VM Pipeling Technique for Minimizing Power Consumption and Make Span in Cloud

M. Dhanalakshmi, Anirban Basu

Abstract- Cloud computing which provides services "on demand" is gaining increasing popularity. However, one of the most challenging problems in cloud computing is to minimize the power consumption in the data centres. The subject of Green Cloud Computing has emerged with the objective of reducing power consumption. While reducing the power consumption it is important to perform the computation in minimum makespan (that is, when all the jobs or Tasks have finished processing). In this paper we propose a technique to achieve the objective of minimizing the power consumption as well as reducing the makespan. To minimize the power consumption, we schedule the tasks on each node utilizing its resources maximum (100%) such that we can reduce the number of nodes used in the data centre. The makespan is reduced using pipeline technique. A method has been proposed and its effectiveness verified by simulating on CloudSim. Results presented in this paper show the advantages of the proposed technique.

General Terms: Power Consumption, Virtualization, Green Cloud Computing.

Keywords- VM (Virtual Machine), Make span, Pipeline.

I. INTRODUCTION

Cloud Computing [1] makes computer infrastructure and services available "on-need" basis. It is believed that cloud computing will be dominant computing platform. However, one of the most challenging problems is to minimize the power consumption in the data centres. The subject of Green Cloud Network Computing has emerged [2][3]. Cloud Computing platforms [4] generally use Virtualization. Virtualization of computer system resources includes processor, memory and I/O devices. Virtualization techniques enable multiple tasks to be consolidated on few servers and results in reduced idle power cost thereby minimizing energy consumption. In cloud computing data centres efficiency is dependent on various aspects; one of the aspects is scheduling. Scheduling is a major factor it needs attention in the field of cloud computing. The scheduling tasks helps in minimizing major causes of concern such as amount of power consumed [5] and makespan to provide services. Many task scheduling algorithms are being used in cloud computing environment to optimally allocate resources to tasks. However most of the existing scheduling algorithms do not take into account the aspects of power consumption and makespan [6]. In this paper the objective is to focus on developing a scheduling technique which combines Virtual Machine (VM) placement algorithm and pipeline concepts is used to reduce the power consumption and makespan. The technique was simulated on CloudSim [16] and experimental results show the algorithm effectiveness of the proposed technique.

Revised Version Manuscript Received on December 18, 2015.

M. Dhanalakshmi, Department of CSE, East Point College of Engineering & Technology, Bangalore, India.

Anirban Basu, Department of CSE-R&D Dept. East Point College of Engineering & Technology, Bangalore, India.

The paper is organized as follows. Section II we discuss related work. Section III is the Proposed Techniques. Section IV is Implementation and Experimental Results. Section V Concludes the paper.

II. RELATED WORK

One of the energy minimization techniques applied at the data centre level, was developed by Ryan Friese et.al[7] in their work they are able to lower their energy consumption while maintaining a high level performance. Minimizing energy consumption while maximizing the performance can be modelled as a bi-objective optimization problem. In their paper, authors specify a method to create different resource allocations that shows the tradeoffs between minimizing energy consumed and minimizing the makespan of a system. By adapting a multi objective genetic algorithm they are able to construct Pareto fronts consisting of Pareto-efficient resource allocations. This technique facilitates the system managers to make intelligent scheduling decisions based on the energy and performance needs for their system. Xin Li et.al [8] has considered the problem of energy-efficient virtual machine placement algorithm with balanced and improved resource utilization in a data centre. The main challenge is to improve the resource utilization to minimize power consumption. The key issue in server virtualization is Virtual Machine Placement (VMP) which selects some available physical machine (PM) to deploy each newly created VM in runtime. When the VMs are fully loaded in PMs, all the utilized resources referred to as resource fragments are wasted. In order to improve the resource utilization such that the number of running PMs is minimized, we have to lower the number of resource fragments and decrease their sizes. To achieve this authors propose a multidimensional space partitioned model to characterize the usage of each PM. This algorithm reduces the number of resource fragments and decreases their sizes and minimizes the energy consumption. Awada Uchechukwu et.al. [9]. In their work, the authors specifies formulations and solution for Green Cloud Environments to minimize its environmental impact and energy consumption under new models by considering static and dynamic portions of cloud components. The proposed methodology presents a model by capturing cloud computing data centre. Author presents energy consumption pattern and show that by applying suitable optimization policies directed through their energy consumption model. The energy consumption is saved in cloud data centres. Christobel et.al [10] in their paper the author's concentred on discrete particle swarm optimization algorithm based on the particle best position and global best position is adopted to find the global optimal solution for higher dimensions.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Their algorithm yields better schedule with minimum completion time. They considered the job completion ratio and lateness; using their algorithm an energy improvement of up to 28% is obtained. Sobir Bazarbayev et al. [11] in their work, authors discussed the infrastructure as a service (IaaS) clouds, provides on demand nature of services. In the large cloud data centre hundreds of thousands of virtual machines can be deployed and terminated. The content based scheduling algorithm schedules the VMs with high content similarity on the same hosts. When deploying a VM on a destination host reduces the amount of data transferred. The content based scheduling algorithm reduces the network traffic. There are many other VM placement algorithms [12-15] that have been proposed. However, none of the algorithms focus on the problem of minimizing power consumption and makespan. In this paper, an algorithm is proposed which is more efficient compared to the above discussed techniques. We propose a technique to achieve the objective of minimizing the power consumption as well as reducing the makespan. To minimize the power consumption, we schedule the tasks on each node by utilizing its resources maximum (100%) such that we can reduce the number of nodes used in the data centre. The makespan is reduced by using pipeline technique.

