Review of Energy Minimization Strategies for Eco friendly cloud in IT

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Abstract— The usage of cloud is increasing in day to day life which leads to consumption of energy.Cloud Computing with reduced energy consumption has been an important topic for the era of researchers and different computer users of computing systems. Cloud IT is an egressing technology which provides information about communication technologies, proposing new challenges for environmental protection. Green Cloud computing is a component of Green IT. The amount of carbon will be reduced with low energy consumption. This paper outlines the methods to reduce energy consumption in the cloud. To reduce the power in cloud, huge numbers of evaluations and optimizations have been done for successful energy efficiency. There are different methods to implement the cloud with minimum energy consumption like hardware, software and firmware. Hardware method includes reduction of energy in various components of cloud like server, etc. Software includes virtualization techniques, DVFS techniques, etc. Energy has to be reduced to create Eco-friendly environment.

*Keywords—*Cloud,optimization,energy efficiency

I. INTRODUCTION

The cloud shares collection of programmable IT resources which lead to support of fast growing and to reduce the effort of managing it. Importance of Cloud Computing is to provide sharing of resources. Cloud Computing is an upcoming technology that relies on a business model with certain components like servers, storage and applications. To provide and deliver the services to user's devices, cloud computing makes use of more number of data centres. Individual data centres comprised of a large number of machines. It generally includes redundant or backup components. A lot of power is used by data centre, spent by two main customs: Apparatus run with the required power and apparatus is cooled by required power. Examples of this are: mass data centres like Google or Facebook.

Batch Processing is one of the old victims of computer technology. For applications that do not need to run interactively or in real time, improved scheduling can create better utilization. Virtualization is one of the essential for cloud services. For example, the online movie service Netflix runs on Amazon's web servers. Virtualization allows a single computer to run multiple "guest" Oss by abstracting the hardware resources. The primary sources of energy consumption within a server are the CPU's, memories, disk drives, and Networks. There are many techniques that have been developed over the years.

The improvement of green cloud computing is intimate to the growth of green data centres, as the data centres are the root of cloud computing. A data centre is an enormous facility that consumes large amounts of power for data processing, storing the data which has an adverse effect on environment which results in increased emissions of carbon. The design of data centre noticed the significance of power efficiency. A simple data centre may need only a few kilowatts of energy. The carbon emissions of a data centre depends on the energy plants that really uses power to the data centre. The development of Green Cloud is related to evolution of green data centres are very important part of cloud computing. As per Koomey [1], the energy expended by data centres in 2010 is represented 1.3% of total consumption. The anticipated emissions of carbon by data centres worldwide in 2050 worldwide are around 42.8 billion metric tons. The main focus is on to reduce carbon emissions and thereby increasing the efficiency of energy. A Green Data centre is a place for reposting, transmission of data. In 1992, the US Environmental Protection Agency (EPA) [2] has organized a program as Energy star whose aim is to develop energy efficiency technologies in monitors, climate control equipment and so on. Microsoft recently announced a new renewable energy initiative, the Sunseap Project. This program, Microsoft first Asian clean energy transaction, will install solar panels on hundreds of rooftops in Singapore, which they claim will generate 60MW to power Microsoft's Singapore Data centre.

The remaining part of the paper is organised as follows: Part II presents a sketch of energy reduction strategies. In Part III, relevant research is deliberated. Part IV describes the software techniques, Part V describes energy consuming components and Part VI explains the conclusion.

