



A Review On Green Cloud Computing

Prabhpreet Kaur ⁽¹⁾, Monika Sachdeva ⁽²⁾

⁽¹⁾ Research Scholar, Department of Computer Science Engineering, SBSSTC, Ferozepur
sandhuprabh36@yahoo.com

⁽²⁾ Associate Professor, Department of Computer Science Engineering, SBSSTC, Ferozepur
monika.sal@rediffmail.com

ABSTRACT

With the increasing call for green cloud, reducing energy consumption has been an important requirement for cloud resource providers not only to reduce operating costs, but also to improve system reliability. Dynamic voltage scaling (DVS) has been a key technique in exploiting the hardware characteristics of cloud datacenters to save energy by lowering the supply voltage and operating frequency. Cloud Computing is being used widely all over the world by many IT companies as it provides various benefits to the users like cost saving and ease of use. However, with the growing demands of users for computing services, cloud providers are encouraged to deploy large datacenters which consume very high amount of energy and also contribute to the increase in carbon dioxide emission in the environment. Therefore, we require to develop techniques which will help to get more environment friendly computing i.e. Green Cloud Computing.

Keywords

Cloud Computing; Virtualization; Green Computing; DVS; VM; Host.



Council for Innovative Research

Peer Review Research Publishing System

Journal: INTERNATIONAL JOURNAL OF COMPUTERS & TECHNOLOGY

Vol. 15, No. 4

www.ijctonline.com, editorijctonline@gmail.com



INTRODUCTION

Cloud computing has rapidly emerged as a widely accepted by the IT, but the research on cloud computing is still at an early stage. Cloud computing have different challenging issues related to software framework, security, standardization, quality of service and power consumption. One of the most challenging research issues is efficient energy management. As the demand of online applications or resources increases day by day like Amazon, FlipKart and Yahoo etc. which lead to the construction of large amount data centers. According to recent research between 2010 and 2012 the amount of energy consumed by data centers around the world has doubled and today datacenter electricity consumption is almost 2% of world production. Due to the energy consumption of components such as memory, hard disk, a server, main board at idle state still consumes about 70% of the energy it consumes at full CPU speed. In order to save energy, unused physical machines (PM) are turned off and will be turned on by using proper techniques such as Wake on LAN when the demand for resource increases. On an individual level music and video downloads, on-line gaming, social networking site visits are key drivers. Industry is also using internet increasingly. Internet usage is growing at more than 10 percent annually leading to increase in server power density which led to an associated increase in data center heat density. One study estimated that for a typical \$4,000 server rated at 500 watts, it would consume approximately \$4,000 of electricity for power and for cooling over three years, at \$0.08 per kilowatt-hour, and double that in Japan. Companies such as Yahoo, Microsoft, Google, and Amazon with the large data centers may not be able to find power at any price in major American cities. Therefore, they have built new data centers in the Pacific Northwest near the Columbia River where they have direct access to low-cost hydroelectric power and this has proved beneficial for them because they do not depend on the overtaxed electrical grid. Carbon emissions to the environment is directly proportional to energy usage. Carbon emissions from different data centers are expected to grow at more than 11% per year to 440 metric megatons by 2025. According to the report, large corporations can save at least 30-60 percent in carbon emissions using cloud applications, whereas medium-size businesses can save 60-90 percent and small businesses can reduced carbon emission – up to 90 percent while using cloud resources.

WHAT IS GREEN COMPUTING

Green computing, also called green technology, is the environmentally sustainable to use of computers and Related resources like - monitors, printer, storage devices, networking and communication systems - efficiently and effectively with minimal or no impact on the environment. Green computing whose goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Conserving resources means less energy is required to produce, use, and dispose of products ,Saving energy and resources saves money .Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.

