Green Computing: A Review

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Abstract- *Today's scenario computers are not only used in offices but also used at home. As the usage of computers is increasing day by day, the energy consumption is growing rapidly which in turns increase the carbon content in atmosphere which gives rise to the concept of "Green Computing". Mainly, IT industries are responsible for 3% of the world's energy consumption with an increase of 20% per year. It is responsible for use of computers and related resources in energy-efficient manner by using energy efficient CPU, Servers and Peripherals .The main goal of Green computing is to increase the efficiency of the IT products during its lifecycle and endorse the recycling of useless goods and factory waste. This paper gives a review of need of Green Computing and related work in this field.*

Keywords- Green computing, Environment protection, carbon sink

I. INTRODUCTION

As the usage of computers increased at a very fast pace,the most challenging field of concern these days is energy conservation in various applications. The growing demands of computing resources in IT industry enhance the yield of carbon which has disastrous effect on environment. Energy crisis led a way to green computing which is a study and practice that uses mechanisms to reduce energy consumption significantly. Most of the IT sector energy consumption happens in data centers.

Computer manufacturers are investing in technology that can help in designing energy-efficient computing devices that mitigate the usage of dangerous materials and also help in maximizing the usage of power efficiency while lowering carbon and gas emissions. By adopting green computing mechanism, companies can not only contribute their bit to the protection of nature but can also achieve cost savings by maximizing the usage of resources.

Governments increasingly place demanding limits on factory and industrial energy consumption and emissions while such power consumption and pollution from IT and computer processing and data centers is often largely ignored.Research warrants that much energy is being squandered as IT needs are universally converted from AC to DC, and made even worse because it costs twice as much to cool a server than to power it. We know that plastic is hazardous to the environment, but e-waste is more damaging than plastic. Additionally, the development and production of digital componentry requires various highly toxic materials, including arsenic, antimony, lead, cadmium, beryllium and worse shown to cause long-term harm to the environment.

II. WHY GREEN COMPUTING

With the increasing use of internet in every sphere of life the requirement of storing large amount of data is required. In order to store voluminous amount of data different companies require big computer servers,CPUs and peripheral devices which uses a lot of power and release a huge amount of heat.Data warehouses and the sprawling data centers that house them use up a huge amount of power, both to run legions of servers and to cool them. Here we present some notable areas of research in green computing:

1) Optimization Techniques in Energy Efficient Computing:

The exponential growth in computing activity and the rising concern for energy conservation have made energy efficiency in computers a technological issue of prime importance. Designing techniques that are optimal with respect to performance, energy and temperature are utmost requirement as far as green computing research challenges are concerned.

2) Information Resource Tier Optimization:

The information resource tier represents important data base management systems in the global computation world. General paradigms include databases, directories, file-systems, and flat files. It also includes the integration of different database structures so that different databases can be analyzed irrespective of their storing mechanisms and data structure.

3) Reduce architectural complexity:

The research area is open to reduce the number of tiers and component dependency to reduce maximum system use. Intel core 2 duo is a mechanism which uses power to run

only those components which are necessary at any computation

4) Efficient data center design:

Standards are emerging for measuring energy efficiency of data centers, such as the concept of Power Usage Effectiveness (PUE). PUE is defined as the ratio of total facility power divided by IT equipment power. Thus, it is a measure of how much of the power being consumed by the facility is actually being used to power the IT equipment itself rather than all the other things.

5) Developing Green Maturity Model:

Full equipment life cycle is the main area for green maturity model, with energy reduction as the best measure of greenness. The need of maturity models for equipment, IT organizations, computing techniques is an issue which has been addressed by some researchers but is limited to specific areas. Green maturity model for virtualization depicts that each level describes the degree of green characteristics.

6) Wireless Sensor Network for Data Center Cooling:

Data center cooling is a major issue as far as power consumption is concerned. Data centers are backbone of any computing organization and must be reliable and available at every point of time. Measuring the data center effectiveness and maintaining the baseline is an issue. Wireless sensors could play a big role for managing data centers power management.

7) Telecommuting:

Internet provides the capability to work from anywhere at any time on any mobile device or computer, employees have the option to work from home. Cutting out the fuel emissions from daily commuting contributes to the global green movement.

8) Paperless:

With the advent of green computing, all the organizations has the option to use paperless tasks, bill payments etc. eliminating the need to purchase paper products and file hardcopy, printed records.

