Optimized Energy Efficient Allocation of Virtual Machines in Cloud Data Center

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Abstract:
Advancement in technology lead to the demand for computational power which in turns has led to the creation of large-scale data centers. They consume enormous amounts of electrical power resulting in high operational costs and carbon dioxide emissions. Moreover, modern Cloud computing environments have to provide high Quality of Service (QoS) for their customers resulting in the necessity to deal with power-performance trade-off. We will propose an efficient resource management policy for virtualized Cloud data centers. Proposed scheme consider the maximum and minimum utilization threshold value. If utilization. If the utilization of CPU for a host falls below the minimum threshold, all VMs have to be migrated from this host and the host has to be switched off in order to eliminate idle power consumption. We present evaluation results showing that dynamic reallocation of VMs brings substantial energy savings, thus justifying further development of the proposed policy.

Keywords: *CPU Cycle Scheduling, Cloud Sim, CPU Utilization, Virtual Machine Scheduling*

1. Introduction

The Cloud computing model leverages virtualization of computing resources allowing customers to provision resources on-demand on a pay-as-you-go basis [1]. Instead of incurring high upfront costs in purchasing IT infrastructure and dealing with the maintenance and upgrades of both software and hardware, organizations can outsource their computational needs to the Cloud. The proliferation of Cloud computing has resulted in the establishment of large-scale data centers containing thousands of computing nodes and consuming enormous amounts of electrical energy. Based on the trends from American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), it has been estimated that by 2014 infrastructure and energy costs would contribute about 75%, whereas IT would contribute just 25% to the overall cost of operating a data center [2]

2. Virtual Machine Scheduling

One of the ways to address the energy inefficiency is to leverage the capabilities of the virtualization technology. The virtualization technology allows Cloud providers to create multiple Virtual Machine (VMs) instances on a single physical server, thus improving the utilization of resources and increasing the Return On Investment (ROI). The reduction in energy consumption can be achieved by switching idle nodes to low-power modes (i.e., sleep, hibernation), thus eliminating the idle power consumption (Figure 1). Moreover, by using live migration [1] the VMs can be dynamically consolidated to the minimal number of physical nodes according to their current resource requirements. However, efficient resource management in Clouds is not trivial, as modern service applications often experience highly variable workloads causing dynamic resource usage patterns. Therefore, aggressive consolidation of VMs can lead to performance degradation when an application encounters an increasing demand resulting in an unexpected rise of the resource usage. If the resource requirements of an application are not fulfilled, the application can face increased response times, time-outs or failures. Ensuring reliable Quality of Service (QoS) defined via Service Level Agreements (SLAs) established between Cloud providers and their customers is essential for Cloud computing environments; therefore, Cloud

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providers have to deal with the energy-performance trade-off – the minimization of energy consumption, while meeting the SLAs.

We wil present a decentralized architecture of the resource management system for Cloud data centers and propose the development of the following policies for continuous optimization of VM placement: [2]

• Optimization over multiple system resources – at each time frame VMs are reallocated according to current CPU, RAM and network bandwidth utilization.

• Network optimization – optimization of virtual network topologies created by intercommunicating VMs. Network communication between VMs should be observed and considered in reallocation decisions in order to reduce data transfer overhead and network devices load. [2]

• Thermal optimization – current temperature of physical nodes is considered in reallocation decisions. The aim is to avoid “hot spots” by reducing workload of the overheated nodes and thus decrease error-proneness and cooling system load.

3. Problem Definition

Proposed scheme consider the maximum and minimum utilization threshold value. If utilization. If the utilization of CPU for a host falls below the minium threshold, all VMs have to be migrated from this host and the host has to be switched off in order to eliminate idle power consumption. If the utilization goes over the maximum threshold, some VMs have to be migrated from the host to reduce utilization to prevent potential Service Level Agreements violation. Further for migrating least number of vms to migrate, it uses minimization of migrations to reduce migration overhead. Our research will follow similar line of implementation by optimizing the migration process by migrating average number of virtual machines based on the utilization of the cpu. Further migration of vms will be considered with lowest usage of cpu and tasks are totally dependent on it. This process will be helpful to minimize total potential increase of the utilization and SLA violation. Round robin scheme of picking vms according to the uniform distributed variable. For validation of our proposed work, we will simulate Non Power Aware policy and DVFS, Comparison will be done with these two schemes.

4. Objectives of the Research

To fulfill our require experimentation we will have following objectives.

