

Minimizing Power Consumption and Improve the Quality of Service in the Data Center

S. R. Jayasimha¹, J. Usha^{1*} and S. G. Srivani²

¹Department of MCA, VTU, Belagavi-590018. R. V. College of Engineering, Bengaluru-560059, Karnataka, India.
jayasimhasr@rvce.edu.in, ushaj@rvce.edu.in

²Department of EEE, R. V. College of Engineering, Bengaluru-560059, Karnataka, India.
srinivasag@rvce.edu.in

Abstract

Background/Objectives: Minimizing power consumption and improve the quality of service in the data centre investigates the power consumption in various devices IaaS in cloud computing environment. **Methods/Statistical Analysis:** Overall, a total of ninety-one studies from 2013 to 2015 have been reviewed in this paper. However, tenth studies are selected that focused on the energy efficient concepts used in the research. **Findings:** From the study the energy plays a major role in the data centre and it has become a big issue for the Information Technology (IT) field and the businessmen. Power is most important in the world with limited resources of energy. Energy efficiency in the environment of cloud has always been a key concern for the design and cost of maintaining the data centres. Virtualization reduces the complexity for enabling an efficient way to use the computing power and improve the Quality of service in data centre. In this work, Xen server is used to compute the power and find the efficiency, power consumption for the size of 10 different nodes are connected to the workload condition by allocating Virtual Machine (VMs) to the server using open stack net and process the workload performance in the data centre has been considered. The experimental results expose that VM selection process works through the energy reduced by up to 35% on the impact. **Application/Improvements:** The review of Minimizing Power Consumption and Improve the Quality of Service in the Data Centre will investigate power consumption in infrastructure level in cloud computing helps researchers to analyze different algorithm techniques for future research directions.

Keywords: Energy Efficiency Data Centre, Power Consumption, Quality of Service, Virtual Machines.

1. Introduction

The computing environment consumption of energy is the main issue in the IT industry, environment and academic. Because of energy usage in data center for its operations such as storage and recover, supply of power and cooling contributed completely on total cost for operations¹. Cloud framework² aims to advanced design, through image processing, virtual machine management and scheduling of VM. The power usage in the data center has become the main issue for cloud computing. Storage and power usage in the data center are mounting in day to day life. Now a days, Amazon, EC2, IBM, Microsoft and Google and many big companies have deployed data centers for hosting Internet applications. In this

paper a framework of cloud computing which is directly contributed towards the energy consumption in the data center is discussed, and also how green cloud computing lowers the power consumption has been discussed. The deployed framework is fully dependent on open stack net with 10 different places tested by multiple physical nodes. Quality of Service (QoS) presented by the application of availability, reliability, and performance of different levels with infrastructure and platform hosts it. Framework and QoS are fundamental for the cloud environment, who is delivering the excellent characteristics and tradeoffs QoS different levels of operational cost.

The data center cost and energy consumption driven in the cloud environment can be reduced as much as possible through VM selection on the workload basis³.

* Author for correspondence

Energy efficiency in the cloud environment and increase in the efficiency through VM in the data center will provide Return on Investment (ROI) to the environment and reduce CO₂ emission which is directly dependent on the globe⁴.

The surveys made in the energy efficiency of data center have found different techniques, they are ⁵ :

- Reducing electricity bills
- Minimizing energy with interconnected networks
- Renewable energy.

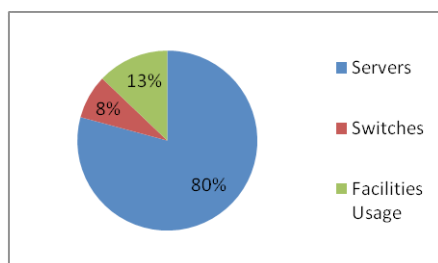


Figure 1. Energy consumption of data center.

According to Google, Microsoft, IBM, EC2 and Amazon data centers, the energy in IT industry is nearly 95% of the total consumption in the year 2015 in that the servers used 80%, switches 8% and other facilities 13% of energy.

2. Framework

The deployment of open stack is fully depending on open source software which is dynamic consolidation by VM. The open stack is designed for VM consolidation dynamically through the environment as Infrastructure as a Service (IaaS) in the cloud environment.