NEED OF GREEN COMPUTING

Modern resource-intensive scientific applications and enterprise create growing demand for high performance computing infrastructures. This has led to the construction of large-scale computing data centers consuming enormous amounts of electrical power. Despite of the improvements in energy efficiency of the hardware, overall energy consumption continues to grow due to increasing requirements for computing resources. For example, in 2006 the cost of energy consumption by IT infrastructures in US was estimated as 4.5 billion dollars and it is likely to double by 2011. Moreover, there are other crucial problems that arise from high power consumption. Insufficient or malfunctioning cooling system can lead to overheating of the resources reducing system lifetime or devices reliability. In addition, high power consumption by the infrastructure leads to substantial carbon dioxide (CO₂) emissions contributing to the greenhouse effect. A number of practices can be applied to achieve energy efficiency, such as improvement of applications' algorithms, energy efficient hardware, Dynamic Voltage and Frequency Scaling (DVFS), terminal servers and thin clients, and virtualization of computer resources. Green computing, also called green technology, is the environmentally sustainable to use of computers and related resources like - monitors, printer, storage devices, networking and communication systems - efficiently and effectively with minimal or no impact on the environment. Green computing whose goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Conserving resources means less energy is required to produce, use, and dispose of products ,Saving energy and resources saves money .Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses. Green computing is commonly referred to as Green IT. The idea is to ensure the least human impact on the environment. Apart from this, it aims to achieve environmental sustainability.

In simple language, green computing is the scientific study of efficient and effective designing, manufacturing, using, disposing, and recycling of computers and computer related products like servers, network systems, communication systems, monitors, USBs, printers, etc. The study uses science to create technologies that help to preserve natural resources and reduce the harmful impact on the environment.

ANALYSIS OF GREEN COMPUTING

- The electricity sector in India had an installed capacity of 255 GW as of end September 2014.
- India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia.



- Non Renewable Power Plants contribute 87.55% of the installed capacity, and Renewable Power Plants contribute the remaining 12.45% of total installed Capacity.
- Coal is the only natural resource and fossil fuel available in abundance in India.
- More than 70% generation is provided by coal-based thermal power plants.
- Hydro-electricity contributes about 25%, and the remaining Electricity is generated from nuclear ,Diesel &Gas Power plants .
- Most of the coal is located in the eastern parts of the country and requires transportation over long distances.
- Adverse environmental and ecological impact of coal-fired power plants.
- The extent of global warming in this century will also Problem by using fossil fuel power plants.

HOW TO ACHIEVE GREEN COMPUTING

Virtualization is a methodology or framework of dividing the resources of a computer into multiple execution environments, by applying one or more technologies such as software and hardware partitioning, complete or partial machine simulation, emulation, time sharing, quality of service, and many others. By using virtualization it is possible to run several operating system all of their applications at same time. As, day by day the need of resources are increasing. So it is essential to allocate the resources dynamically as static allocations have some boundaries. For dynamic resource allocation using the virtualization technology which migrate virtual machines to physical machines effectively. By doing this some machines goes to the idle state and these machines can turn off will lead to save the energy. Therefore, it supports the green computing as resources can be dynamically allocated properly. Virtual machines are representation of a real machine using software that provides an operating environment which can host or run a guest operating system. Virtual machines are managed and created by virtual machine monitors. Guest operating system which is running inside the created virtual machine. Virtualization enables enterprises to consolidate multiple servers without sacrificing application isolation and scale their infrastructure as their needs grow. It increases availability through dynamic provisioning and relocation of critical systems. Examples of Virtual Machine Manager are VMware, Xen, KVM, etc. Thus benefits of virtualization can be enumerated as:

- (i) Take advantage of Operating System services.
- (ii) Save hardware cost and footprint.
- (iii) Make use of Multicore Processors.

