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A Study on Energy Efficient VM Allocation in Green Cloud Computing

Chingrace Guite[1*], Kamaljeet Kaur Mangat[2]

[1]Dept. of CSE, PURCITM, Mohali, India

[2]Dept. of CSE, PURCITM, Mohali, India

[*]*Corresponding Author: guitegrace.chin.gg@gmail.com, Tel.: 7085936207*

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***Abstract*—** Cloud computing plays a significant role since its evolution. With its ubiquitous nature, sharing of resources and management of services has never been convenient than ever before. Due to its ability to provide scalability and elasticity infrastructure, many organization utilizes the services, where the workload is shifted in cloud data centers. This data center consumes more power and there is the release of unwanted carbon footprint in the environment. Therefore here lies the need to improve the use of energy and at the same time minimizing power consumption. In this paper, we present a survey on VM placement and migration to achieve energy efficiency in cloud data centers.

***Keywords*—** Power Consumption, Virtual Machine Allocation, Virtual Machine Migration, Green Computing

I. INTRODUCTION

Cloud computing is well known in technologies for providing service model[1]. It gives the flexibility to access resources to clients or users through means of internet. Services offer in cloud consist of Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) and deployment services are public, private, hybrid and community which depicts where. Widely known companies such as IBM, Google, Amazon AWS, Dropbox provides services to users around the world.

In the cloud, data centers houses both hardware and software technology along with computing services which consume a large amount of energy violating the environment. In 2006, DataCentre knowledge explained that in USA alone datacentres consumes 70 million kilowatt-hours of electricity in 2014 and was believed to increase more than 40 billion kWh if not for energy efficiency measures. Moreover, the CO2 emission is no a secret which effects environment badly and with the improvement of energy efficiency, the survey stated that 620 billion kWh will be able to save between 2010 and 2020 [2]. The defining challenges as inferred in [3] gives ample explanation on how important virtualization is and the significant role and principles of cloud computing against traditional computing. Energy efficiency can be achieved with the help of virtualization which now serves as a major purpose for green cloud computing. It is still a recent exploration area under virtualization techniques and is becoming more popular than ever before. The idea is to reduce physical host in which multiple instances run along with resources on a single platform called the physical host and pave the way to revolutionized in cloud computing.

The remainder of the paper is organized as follows. A brief introduction to Virtualization is discussed in Section 2 and describes various optimization techniques to minimize the energy consumption in the cloud. In section 3 we describe related work of the previous study on VM placement and migration. Finally, Section 4 presents our conclusion.

II. NEED OF VIRTUALIZATION

It is not new that the cloud infrastructure itself cannot provide energy efficiency [4]. There is a tendency of more workload in cloud data centers due to immense energy consumption leading to emitting high emission of CO_2 and here lies the necessity of energy efficiency. In order to analyze and predict the performance of workload, author G. Kousiouris, T. Cucinatta et al [5] focus on some parameters

such as real-time scheduling decisions, allocation percentages, and co-placement. Virtualization techniques and tools discuss the justification for dynamic resource allocation, fault tolerance isolation and ease of management as such. Virtualization is an abstraction layer that allows multiple operating systems runs side by side with virtual machines as a single unit as depicted in fig 1. It provides hardware independence, encapsulation, server consolidation and VM migration.

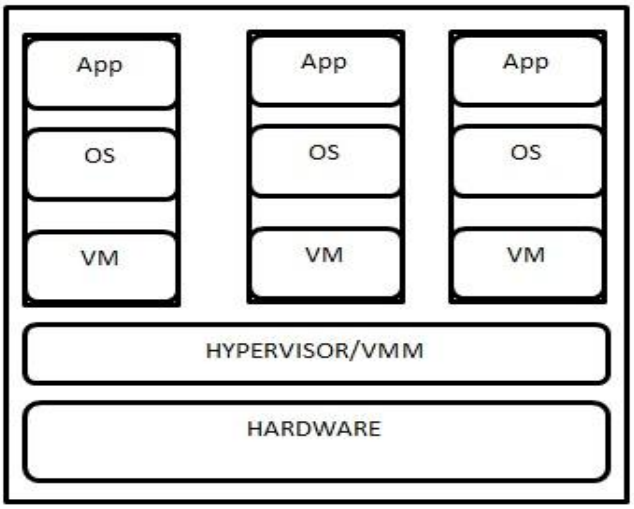

Fig:1 Virtualization[6]

The traditional workload for solution attempt to concentrate on minimizing the computing resources and increasing the number of resources to idle mode, however in [7] author briefed on GreenCloud that offers users to utilize resources on servers, switches, and link. The author of [8] presented a technique which monitors network affinity from intensive resource bottleneck among VMs (virtual machines) and migrations. The task is a dynamic adjustment in VM placement which helped to achieve minimal network contention and improve performance. Since VM selection and placement is taken into consideration it is indeed important to decide on the location of cloud infrastructure [9] and provide and meet customer requirements. In [10] the authors presented a scheduling for power-aware virtual machines placement in the cloud. In it, parameter says SLA are taken into consideration which satisfies the policy and gives less power consumption.

