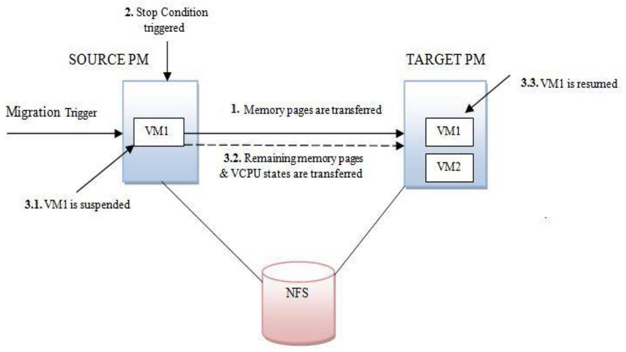


Fig 3:VM migration

• **Minimization of Migrations** (**MM**) – migrating the least number of VMs to minimize migration overhead.

• **Highest Potential Growth** (**HPG**) – migrating VMs that have the lowest usage of CPU relatively to the requested in order to minimize total potential increase of the utilization and SLA violation.

• **Random Choice** (**RC**) – choosing the necessary number of VMs by picking them according to a uniformly distributed random variable.

Energy Consumption and SLA violation of ST policy:

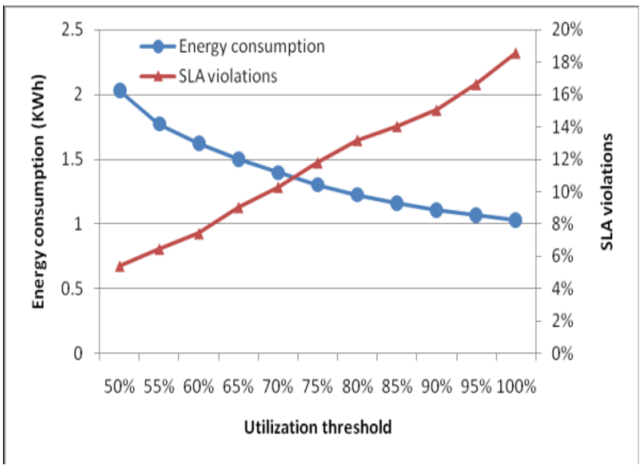
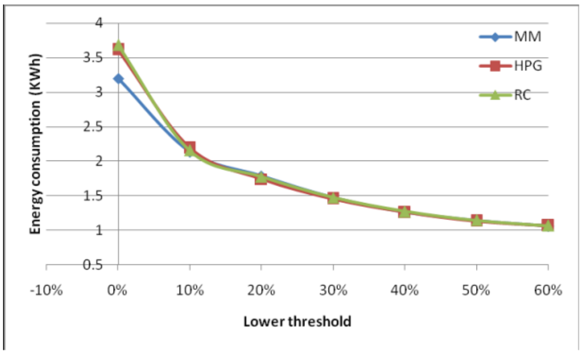


Fig 4: simulation results of ST policy

Energy consumption and SLA violations of other policies



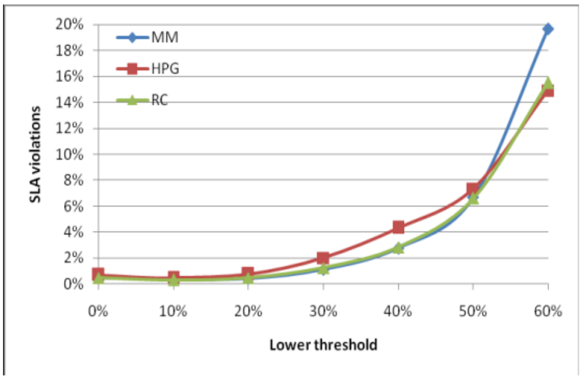


Fig 5:-SLA violations of different policies under different thresholds

4. CONCLUSION

Virtual servers are not expensive to maintain, but also unfriendly to the environment. High energy costs incurred due to massive amounts of electricity needed to power and cool numerous servers hosted in these data centers. Cloud service providers need to adopt measures to ensure that their profit margin is not dramatically reduced due to high energy costs. Lowering the energy usage of data centers is a challenging and complex issue because computing applications and data are growing so quickly that increasingly larger servers and disks are needed to process them fast enough within the required time period. In this paper by using" VM migration threshold " If cpu utilization is goes into lower threshold value, then all VM's are migrated from this host to reduce power consumption. Dps(by using Dvfs technique) is used monitoring the CPU utilization. The result shows the reduction of execution time and energy consumption.

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