III. PROPOSED TECHNQUE

We now discuss a technique for Task Scheduling which minimize the power consumption as well as reduces the makespan. The proposed method is a combination of Virtual Machine (VM) placement and pipelining concepts is used to reduce the power consumption and makespan for set of tasks by utilizing the resources maximum[4][5].

3.1. Minimizing Power Consumption

In this paper we consider set of tasks T = {t1, t2…tm} and arrival rate for task is denoted as α (i=1, 2…n). For each task the VM is created and arbitrarily allocated. VM = {vm1, vm2....vm_m} [6].

3.1.1. Power Equation

The power consumed by VMs which composed of n tasks and its model is represented as specified below.

$$Pvm = Min \sum_{j=1}^{n} P(vm(tj), tj) \text{x} T(vm(tj), tj)$$

The Pvm denotes the total power consumption of VMs execution, VM(tj) represent the selected VM for task tj, P(VM(tj),tj) denotes the power required to execute task tj on selected Virtual Machines (VM). T(VM(tj), tj) represents the time required to execute task tj on selected VM.

3.2. Proposed Power Efficient VM Pipelining Algorithm.

In the proposed Power Efficient VM Pipelining algorithm [7], VM placement is done as specified. First the set of random tasks is defined as Random(T) where T is consists of m tasks (t1, t2…tm) for each task a VM is allocated. On the arrival of the tasks admission of new requests for VMs provisioning is done on the nodes and we ensure VMs utilizes the resources maximum on each node. In most of the existing techniques, if the active nodes does not meet the VM resource requirements because of insufficient amount of resource is available in such case we switch on or turn on the next node from sleep mode to active mode then the VM is created on that node this increases the power consumption[8][9]. In the proposed technique we utilize the resources maximum (100%) for example already two VM1 and VM2 are allocated for the third VM3 sufficient resource is not available as shown in the Figure 1, because resource utilization exceeds more than 100% on that node. We can increase the execution time of the VM3 and allocate the third VM3 on the available resource with other two VMs as shown in Figure 2. [10][11].