III. RELATED WORK

H.T. Vu and S. Hwang [11] put forward an algorithm with more details on energy-aware VM placement and throw some light to improve overall performance by controlling VM traffic in order to increase CPU utilization so that factor such as SLA violation and energy consumption are taken into consideration.

In [12] M. Bala and A.Green stated the importance of virtual machine migration in cloud data centers when VM face workload and focuses mainly on energy performance. Another proposed work by N.J Kansal and I. Chana on energy-aware is adapted from power aware using firefly algorithm [13] that can perform the live migration and minimizing energy consumption by selecting VM from source to destination and it tries to enhance techniques to give maximum scalability so that energy efficiency can be achieved.

Another yet discussed in [14] is explained by M. Mishra and A. Sahoo the use of vector-based technique considering different metrics and their intention to improve the existing methods are also presented with a list of properties therefore balanced servers is achieved after VM allocation. The modified algorithm of BFD (Best fit decreasing)i.e. MBFD is explained by S. Mustafa B.Nazir, A.Hayat et al [15] that which is based on the bin packing problem. In Modified BFD the Virtual machine is sorted in increasing order based on their utilization of CPU.

All Virtual machines after sorting are deployed to the host's machine based on the power or energy consumption and according to which it is then checked that how much change in power consumption of the hosts after placement of specific VM. VMs are consolidated and minimizes congestion in network hence gives better result in less cost, reduces power consumption and SLA violation.

E.P Zaw and N.L Thein [16] proposes a framework for improving further Live migration performance that reduces the number of memory pages to be transferred. The author uses Least Recent Used cache with a splay tree prediction algorithm along with working set prediction method. A comparative analysis is performed with Xen’s pre-copy migration algorithm and reduces 23.67% of overall transferred while migrating.

This table describes various energy efficiency techniques, the algorithm used by the various author, and the outcomes. They have taken numerous parameters such as downtime, migration time, VM placement technique, SLA violation and power consumption.

Table.1 : Comparison between various efficiency techniques

Proposed by	Algorithm used	Description	Outcome
Thiago Kenji et al[17]	First fit decreasing (FFD), GABFD and PABFD	Aims to minimize energy consumption and also the use of resources is optimized.	Migration time is minimized and hence satisfies Quality of Service due to a reduced active machine that shifted numbers of workload on lesser machines
Hieu trong et al[11]	Traffic and power-aware Virtual Machine (TPVMP)	Consolidated VM utilizes various policies to place VM	Increase overall performance and minimizes VM traffic cost
Anton beloglazov and Rajkumar buyya [18]	VM placement algorithm and minimum migration (MM) policy	VM is optimized continuously and follows SLA policies	Consolidated VM gives minimization of energy
Young Choon et al [19]	ECTC and MaxUtil algorithm	The task of MaxUtil is to consolidate VM	Less power consumption and save energy. Also reduces the carbon footprint of environment .
Nguyen quang hung et al[20]	EPOBF(Energy aware and performance-per-watt oriented Best-fit)	Propose new VM allocation and perform comparative analysis with PABFD	Shows significant save of power thereby reduce energy consumption
Gregor won laszewski et al[21]	Power-Aware Scheduling algorithm	VM dynamically performed in a cluster in order to improve computing performance	Improves overall execution and performance hence minimize processor power
A. kochut and kirk beaty[22]	Presents analytical model VM migration, the time required to migrate, ability to predict VM demands and due to migration chance of additional resource consumption	Gives apprehensive way to the dynamic reallocation of VM	Migration time is significantly minimized and overall improvement due to convenient response time during VM migration
S. S. Masoumzadeh and H. Hlavacs [23]	Proposes a decentralized dynamic consolidation of VM, uses three approaches	It uses live migration techniques peerSim simulation tool is used resulting in an optimal solution	Reducing energy consumption and satisfies QoS
Monil et al[24]	Proposed on three VM selection algorithm with migration control strategy	With migration strategy and applying that three algorithm saves energy and minimizes the number of migrations	Reduces network traffic and improves performance than other heuristics approaches

IV. CONCLUSION

In this paper, with the provision of a holistic view on virtualization, we reviewed and presented related to VM placement, migration and consolidation based on different techniques in order to minimize energy consumption while providing reliable quality of service.

Some of our findings on existing work can be concluded that in the future an approach such as an Artificial neural network for selection, machine learning like Support vector machine (SVM) with genetic algorithm for optimization can be applied to improve quality of service, reduce SLA violation and attain energy efficiency.

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