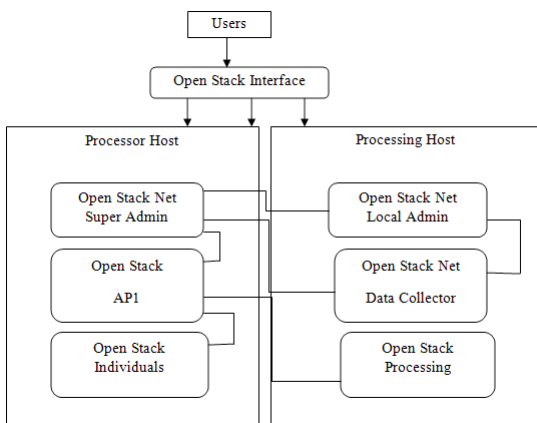


Figure 2. Deployment of Open Stack Net.

Web services, EC2, Amazon are some of the components provided by the data center by the VMs⁶. The open stack implementation by the open source software framework used by the software python 2.0. The framework with 10 nodes open stack deployment in different workload conditions consolidation of servers by the VM. The open stack server placed in more than 10 places with in the city. The algorithm works through the energy reduced by up to 35% on the impact.

The data centre consisting of N different physical nodes. Each and every node i is characterized by the Million Instructions Per Second (MIPS). Amount of power usage per second by the server and different network components is huge.

To store information, server not having direct relationship between network equipments and storage networks to allocate VM. The environment type implies network and workload configuration with time on the provisioning of VM.

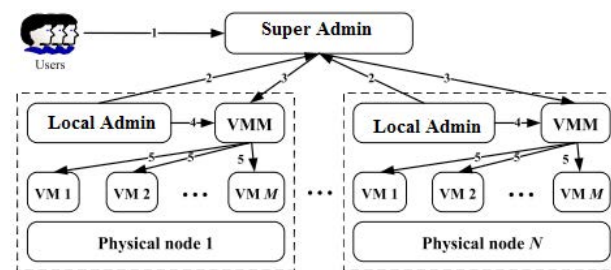


Figure 3. System Model.

Multiple users request multiple characteristics to M heterogeneous VMs to process power in MIPS and depend on the network bandwidth and how much utilization of Random Access Memory (RAM) is utilized in the server.

The individual users are requested by the super admin then super admin will check the Local admin to look over the availability of space in the server and convey to the super admin. Again super admin is requested by Virtual Machine Manager (VMM) to allocate the provisioning of workload and power utilization by the server, then each VM to migrate individually through physical node and N physical nodes⁷. The users will get establishment of the QoS improvement in the data center.

In this paper it is discussed about the selection of VM depending upon the workload condition by keeping time factor as a parameter. If the host is overloaded the local admin behind the overloaded host initiates the VM

selection process to identify the VM offload working in the host⁵.

I. Power Management in Data Center

3. Power Management in Data Center

Virtualization is the main key in the continuous improvement of power management in cloud computing. The servers and costs are the two factors considered in the energy efficient cloud environment. The fact that closely (80 to 82) % of workload in server is supported by X86 hardware component are in virtual machine in the year 2018.

Usage of virtualization is more popular and very easy to understand. The benefits among virtualization in the data center are:

- Hardware expenses: Used large number of lower capacity servers. Instead of using many physical hosts machines it is replaced into virtual ones. It consolidates the total power consumption used is significantly lower.
- Increase availability: During server utilization with "VM allocation" the Capabilities of VMs relocate and the feature of physical host connectivity quickly in the business field keep track of applications up and running simultaneously⁸.

II.

4. Proposed Mechanism

There are many ways to define the usage of servers and improve the QoS in the data center. For example: if any of the application run on the servers power utilization 8 to 10 years old is the twice the power utilization in the newer servers and new servers are most efficient servers⁹. A simple advanced relationship between Central processing Unit (CPU) utilization and power utilization is engaged with power model in the data center of the cloud environment. VM allocation and selection process is enhanced through the memory usage in the data center and even it requires some extra memory to be considered as a buffer temporarily. The VM migration policy is proposed towards the time and CPU utilization during the time period is considered as 10% of energy is consumed during migration policy¹⁰. The VM migration is accurate and depends on the time period in selecting the bandwidth. The Service Level Agreement (SLA) is

placed by considering the whole CPU utilization and all the networking components. The Million Instructions per Second (MIPS) can be obtained purely depending on the total number of hosts who requested the work on demand to VM in the data center.

