International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-6, August, 2019

Energy-Efficient Consolidation of Virtual Machines in Cloud Data Centers

Harshit Mathur, Pradeep K V

Abstract: ***The lightning increase in demand of computational power consumed by modern applications has made us to shift for Cloud Computing Model which has led to establish very large-scaled virtualized Data Centers. Such Data Centers consumes huge amount of electrical power which results to high Operating cost and Carbon-di-oxide emission.The servers in Data Centers consume/waste a substantial amount of energy/power. Since servers are deployed and configured for peak capacity, performance, usually at the expense of efficiency. Such waste increases the capital and operational expenditure which can result in power and space being exhausted, which creates a situation where the organization may grow in data centers.Consolidating and Virtualizing servers can increase overall utilization of resources from 10% to 30%. The rapid reduction in capital and expenditure can motivate many organizations to virtualize the servers.***

Keywords- Virtual Data Centers, Power, Virtualized Servers, Green Cloud, Cloud Data Centers, Virtual Machine Consolidation, Energy Efficient.

I. INTRODUCTION

The power consumption by servers in cloud data centers has become an important issue in recent years. Cloud Data Centers consumes huge amount of electrical energy, which leads to high operational cost and carbon-di-oxide emission. Consolidation of virtual machines in data centers via live migration and making idle node in sleep mode allow cloud providers to optimize resources and reduce energy consumption. Due to intense growth in cloud services and its corresponding technology, cloud infrastructure has become more complex. Hence there is a much need to manage resources in cloud environment, affecting the efficient deployment of cloud services.

It was estimated that in 2010 Google's data centers consumed approx. 1.5% of all electrical power consumed in the world and this figure increased to 3% in 2016. 260 million Watts of electricity was consumed by Google's data center which is now enough to power 200,000 homes. To consolidate VMs is the most productive technique in energy- efficient management of resources in cloud computing. Consolidation refers live migration of Virtual Machine between the hosts. The main aim is to move VM to minimal hosts and switching idle nodes to power saving mode.

In this paper we will discuss about two technologies i.e 'Virtual Clock' and 'Graphene Wire' that can be utilized in cloud data centers for customized power consumption.

Revised Manuscript Received on October 30, 2019.

* Correspondence Author

Harshit Mathur*, Computer Science, Vellore Institute Of Technology, Chennai, India.

Prof. Pradeep K V, Computer Science, Vellore Institute Of Technology, Chennai, India.

II. RESEARCH CONTRIBUTION

1. To undertake a literature review on power consumption in cloud data centers.
2. To develop a new technique to reduce the current leakage while running the servers.
3. To enhance the working of VM installed in data centers.

III. RELATED WORK

Several implementations are done to minimize the consumption of energy in data centers. Various algorithms are made for working of VMs energy efficiently.Research had been carried out between physical machines power effectiveness

and machines that are virtualized. Since computing in the cloud involves data centers that are used to operate these cloud applications, optimizing the physical data centers is essential. This research showed a 30% reduced use of virtual data server energy as opposed to physical servers. Since the inquiry was conducted at Greenwich University and analyzed only a few data centres.

People have suggested an effective resource allocation scalable and decentralized algorithm that reduces electricity usage by 66% relative to the DVFS-only scheme applies and not VM consolidation. VM consolidation has excellent impacts on resource sharing and energy savings strategies.

Many energy models have been suggested in history based on the elimination of dynamic energy consumption a VM's complete energy consumption. This model requires both dynamic (CPU) and static (memory) resource usage into consideration.

IV. METHODOLOGY

In the recent scenario, two technologies can be applied or bring into practice i.e. 'Virtual Clock' and 'Graphene Wire'. These two implementation can bring a drastic change in the cloud computing world. By the help of these two technologies, a huge amount of power consumption can be minimized in running servers of cloud data centers.

Data Centers can bring down their utility bills by implementing these two technologies efficiently. Improving the energy efficiency of the computational components definitely reduce the energy consumption of data centers. The computing resources would consume nearly 100% of the data centers energy. The first strategies to increase the energy efficiency in computing system focused on reducing the power consumed to run the computational resources.