- To find the better virtual machine resource management particularly migration of virtual machines.
- Find the solution for better scheme based on virtual machine migration based on low utilization of cpu.

5. Methodology

Our research will start with study of virtual machine management in cloud environment by simulator based on cloud computing for virtualization in following steps.

<u>1st Phase:</u> This phase will contain the basic functionality and collection of information (simulator, basic virtualization functions etc). Layout for comparison will be done in this phase.

<u>2nd Phase:</u> In this phase we will implement a simple scenario for virtual machine resource allocation scheme.

<u>3rd Phase:</u> In this phase we will create a migration scenario based on related work to find the best fit resources to migrate.

<u>4th Phase:</u> We will implement the proposed scheme consider the maximum and minimum utilization threshold value. If utilization. If the utilization of CPU for a host falls below the minimum threshold, all VMs have to be migrated from this host and the host has to be switched off in order to eliminate idle power consumption. If the utilization goes over the maximum threshold, some VMs have to be migrated from the host to reduce utilization to prevent potential Service Level Agreements violation.

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Further for migrating least number of vms to migrate, it uses minimization of migrations to reduce migration overhead. Our research will follow similar line of implementation by optimizing the migration process by migrating average number of virtual machines based on the utilization of the cpu. Further migration of vms will be considered with lowest usage of cpu and tasks are totally dependent on it. This process will be helpful to minimize total potential increase of the utilization and SLA violation. Round robin scheme of picking vms according to the uniform distributed variable.

5th Phase: For validation of our proposed work, we will simulate Non Power Aware policy and DVFS, Comparison will be done with these two schemes.

In our initial experimentation, we have considered the cpu scheduling with virtual machine scheduling with help of basic genetic algorithm for optimization of vm scheduling. In Fig 1, basic scheduling process is explained.

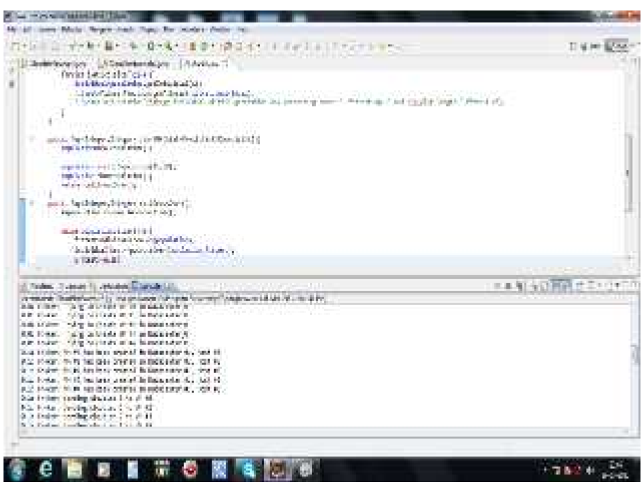

Fig 1: Basic implementation of the CPU Scheduling

In Fig 2, basic process of virtual machine scheduling is shown. CPU scheduling time and Cloudlet used have been shown.

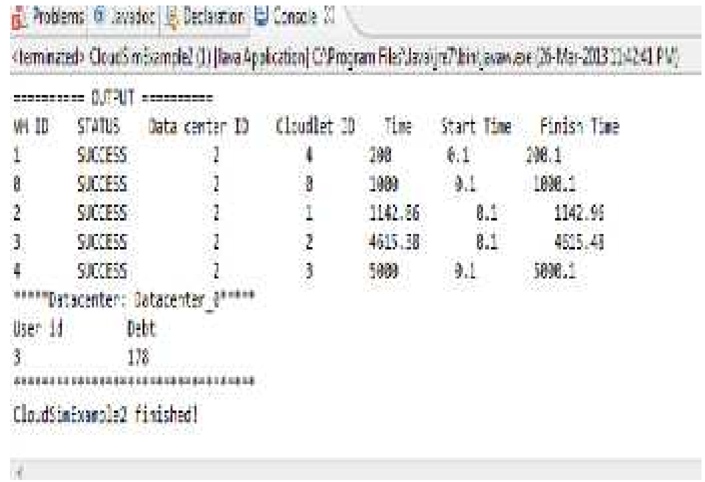

Fig 2: VM Scheduling process

7. Conclusion

This Research will prove to be a good solution for saving resources while finding the best scheduling process available. This Research is still in process and experimentation in running phase to test and implement the scheduling process.

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