III. RELATED WORK

Liang Liu et al.[1] has proposed Green Cloud architecture, which aims to reduce data center power consumption, which can help consolidate workload and achieve significant energy saving for cloud computing environment, at the same time, guarantees the real-time performance for many performance-sensitive applications from users' perspective. It's an optimized cost model for calculating total cloud utilization cost.

Borah et al. [2] have describes various power saving strategies to obtain energy efficiency in base stations and also propose some cooling mechanism for green cellular base stations.

TaehoKgil et al.[3]has proposed Pico server architecture which is simple that employs 3D technology where die are stacked on top of one another to implement a class of low-cost, low-power, compact server architectures to build energy efficient servers.These remove the need for an L2 cache allowing its area to be re-allocated to additional simple cores. Our intent is to minimize risk of introducing a new technology (3D) The ability to tightly couple large amounts of memory to the cores through wide and low-latency interconnect pays dividends by reducing system complexity and creates opportunities to implement system memory with non-uniform access latency.For a wide range of server workloads, the resulting systems have significant energy efficiency in a compact form factor.Innovative interconnect technology is one another such prime approach for e. g., three dimensional stacking technology.

Heller et al.[4] proposed a dynamic power management scheme named Elastic Tree for data center network that determines the set of active network elements such as switches and links dynamically to satisfy changing data center traffic loads.

Ananthanarayanan et al. [5] proposed two simulation plans - a lower power mode for ports and time window prediction techniques that vendors can implemented in future switches. While these and other improvements can be made in future switch designs to make them more energy efficient, most energy (70-80% of their total power) is consumed by switches in their idle state. A more effective way of saving power is using a traffic routing approach such as ours to maximize idle switches and power them off.

Fisher et al.[6] in his research proposed turning off individual cables and Network Interface Cards (NICs) rather than links, because the links in core networks are "bundles" of multiple physical cables and line cards.

Kliazovich et al. [7] proposed DENS a network-awaked methodology while making energy efficient

scheduling in data centers. DENS method tries to minimize the energy consumption by scheduling jobs to computing resources according to best fit algorithm, while taking into account load level and the communication potential of the network components. Its main objective is to avoid congestion while minimizing the number of computing servers to meet the strict QoS requirements of jobs while slightly increasing the energy consumption.

Nathuji and Schwan [8] recommended a virtual power method that integrated 'soft' and 'hard' scaling techniques and combined task consolidation and power management. The researchers found that this combination may save more energy according to the restricted number of hardware scaling cases. This method had an extensive virtualization principle to supply efficient strategies of power management. Algorithms which are presented in this paper are based on DVFS and resource consumption control that is made with physical processors and CPUs.

Raghavendra et al. [9] have studied the problem of power management for a data center environment through merging and arranging five different power management strategies based on 180 server traces from nine different real-world enterprises. The researchers investigated the problem regarding to control theory and exerted a loop to control the feedbacks for coordinating the controllers' activity. This strategy deals just with the CPU management and is independent of the workload type.

Srikantaiah et al.[10] conducted a study and examined the problem of applying the schedule of multi-tiered web applications in systems with heterogeneous virtualization. This research evaluated energy consumption, performance changes, and resource usefulness as multiple workloads with different resource usages are joined on common servers. Researchers have recommended an innovative method for the multidimensional bin packing problem like an algorithm that consolidates the workloads, to control the efficiency over numerous resources.

Cardosa et al. [11] have offered a method for solving the problem of allocating the energy efficiency of Virtual Machines in virtualized heterogeneous environments. Research team has controlled the min, max and sharing factors of Virtual Machine Manager (VMM), which means minimum, maximum, and suitability of the CPU allotted to Virtual Machines sharing the equivalent resource.

Gandhi et al. [12] have deliberated the problem of assigning an accessible power budget between servers, while reducing the mean response time in a virtualized heterogeneous server environment. The authors introduced a queuing theoretic model for investigating the impact of various factors on mean response time. The model makes it possible to predict the mean response time as a task of the arrival rate, power-to-frequency relationship, and peak power budget. Moreover, the model is used to discover the optimum energy assignment for any configuration of the mentioned factors

Verma et al. [13] proposed dynamic placement of applications in a virtualized heterogeneous system based on maintaining the optimization. To achieve this purpose, the placement of virtual machines is optimized at each time frame to reduce energy usage and increase performance. Researchers using variable bin size and costs to implement a heuristic method for the bin packing problem. Moreover, the authors applied live migration of virtual machines in their study while the recommended algorithms do not consider the exact requirements of SLA.