5. VM Selection Process

VM allocation through the server will reduce the energy consumption in the data center. The VM allocation and process through the selection can be described as the following process.

```

Input: n, t, vms, cpu, RAM
Output: VM to allocate
1: RAM ← min VM
2: Max CPU ← initialization
3: Select VM ← initialization empty
4: for VM, CPU in VMs CPU do
5:   if VMs Ram[VM] > minRAM then
6:     continue
7:   val ← n values from CPU
8:   mean ← sum (val)/len(val)
9:   if max CPU < mean then
10: return selected VM

```

VM selection process begins with the number of physical hosts with time as a main factor and CPU utilization with RAM is considered. Initially the minimum workload allocated VM and RAM are to be considered. The maximum CPU utilization with different workload condition to be identified. Select the VM which is empty at initial condition. Consider the VM and CPU utilization with maximum and select the VM RAM which is greater than the RAM and continue till the completion of the process then calculate mean while selecting sum of the n from CPU and length^{6,11}.

The VM selection process includes P as a parameter represents the total VM performance of object j. C is the co-efficient of the average performance used in VMs. Whereas CPU utilization in the cloud as 0.2(20%) of the approximation.

For test the environment of data set considered R1, R2,...,Rn is used to calculate the utilization of memory and mean of the total VMs considered^{7,12}.

$$P = C \cdot \int_0^t 1 + T_{nj} \cdot q_j(t) dt \quad (1)$$

$$R_{nj} = M_j / B_j \quad (2)$$

Whereas $q_j(t)$ is the time utilization of V_{mj} , t_0 shows the time to process the VM to physical host. R_{nj} is the

completion of the process. M_j used by utilization of memory, B_j is the bandwidth usability.

6. Experimental Setup and Results

In the cloud environment the Infrastructure as a Service (IaaS) is considered with infinite resources to the users. Cloud improves the Quality of Service through availability, reliability and performance applicable in the (IaaS) Level¹³. QoS improve the cloud service and emission of Carbon Dioxide CO_2 . The software environment Cloud Sim tool kit is a modern framework which is used to test many simulation experiments. The energy consumption in the various storage devices is up to 70 to 80% of the total utilization of hardware components^{14,15}.

Table 1. Hardware component

IXDelloptiplex 440
Intel® core(TM) 2CPU(1cores,1threads)
2GB DDR2, Segate 80GB, 4200RPM SATAII
Broadcom 2487 Nextreme Gigabit controller
3X113M systems X 1800MZ
Intel® Xeon (R) CPU (4 cores, 16 threads)
2GB DDR3 – 890
Western digital 120GB, 4100 RPM SATA II

The experimental data centre consists of 200 physical nodes. Among the many are HP LiantG1 servers and rest are used with HP LiantG2 servers. The power consumption in VM consolidation data centre is given in the table 2. The servers G1 and G2 are having 1GB/S network bandwidth.

HP LiantG1 (Intel Xeon 1020, 2 cores X 1240 MHZ 2GB) and HP LiantG2 (Intel Xeon 1025, 2 cores X 1220MHZ, 2GB) the power consumption in the Table 2 shows the power consumption with different servers in watts. VM selection process performs an efficient result

with VM consolidation for every 10% difference from 0 to 100% has verified. The simulating results in CPU is advantageous by overloading a server a lighter workload is required.

Table 3. VM Consolidation

Sl. No	Date	No. of VMs	Mean
1	3/3/2016	120	8.31%
2	4/3/2016	89	7.46%
3	7/3/2016	334	8.96%
4	9/3/2016	286	7.89%
5	12/3/2016	412	9.23%

VM consolidation shows the result by considering the different number of VMs assigned with workload with different days and calculated mean by selecting total number of physical nodes and workload in different servers used by the day with the number of servers actively working on that day.

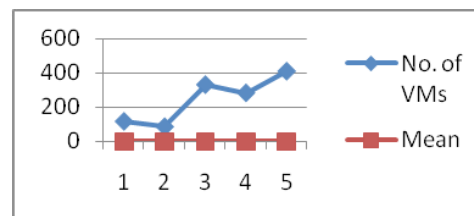


Figure 4. Performance of VM consolidation.

The graph represents the total number VMs considered in the particular date with different workload conditions and calculated mean to be shown in VM consolidation and improved Quality of Service.