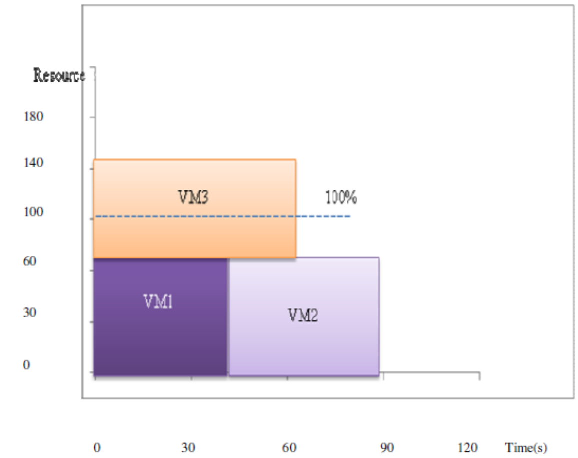

Figure 1. Resource Utilization of VMs > 100%

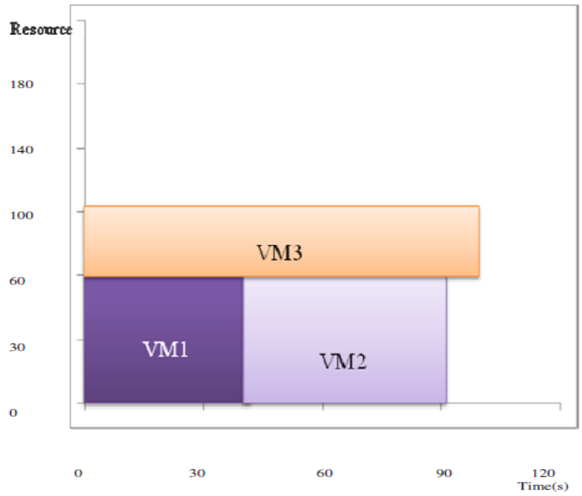

Figure 2. Resource Utilization of VMs = 100% by Increasing execution time of VM3

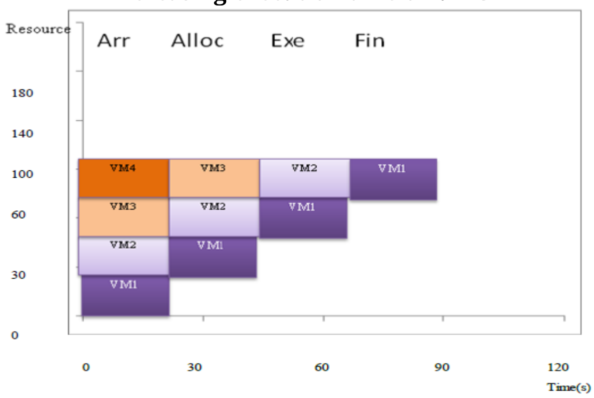

Figure 3. VMs in Pipelined

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

For allocating VMs we utilize each node resources 100%. Thus the power consumption is minimized by reducing the number of nodes usage in the data centre [12] [13]. If we cannot allocate the VMs then instead of migrating to the next data centre. Check whether we can reallocate the VMs which completed its execution. The energy usage for migration is further saved. In the proposed technique VMs in pipelined as shown in the Figure 3. In the stage 1 the VM1 is arrived, stage 2 VM1 is allocated on the node in pipeline VM2 arrival process is performed in the stage 3 when the VM1 is executed in pipeline VM2 is allocated and VM3 is arrives. Stage 4 VM1 is finished execution in pipeline VM2 is executed, VM3 is allocated and VM4 arrives. We reduce the makespan by allocating and executing previously allocated VMs in pipeline as shown in above Figure 3. The pseudo code for the algorithm is presented below.

Algorithm 1:

1.**Input**:nodeList,vmList,ResourceFlag
RandomTaskList
2.**Output** : allocations tasks to VMs and Execute Task
3. Foreach task in RandomTasklist
VMProvisionForEachTask();
4. **foreach** vm in vmlist **do**
5. MinPow = MAX
6. NodeAllocated = NULL
7. **foreach** node in NodeList **do**
8 Reqpower = *PowerReq*(node,vm)
9. ResourFlag = requireResource(node,vm)
10. **If** (Reqpower<MinPow)&&(ResourFlag) **then**
11. NodeAllocated = node
12. Minpow = Reqpower
13. ResourFlag = True
14. else
15. **If** (!ResourFlag) **then**
16. Nodeallocated = node
Allocate VM on available resource by increasing its execution time and in pipeline execute the previous allocated vm
17. **If** (Nodeallocated≠NULL) **then**
Allocate vm to Nodeallocated and in pipeline
while previously allocated vm is in execute stage
18. **If** (RunningVMs = = completedTasks) **then**
19. Reallocate the VMs and the Resource Available
20. to other VMs such that avoids migration and decreases The execution time.

IV. IMPLEMENTATION AND EXPERIMENTAL RESULTS

The performance of the proposed method is measured by simulating using CloudSim [16]. In the cloudsim new scheduling mechanism is compared with existing Round Robin techniques. The simulation is conducted with specified conditions as tabulated in Table 1.

Table 1: CloudSim Simulation Setup

No of Data Centres	1
No of Cloudlets	25
No of Hosts in Data Centre	40
No of VMs	25
No of Resource Configuration for Hosts	1
Resource Configuration 1	100 MPS CPU, 4GB RAM, 140 GB disk

The simulated results is as shown in Figure 4 illustrate the proposed technique minimizes the power consumption by utilizing the each node resources 100%. Figure 5 shows the make span is reduced using pipeline concepts.