Kusic et al. [14] have presented Limited Lookahead Control (LLC) in a paper to address the problem of power management as a continuous optimization in virtualized heterogeneous environs. The main goal of this study was to maximize the benefits of the resource provider by reducing energy usage and SLA outrage.

Aroca et al. [15] demonstrated the possibility of making servers regarding to low power computers by an empirical comparison of server programs executing on ARM computer architectures and x86 systems. This research compares numerous ARM and x86 systems in typical server with applications and some crunching functions like database server, web server, and floating point calculation. Based on the findings of this study, ARM based systems are a good option while power productivity is required by considering the quality of performance. The results compare CPU, temperature and power consumption for each device at different workloads.

IV. CONCLUSION

In order to protect the atmosphere green computing is the need of the hour. Due to increasing rate of computer usage the carbon emission rate is increasing at fast pace and the solution of this is adoption of green computing resources. Thus, it can be concluded that in order to have a healthy and clean environment all stake holders must implement Green Computing environment to save energy and remove pollution for future generations.

REFERENCES

[1] L. Liu, H. Wang, X. Liu, X. Jin, W. He, Q. Wang, and Y. Chen "Green Cloud: a new architecture for green data centre," in IEEE Conference on Autonomic Computing (ICAC), Barcelona, Spain, 2009, pp. 29-38

[2] J. Borah, S. K. Singh, A. D. Borah, "Cellular Base Station and its Greening Issues", International Journal of Advanced Electronics and Communication Systems (CSIR-NISCAIR Approved), Vol.3, No.2, pp.1-4, April-May 2014.

[3] TaehoKgil, David Roberts and Trevor Mudge "PicoServer: Using 3D Stacking Technology to Build Energy Efficient Servers", ASPLOS'06October 21–25, 2006, San Jose, California, USA.

[4] B. Heller, S. Seetharaman, P. Mahadevan, Y. Yiakoumis, P. Sharma, S. Banerjee, and N. McKeown, "Elastictree: saving energy in data centre Networks," in Proceedings of the 7th USENIX conference on Networked Systems design and implementation, 2010

[5] G. Ananthanarayanan and R. Katz. Greening the Switch. In Proceedings of HotPower, December 2008.

[6] W. Fisher, M. Suchara, and J. Rexford, "Greening backbone networks: reducing energy consumption by shutting off cables in bundled links," in Green Networking, 2010, pp. 29–34.

[7] D. Kliazovich, P. Bouvry, and S. Khan, "DENS: Data Centre Energy- Efficient Network-Aware Scheduling," in Green Computing and Communications (GreenCom), 2010, pp. 69 –75.

[8] R. Nathuji and K. Schwan, "Virtualpower: coordinated power management in virtualized enterprise systems," in ACM SIGOPS Operating Systems Review, 2007, pp. 265-278

[9] R. Raghavendra, P. Ranganathan, V. Talwar, Z. Wang, and X. Zhu, "No power struggles: Coordinated multi-level power management for the data center," in ACM SIGARCH Computer Architecture News, 2008, pp. 48-59.

[10] S. Srikantaiah, A. Kansal, and F. Zhao, "Energy aware consolidation for cloud computing," in Proceedings of the 2008 conference on Power aware computing and systems, 2008.

[11] M. Cardosa, M. R. Korupolu, and A. Singh, "Shares and utilities based power consolidation in virtualized server environments," in Integrated Network Management, 2009. IM'09. IFIP/IEEE International Symposium on, 2009, pp. 327- 334.

[12] A. Gandhi, M. Harchol-Balter, R. Das, and C. Lefurgy, "Optimal power allocation in server farms," in ACM SIGMETRICS Performance Evaluation Review, 2009, pp. 157-168.

[13] A. Verma, P. Ahuja, and A. Neogi, "pMapper: power and migration cost aware application placement in virtualized systems," in Middleware 2008, ed: Springer, 2008, pp. 243-264.

[14] D. Kusic, J. O. Kephart, J. E. Hanson, N. Kandasamy, and G. Jiang, "Power and performance management of virtualized computing environments via lookahead control," Cluster computing, vol. 12, pp. 1-15, 2009.

[15] R. V. Aroca and L. M. G. Gonçalves, "Towards green data centers: A comparison of x86 and ARM architectures power efficiency," Journal of Parallel and Distributed Computing, vol. 72, pp. 1770- 1780, 2012.