LITERATURE SURVEY

- Jianzhe Tai et al. have propose adaptive resource allocation for cloud computing environment under bursty workloads. Nowadays cloud computing becomes quite popular among a community of cloud users by offering a variety of resources. However, burstiness in user demands often degrades the application performance. Motivated by this problem, they propose new burstiness-aware algorithms to balance bursty workloads across the all computing sites, and therefore improve the overall system performance. They present a smart load balancer, which leverages the knowledge of burstiness to predict the changes in user demands and on-the-fly shifts between the schemes that are "greedy" (i.e., always select the best site) and "random" (i.e., randomly select one) based on the predicted information.
- Michael Cardosa et al. have proposed techniques that dynamically scale MapReduce clusters to further improve energy consumption while ensuring that jobs meet or improve their expected runtimes. MapReduce clusters are dynamically created using virtual machines (VMs) and managed by the cloud provider. This algorithms achieve energy savings over existing placement techniques, and an additional optimization technique further achieves savings while simultaneously improving job performance.
- Xiaolong Xu et al. presenting Adaptive Task Scheduling Strategy Based on Dynamic Workload Adjustment termed as ATSDWA. With ATSDWA, task trackers can change the load at runtime, tasks obtained in accordance with the computing ability of their own, and realize the self-regulation, while avoiding the complexity of algorithm, which is the prime reason to make job tracker the system performance bottleneck. Furthermore, its performance is superior to the original and improved task scheduling strategy of Hadoop, from the aspects of the execution time of tasks, the speed-up ratio and the resource utilization.
- Khaled Alhazmi et al. this paper present a comprehensive system is introduced to solve virtual network mapping for a set of connection requests sent by cloud clients. Connections are collected in particular time intervals called windows. Consequently, link mapping and node mapping are performed. Different window size selection schemes are introduced and evaluated in context of virtual network mapping for cloud computing data center. Simulation results show that the dynamic window size algorithm achieves cloud service providers objectives in terms of served connections ratio, resource utilization and computational overhead.
- Hiroki Yanagisawa concentrate on the difficulty of allocating virtual machines (VMs) on servers from the requirement that sufficient resources like network bandwidth and CPU capacity must be available for each VM in the event of a maintenance or failure work as well as for temporal fluctuations of resource demands in a periodic patterns. They



propose a mixed integer programming approach that considers the fluctuations of the resources on demands for dependable and optimal allocation of VMs.

- Hong Xu et al. presents Anchor, a unifying resource management architecture in cloud that uses the stable matching framework to decouple policies from mechanisms when mapping virtual machines to physical servers. They developed new theory in Anchor is a job-machine stable matching with heterogeneous resource needs to servers, using both online and offline algorithms. Therefore, the scalability and efficiency of Anchor are demonstrated using a prototype implementation and large-scale trace-driven simulations.
- Vishwas Bagwaiya et al. propose enhanced and efficient Hybrid scheduling algorithm that can maintain the load and provides modified resource allocation techniques. They presents Hybrid approach which is applied for load balancing using Throttled and Equally Spread Current Execution (ESCE) algorithms. The proposed algorithm is implemented in cloud computing environment using CloudSim toolkit. In ESCE load balancer maintains an index table of Virtual machines as well as number of currently assigned requests to the Virtual Machine. In Throttled load balancing algorithm the load balancer maintains an index table of virtual machines as well as their states (Available or Busy).
- Zhen Xiao et al. introduce the concept of “skewness” to measure the unevenness in the multi-dimensional resource utilization of a server. By using the skewness metric to combine VMs with different resource characteristics appropriately so that the capacities of servers are well utilized. This algorithm achieves both overload avoidance and green computing for systems with multi resource constraints.
- Qi Zhang et al. propose Heterogeneity-Aware Resource Management System (HARMONY) for dynamic capacity provisioning in cloud computing environments. In this first they use the K-means clustering algorithm to divide the workload into different task classes with similar characteristics in terms of resource and performance requirements. Then they dynamically adjusts the number of machines to strike a balance between scheduling delay and energy savings, while considering the reconfiguration cost. Through experiments using Google workload traces, they found HARMONY can lead to up to 28% energy savings while significantly improving task scheduling delay.
- Gonzalez et al. they agree with the concept that, failures are undesirable events that are always prevented but they are also aware that failures are unavoidable events. The aim of this paper is show how cleverly failures can handled through fault management mechanism which direct positive impact on energy efficient cloud computing deployment. They show the positive impact of failures on the virtual machines consolidation problem.
- Tao Jiang et al. paper investigate the problem of minimizing the long-term energy cost for an Internet data center (IDC) in deregulated electricity markets. They proposed a risk-constrained decision framework to achieve the optimal tradeoff between expected energy cost and operation risk in deregulated electricity markets according to the risk preferences of IDC operators.
- Marco Polverini et al. propose a provably-efficient online scheduling algorithm—GreFar—where Gre stands for optimizes the energy cost and Far for fairness among different organizations to queuing delay constraints, while satisfying the maximum server inlet temperature constraints. They presents a provably-efficient online algorithm, for scheduling batch jobs among multiple geographically distributed data centers. For arbitrarily random job arrivals, electricity prices, and server availability, GreFar minimizes the energy-fairness cost while providing queuing delay guarantees.