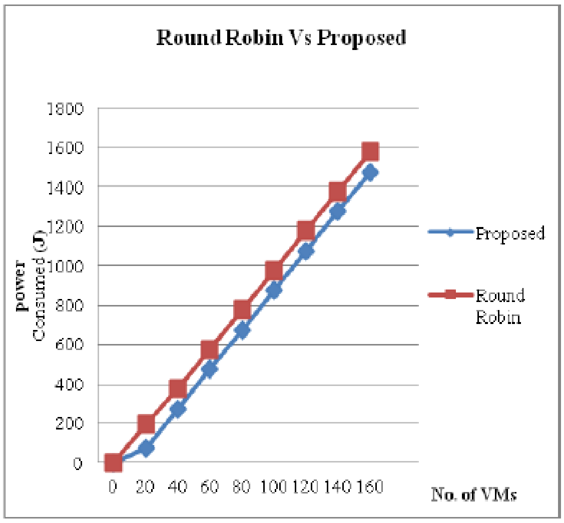

Figure 4. Power reduced using proposed algorithm and compared with Round Robin

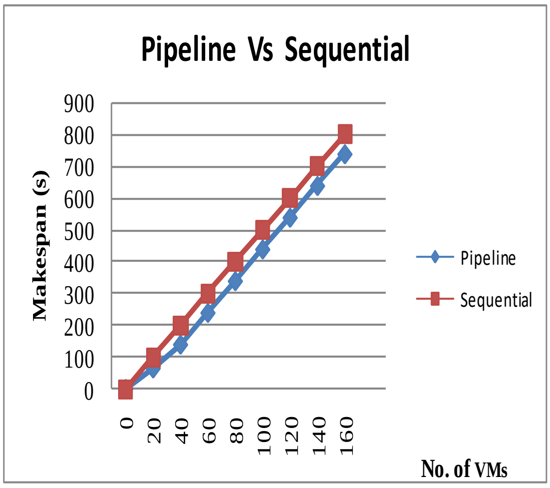

Figure 5. Makespan reduced using proposed pipeline algorithm and compared with sequential algorithm

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

V. CONCULSION

Existing techniques do not consider both reducing power consumption and make span. Therefore there is a need to implement a new proposed algorithm that can minimize the makespan as well as reduce the power consumption to provide best possible solution. The paper presents a technique to achieve the objective of minimizing the power consumption as well as reducing the makespan. To minimize the power consumption, the tasks are scheduled on each node by utilizing its resources Maximum (100%) such that we can reduce the number of nodes used in the data centre. The makespan is reduced by using pipeline technique. The experimental results simulated on cloudsim. It can be concluded that both the power consumption and make span is reduced by the proposed method.

REFERENCES

1. Open Cloud Manifesto. [Online]. Available: http://www.opencloudmanifesto.org/.
2. The green grid consortium,2011.
3. Ministry of Economy, Trade and Industry establishment of the Japan data centre council, press Release.
4. Rajkumar Buyya, James Broberg, Andrzej Goscinski. 2011. CLOUD COMPUTING: Principles and Paradigms. A John Wiley & Sons, Inc. Publication.
5. EMC 2008 Annual overview releasing the power of information, http:\\www.emc.comJ digital_universe.
6. S.Albers.May 2010.Energy efficient Algorithms Communications of the -ACM, Vol.53, no.5, pp.86-96.
7. Ryan Friese*, Tyler Brinks*, Curt Oliver*, Howard Jay Siegel* and Anthony A. Maciejewsk*.2012.Analyzing the Trade-offs Between Minimizing Makespan and Minimizing Energy Consumption in a Heterogeneous Resource Allocation Problem.The Second International Conference Advanced Communications and Computation.
8. Xin Li [a] , ZhuZhong Qian [a,*] , Sanglu Lu [a] , Jie Wu [b] Feb 2013.Energy efficient virtual machine placement algorithm with balanced and improved resource utilization in a data centre.
9. Awada Uchechukwu, Keqiu Li, Yanming Shen. June 2014.Energy Consumption in Cloud Computing Data Centres", International Journal of Cloud Computing and Services Science.
10. M Christobel, S. Tamil Selvi and Shajulin Benedict.2015 Efficient Scheduling of Scientific Workflows with Energy Reduction Using Novel Discrete Particle Swarm Optimization and Dynamic Voltage Scaling for Computational Grids. ScientificWorldJournal.
11. Sobir Bazarbayev and Matti Hiltunen,, Kaustubh Joshi,William H. Sanders,Richard Schlichting.2013.Content- Based Scheduling of Virtual Machines(VMs) in the Cloud. 2013 IEEE 33rd International Conference on Distributed Computing Systems.
12. Anton Beloglazov and Rajkumar Buyya .2010. Energy Efficient Allocation of Virtual Machines in Cloud Data Centre. 10th IEEE/ACM International Conference on Cluster, Cloud and Grid Computing,2010.
13. K. Kim, A. Beloglazov, and R. Buyya.2011.Power-aware provisioning of virtual machines for real-time Cloud services," Concurrency and Computation: Practice and Experience, 2011.
14. http://opennebula.org/documentation:archives:rel2.0:Schg accessed on oct 30 2013.
15. GWDG escience Group.2012.Virtual Machine allocation in current Cloud Computing Middleware.
16. R.Buyya. Cloud Simulator cloudsim version 2.1, GRIDS Lab, http://code.google.com/p/cloudsim, July 27, 2010.