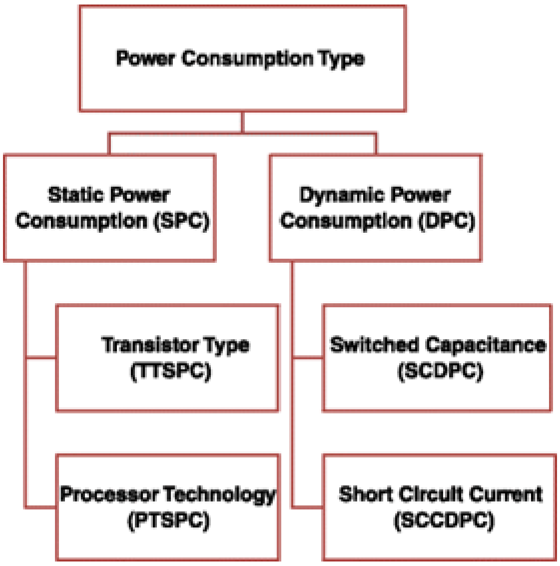


Fig 1. Type of current leakage/power consumption

A. Virtual Clock

How to control the information flow rate is the difficult problem in high-speed networking. Use virtual clock to keep the flexibility of multiplexing in packet switching while simultaneously ensuring that each information stream maintains the rate of throughput. It regulates the average information flow rate of transmission, enforces the resource use of each user depending on their reservation.

Virtual clock is designed for a new network architecture. It models the data transmission demand of the user as a stream, the power and bandwidth of the switching processing as distributed assets and controls the power consumption. Virtual clock is designed to provide following functionalities-

Supporting applications throughput requirements by implementing resource use based on the average flow throughput.

- To monitor information flow and provide other control features with measurement input.
- Provides firewall between flows of information.
- Preserve the flexibility of packet switching statistical multiplexing.

The virtual clock's primary function is to measure the average information flow quantity and create firewalls between flows. It interleaves packets from different data flows and reserve the throughput rates. Virtual clock can be regarded as a fair queuing feature where the required throughput rate is ensured for each user.

The Virtual clock is a set of instructions which is installed in data servers which manages the power consumption or electricity flow to run the servers. It manipulates by allowing power supply as much as needed by servers to run hard- drives. As the hard-drives are not in use, it cut-off the extra supply of power, it only allows power needed to make hard-drives live. When those hard- drives are not in use, virtual clock make them to sleep mode not the whole server rack. Because to make a whole server rack from sleep mode to live mode, it consumes a lot of power. To conserve that extra power, we make only those hard-drives to sleep mode which are not in use for a longer time as hard-drives consumes less power than whole server rack to switch from sleep mode to live mode.

B. Graphene Wire

Enabling the world transformed through lighter, much more conducting wire than copper i.e 'Graphene Wire'. Reducing wire cable weight means better fuel consumption or economy, in case of power supply, more time between charges. Less fuel means lower emissions of carbon-dioxide, significantly saving operational cost.

Replacing copper with graphene wire could save 70% of cable weight, as any reduction in weight can significantly lower costs or allow weight for equipment or fuel. Graphene-based wires are composed of grapheme ribbons that are continuous along the length of conductive wires.

This provides increase in electrical properties, in fact graphene boasts a current carrying capacity 1,0000 times that of copper. Due to high current carrying capacity, a graphene- based wire can be made with a much smaller diameter and carry equivalent amount of current as compared to copper.

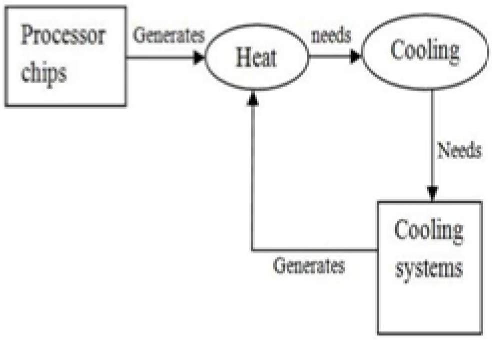


Fig 2. Cycle of the continuous generation of heat from DCs

V. IMPLEMENTATION AND EVALUATION

Electrical Resistivity

Any conductive material's electrical resistivity is a measure of how heavily the material opposes the electrical current flow. The resistivity factor, called "specific electrical resistance," makes it possible to compare the strength of distinct conductors according to their physical characteristics at specific defined temperatures without regard to their length or cross-sectional region.

$$\rho = \frac{R \times A}{L} = \frac{\text{ohms} \times \text{meters}^2}{\text{meters}} = \Omega\text{m}$$

To compare the properties of graphene with copper we did some lab experiments related to electrical section. We found out the electrical resistance of copper powder and graphene powder under the same specific temperature. Having the similar values cross-sectional area and length of layers, we used the above standard formula to find out the resistivity of both copper and graphene and compared them.