Research Motivation

Although cloud computing has been widely adopted by the industry, but the research on cloud computing is still at an infancy stage. There are many issues in Cloud computing such as Virtual Machine Migration, Data security, Energy Management, Server Consolidation etc. as discussed in previous section that have not been fully addressed. Energy management is one of the challenging research issues. Cloud Infrastructure is the most important component in a cloud. It may consists tens of thousands of servers, network disks and devices, and typically serve millions of users globally. Such a large-scale data center will consume enormous amount of energy. For example, according to research of Google datacenter used about 2.26 million MW hours of power to operate in 2010, resulting to carbon footprint of 1.46 million metric tons of carbon dioxide. In other words, a single data center can consume power which is equal to a power consumed by small town. In order to reduce power consumption, it is necessary to balance the load among the different nodes.

Green Computing is the practice of implementing procedures and policies that improve the efficiency of computing resources in such a way as to reduce the energy consumption and maintains environmental sustainability. Various existing scheduling techniques are there which manages load among the nodes but are not energy efficient for the Cloud computing platform. Aim of the thesis is to consolidate the load balancing in an efficient way so that the resource utilization can be maximized and the energy consumption of the data center could be minimized that can further result in reducing global warming and hence assist in achieving Green Computing.

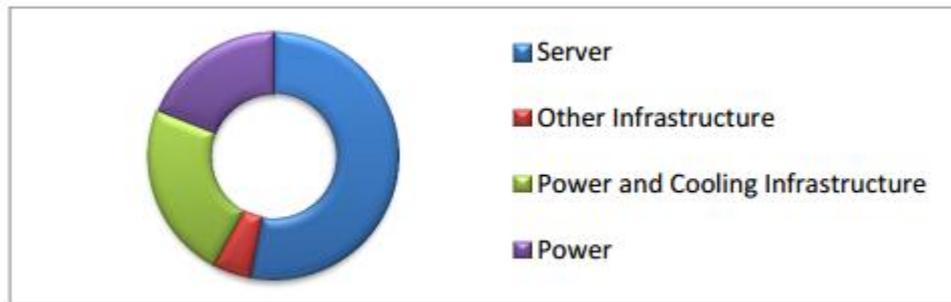


Figure 1. Distribution of energy in data center

PROBLEM FORMULATION

1. In part1 of the base work, both the tasks are executing at F_{max} (full frequency) and thus consuming more power and produces more heat which will lead to green house effect.
2. Moreover, There is no proper decision making process whether the process should execute at full frequency or it should execute using DVS.

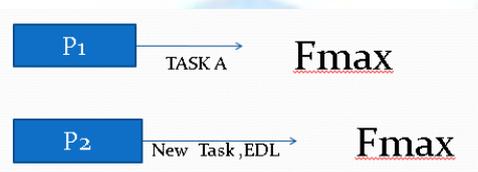


Figure 2. Standby Sparing Technique of Base Work

We will be working on reducing the power consumption of data centers to achieve the following objectives:

- To reduce the power consumption of datacenters.
- To implement the proper load balancing algorithm to have the effective utilization of the resources
- To reduce the cost and increase the profits of the cloud provider.
- To reduce the processing time of the tasks

CONCLUSION

To meet the energy cost and reliability constraints of cloud server, we have studied how to minimize the total energy consumption. In this paper, how the computational framework in Service oriented architecture can be thought in an environment friendly way, has been presented. In the model formulation of the problem, the Service based Cloud Computing framework has been taken into consideration. In the model formulation of the problem the energy efficiency architecture and low emission rate has been proposed in an environment friendly way. In the presented approach, how does CO₂ emissions effect in the future world has been described and further how its effect from multi locations data center has also been presented. Finally the Green Computing Targets and Illustrations has been proposed to bridge these two diversified however somewhere linked dimensions of Computing.