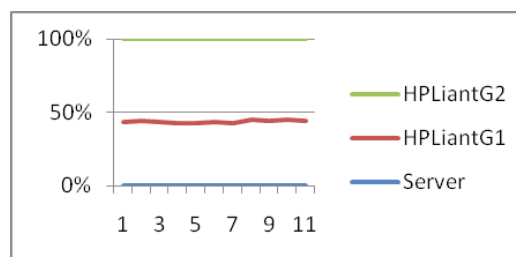


Figure 5. Power consumption in servers.

Table 2. Power consumption in different workload condition in Watts

Server	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
HPLiantG1	40	46.4	47.2	49	52	54	55	62	64	67	69
HPLiantG1	52.3	58	61	65	69	71	74	76	80	82	86

The graph represents power consumption with different servers in watts with VM consolidation for every 10% differences from 0 to 100% as plotted.

7. Conclusion

The experiment compares the power consumption in the data center through VM selection process. The main aim is to reduce the power consumption in data center through VM selection process. Power consumption in different workload conditions is shown in Figure 5. The experimental results show an efficient result with VM consolidation for every 10% differences from 0 to 100% has verified. The simulating results of CPU are advantageous by overloading to a server. The different number of VMs assigned with different workload condition in the data center and the energy is reduced by 35% on the total impact and Qos is improved. Future work can be carried out to reduce the VM selection process and increase VM performance in the data center with large number of physical nodes in the data center.

8. References

1. Armenta-cano F, Tchernykh A, Cortés JM, Yahyapour R, Drozdov AY, Bouvry P, Avetisyan A. Heterogeneous Job Consolidation for Power Aware Scheduling with Quality of Service. *Russina Supercomputing Days*. 2015 March; (218):687–97.
2. Younge AJ, Laszewski GV, Wang L, Lopez-alarcon S, Carithers W. Efficient Resource Management for Cloud Computing Environments. *Green Computing Conference*. 2010 Aug.
3. Kurpicz M, Sobe A, Kurpicz M. Energy-proportional Accounting in VM-based Environments Energy-proportional Accounting in VM-based Environments. *Parallel, Distributed and Network Based Processing*. IEEE; 2016.
4. Li X, Jiang X, Ye K, Huang P. DartCSim Enhanced Cloud-Sim with the Power and Network Models Integrated. *6th International Conference on Cloud Computing*. IEEE; 2013 June. 644–51.
5. Intelligent E, Manager P. Simplifying power management in virtualized data centers, Powering business worldwide. *IEEE International Conference*. 2016.
6. Kalange PR. Applications of Green Cloud Computing in Energy Efficiency and Environmental Sustainability. *Journal of Computer Engineering*. 2014; 25–33.
7. Albers S. Energy-efficient algorithms. *Communications of the ACM*. 2010; 53(5):86–96.
8. Meng X, Zhengt L, Li L, Li J. PAM, An Efficient Power-Aware Multi-level Cache Policy to Reduce Energy Consumption of Software Defined Network. *Communications of the ACM*. 2015; 56(5):18–23.
9. Namdev S. Improved Minimum Migration Time VM Selection Policy for Cloud Data Center. *International Journal of Application or Innovation in Engineering and Management*. 2015 Apr; 4(4):157–60.
10. Jayasimha SR, Usha J, Srivani SG. Analysis of Power Consumption under Different Workload Conditions in the Data Center. *ICECS*; IEEE. 2016;1036–40.
11. Jayasimha SR, NarasimhaPrasad N, Hamsa K, Sumithra Devi KA. Prevention of Data from the Data Leakage in Cloud Computing. *ISRASE*. 2014 October;1–5.
12. Piraghaj SF, Dastjerdi AV, Calheiros RN, Buyya R. n.d.. A Framework and Algorithm for Energy Efficient Container Consolidation in Cloud Data Centers. *Cloud Container*. IEEE; 2015.
13. Giordanelli R, Mastroianni C, Meo M, Roscetti A. Saving energy in data centers through workload consolidation. *White paper*. 2015 December; 2–3.
14. Ardagna D, Casale G, Ciavotta M, Pérez JF, Wang W. Quality-of-service in cloud computing: modeling techniques and their applications. *Journal of Internet Services and Application*. 2014; 1–17.
15. Hamid S, Madni H, Shafie M, Latiff A, Coulibaly Y, Abdulhamid M. An Appraisal of Meta-Heuristic Resource Allocation Techniques for IaaS Cloud, *Indian Journal of Science and Technology*. 2016 January;9(4).