ELECTRICAL CONDUCTIVITY

Since Conductivity is the reciprocal of resistivity, so more less the resistivity, more the conductivity of material.

Retrieval Number E7854068519/2019©BEIESP
DOI: 10.35940/ijeat.E7854.088619
Journal Website: www.ijeat.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

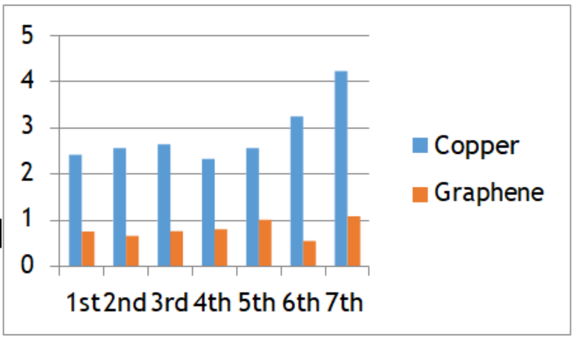
$$R = \rho\frac{L}{A} \quad \text{and} \quad \sigma = \frac{1}{\rho}$$

$$\therefore R = \frac{L}{\sigma A}\ \Omega$$

VI. RESULTS

Here is the experimented values of resistance of both copper and graphene which is calculated under the room temperature i.e 293 Kelvin. The resulted value may vary from place to place but on an average it remains same.

Graphene(K Ohm)	Copper(K Ohm)
0.762	2.428
0.664	2.565
0.772	2.648
0.811	2.335
1.018	2.565
0.562	3.256
1.092	4.232



Resistivity of Graphene = 0.152 x 10-6 ohm m Resistivity of Copper = 1.72 x 10-5 ohm m

VII. CONCLUSION

Graphene conducts electricity much better than copper. Graphene is pliable and can take any form desired. Electrons move through grapheme with virtual phase with no resistance and without mass.

Anton Beloglazov et al.[8] suggested an energy-conscious resource allocation heuristics for effective cloud computing management of data centers. The resource allocation architectural system structure given in this article focuses not only on information accessibility, but also on operating expenses and energy effectiveness. Due to growing cloud computing, growing information centers, the pitfalls of the scheme used for the same need to be looked at. The methodology employed in this article is completely based on virtual machine consolidation and is aimed at reducing live physical node and cloud migration.

Arthi T and Shahul Hamaed H[9] put forward a proposition based on live virtual machine migration. This enables dynamic movement of VMs from one node to the next. This in turn reduces the working expenses of the system and power consumption, resulting in the information accessible being flexible. The benefit of migration is that before big computations, information can be pre-processed.

In order to attain green computing, S. Usmin et al.[10] suggested a method to optimize server activity or minimize it. This method is a practical algorithm known as EVISBP internet bin packaging. For balance of loads and energy savings purposes, this algorithm manages the VM design.

R.Yamini[11] provided a heuristics algorithm for Consolidation of the energy-conscious assignment and the GREEN algorithm. This algorithm significantly reduces pollution and significantly reduces power use.

Kwang Hyo Chung[12] provided a chip incorporating graphene heaters and thermal convection in the polymerase chain reaction (PCR). To replace the bulky metal heating materials, they introduced graphene heaters.

Keiichi Hirose[13] has shown that a 380VDC power supply saves more energy than the AC power supply system and shows how much carbon dioxide emissions can be lowered through the integration of a solar power system.

Yang Li[14] has created CapMaestro, a fresh power management architecture with three main characteristics, i.e. working with various energy feeds, using a scalable, worldwide priority-aware strategy to energy capping and redundant power infrastructure.