REFERENCES

- [1] M. Rosenblum and T. Garfinkel, "Virtual machine monitors: current technology and future trends," Computer, vol. 38, no. 5, pp. 39–47, May 2005.
- [2] C. Clark, K. Fraser, S. Hand, J. G. Hansen, E. Jul, C. Limpach, I. Pratt, and A. Warfield, "Live migration of virtual machines," in Proceedings of the 2Nd Conference on Symposium on Networked Systems Design & Implementation, ser. NSDI'05, vol. 2, 2005, pp. 273–286.
- [3] A. Beloglazov and R. Buyya, "Optimal online deterministic algorithms and adaptive heuristics for energy and performance efficient dynamic consolidation of virtual machines in cloud data centers," Concurrency and Computation: Practice and Experience, vol. 24, no. 13, pp. 1397– 1420, 2012.
- [4] A. Murtazaev and S. Oh, "Sercon: Server consolidation algorithm using live migration of virtual machines for green Computing," IETE Technical Review, vol. 28, no. 3, pp. 212–231, 2011.
- [5] F. Farahnakian, P. Liljeberg, and J. Plosila, "LiRCUP: Linear regression based CPU usage prediction algorithm for live migration of virtual machines in data centers," in Software Engineering and Advanced Applications (SEAA), 2013 39th EUROMICRO Conference on, 2013, pp. 357–364.



- [6] T. Cover and P. Hart, "Nearest neighbor pattern classification," *Information Theory, IEEE Transactions on*, vol. 13, no. 1, pp. 21–27, 1967.
- [7] N. Bobroff, A. Kochut, and K. Beaty, "Dynamic placement of virtual machines for managing sla violations," in *Integrated Network Management, 2007. IM '07. 10th IFIP/IEEE International Symposium on*, May 2007, pp. 119–128.
- [8] F. Farahnakian, A. Ashraf, T. Pahikkala, P. Liljeberg, J. Plosila, I. Porres, and H. Tenhunen, "Using ant colony system to consolidate vms for green cloud computing," *Services Computing, IEEE Transactions on*, vol. 8, no. 2, pp. 187–198, March 2015.
- [9] A. Verma, P. Ahuja, and A. Neogi, "Pmapper: Power and migration cost aware application placement in virtualized systems," in *9th ACM/IFIP/USENIX International Conference on Middleware, 2008*, pp.243–264.
- [10] T. H. Nguyen, M. D. Francesco, and A. Yi'a – J'a'aski, "A virtual machine placement algorithm for balanced resource utilization in cloud data centers," *The 7th IEEE International Conference on Cloud Computing (IEEE CLOUD)*, p. 474481, 2014.
- [11] B. Li, J. Li, J. Huai, T. Wo, Q. Li, and L. Zhong, "Enacloud: An energy-saving application live placement approach for cloud computing environments," *2013 IEEE Sixth International Conference on Cloud Computing*, vol. 0, pp. 17–24, 2009.
- [12] F. Farahnakian, T. Pahikkala, P. Liljeberg, and J. Plosila, "Energy aware consolidation algorithm based on k-nearest neighbor regression for cloud data centers," in *Utility and Cloud Computing (UCC), 2013 IEEE/ACM 6th International Conference on*, Dec 2013, pp. 256–259.
- [13] R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, "CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms," *Software: Practice and Experience*, vol. 41, no. 1, pp. 23–50, 2011.
- [14] K. Park and V. Pai, "CoMon: a mostly-scalable monitoring system for PlanetLab," *ACM SIGOPS Operating Systems Review*, vol. 40, pp. 65– 74, 2006.
- [15] D. Kusic, J. Kephart, J. Hanson, N. Kandasamy, and G. Jiang, "Power and performance management of virtualized computing environments via lookahead control," in *Autonomic Computing, 2008. ICAC '08. International Conference on*, June 2008, pp. 3–12.