Z.Jiang[15] manufactured a GSA using ultrasonic therapy to exfoliate graphite flakes in a deionized water solution and proved a mode-locked fiber laser using a graphene film saturable absorber.

REFERENCES

1. Dabiah Ahmed Alboaneen, Bernardi Pranggono, Huaglory Tianfield," *Energy-aware Virtual Machine for Data Centers*",2014 IEEE/ACM 7th International Conference on Utility and Cloud Computing.
2. Kejing He*, Zhibo Li, Dongyan Deng, Yanhua Chen,"*Energy-Efficient Framework for Virtual Machine Consolidation in Cloud Data Centers*", 2014 IEEE/ACM 7th International Conference on Utility and Cloud Computing.

3. Mohammad Ali Khoshkholghi, Mohd Noor Derahman, Azizol Abdullah, Shamala Subramaniam, Mohamed Othman,"*Energy-Efficient Algorithms for Dynamic Virtual Machine Consolidation in Cloud Data Centers*", DOI.10.11.09/ACCESS.2017.2711043, IEEE.
4. Md Anit Khan*, Andrew P Paplinski*, Abdul Malik Khan*, Manzur Murshed+, and Rajkumar Buyya†,"*Exploiting User Provided Information In Dynamic Consolidation of Virtual Machines to MinimizeEnergy Consumption of Cloud Data Centers*", 2018 Third International Conference on Fog and Mobile Edge Computing (FMEC).
5. M.pretorius, M. Ghassemian, C. Ierotheou: "*An investigation into energy efficiency of data centre virtualisation*" in 2010 international Conference on P2P, parallel, grid, cloud and internet computing.
6. Anton Beloglazov, Rajkumar Buyya: "*Energy Efficient resource management in virtualized clouddata centers*" in 2010 10th IEEE/ACM internationalconference on cluster, cloud and grid computing.
7. Quesnel, Flavien, Hemant Kumar Mehta, and Jean-Marc Menaud. "*Estimating the power consumption of an idle virtual machine.*"Green Computing and Communications (GreenCom),2013 IEEE and Internet of Things (iThings/CPSCom), IEEE International Conference on and IEEE Cyber, Physical and Social Computing. IEEE, 2013.
8. Beloglazov, Anton, Jemal Abawajy, and Rajkumar Buyya. "*Energy-aware resource allocation heuristics for efficient management of data centers for cloud computing.*" Future generation computer systems 28.5 (2012): 755-768.
9. Arthi T, Shahul Hamead H: "*Energy aware cloud service provisioning approach for green computing environment*"in IEEE 2013.
10. S. Usmin, M. Arockia Irudayaraja, U. Muthaiah: "*Dynamic placement of virtualized resources for data centers in cloud*" june 2014 IEEE.
11. R.Yamini: "*Power Management in Cloud Computing Using Green Algorithm*" in IEEE-International Conference On Advances In Engineering, Science And Management (ICAESM -2012) March 30, 31, 2012.
12. Kwang Hyo Chung, Yo Han Choi, Hong Kyw Choi: "*Convection-Based Real Time Polymerase Chain Reaction (PCR) Utilizing Transparent GrapheneHeaters*" in SENSORS, 2014 IEEE.
13. Keiichi Hirose : "*DC powered data center with 200kW PV panels* " in 2018 International Power Electronics Conference (IPEC-Niigata 2018 -ECCE Asia).
14. Yang Li : "*A Scalable Priority-Aware Approach to Managing Data Center Server Power*" in 2019 IEEE International Symposium on High Performanc Computer Architecture (HPCA).
15. Z. Jiang : "Graphene saturable absorber power scaling laser" in 2014 Conference on Laser and Electro Optics(CLEO)- Laser Science to Photonic Applications.

AUTHORS PROFILE

Harshit Mathur is a M.Tech Student in VIT Chennai Campus,Chennai. He is doing specialization in Cloud Computing. His area of interest is in Cloud Computing, Cloud Data Centers. He has also been awarded with Best Research Paper.

Pradeep K V, is an Assistant professor, in SCSE, VIT Chennai Campus, Chennai. He has more than 10 years of teaching experience. His area of interest in research is Image processing, Cloud Computing, Security in Cloud, Parallel programming. He has published many articles in national and international level journals.