II. RELATED WORK

A COMPLETE REVIEW OF ENERGY REDUCTION
 STRATEGIES:
Energy saving can be done in two ways: **using Hardware and using Software.**
One of the important issue addressed in this paper is energy saving. There are huge numbers of techniques [3] suggested by researchers in the previous papers in which some are software based and few are hardware based. Cloud complex system has different components i.e. modelling, simulation, analysis, and virtualization. There are different methods whose primary aim is to provide energy efficiency without having any performance issues. And, also the performance of each strategy is measured by different parameters.
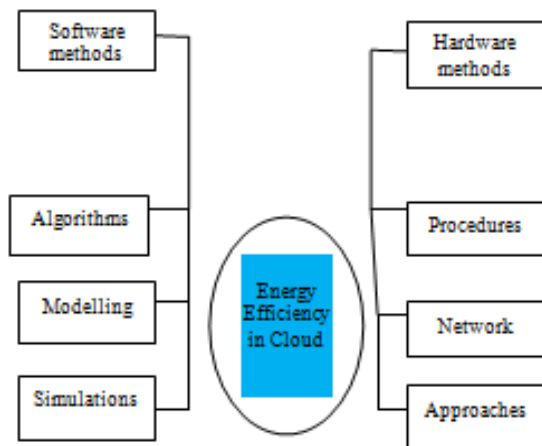

Figure 1. Energy saving ways in cloud computing**.**

Hardware methods:
DVFS (Dynamic Voltage Frequency Scaling):
An approach which shows the relation between voltage and frequency is DVFS approach. The relativity between these quantities is given as P=V2.f [4]. Whereas P defines power consumed, v defines voltage and f defines frequency. It's noted that server needs 70% power when it is not processing data [5] which has a great effect in scaling down the power. This approach solves the problem in a well-defined manner.
It results in development of resource utilization and scaling down the usage of power for completion of work. The energy usage of CPU is calculated by square of the voltage and frequency of the system. It is also called as power aware scheduling algorithm [6].

Suitable supply voltages has to be chosen to lessen the energy usage without contravening the SLA [7].In Cloud Sim [8], Million Instructions per second (MIPS) and frequency are directly associated. There are three strategies effects in energy reduction. The energy consumed is measured by multiplying the voltage square with the system frequency [9]. There are three strategies results in reduced energy consumption: low DVFS, Adaptive DVFS, Advanced DVFS to allocate appropriate MIPS rate to real time service [10].
         DVFS can be operated in four different ways [11]:
a) Frequency level-low
b) Frequency level – high
c) CPU – available frequency
d) Selecting frequency – dynamically.

Software Method:
Virtualization:
It is important power efficient method which requires sharing of physical component with several instances of many operating systems. Memory in virtualization and CPU are required to maintain the performance. It is one of the efficient methods to reduce energy. It provides resource utilization efficiently.

Network Method:
With the growing requirement of power consumption, several methods are incorporated from the list of various resources.
Clustering with power efficiency:
It is one of the important strategies which are about the behaviour of the nodes. In clustered structure, the energy required in inter and intra communication is reduced. An algorithm is designed to implement the power reduction method. Wireless sensor network are designed with energy efficient clustering to meet the requirements [12].Sensors in wireless network are arranged in clusters. Each cluster has a node called Cluster Head (CH). Each CH accumulates the sensed data from its sensor nodes to be transmitted to a base system (BS).Energy consumption is an important thing for WSN.

Load Balancing Techniques:
A novel method that encourages networks and resources by giving a maximum throughput with minimum response time [13].Traffic is split between servers; data can be sent and received without higher hindrance. Many types of algorithms are possible that favours in traffic loaded between numbers of available servers. Carton, compare and balance, events-driven, etc. are few of balancing load methods.

III. POWER AWARE COMPILERS:

The alternate method to enhance the reduction of power consumption. In paper [14], it is stated that energy E,

absorbed by program is stated by E = P X T, where T is the number of execution cycles of the program and P is the average power. The average power P is given by P = $\frac{1}{2}.C.vdd^2.f.D$, where C is the load capacitance, vdd the supply voltage, f the clock frequency and D the transition density.

The various forms and strategies to reduce power consumption through power aware compilers are:

Activities of the instruction bus: In the CMOS circuits, power is dissolving in a gate when the gate output varies from 0 to 1 or from 1 to 0. [15]

2. Dynamic voltage scaling: It is used mainly in embedded Systems. Its main logic is to change the power in few places. Even though power is reduced, it doesn't lead to Performance deterioration. [15]

3. Bit switching minimization: when the bits switches on Control and data bus maximizes the usage of power Consumption [15].

4. Modulating the memory access: In memory, memory Subsystems cause huge power consumption.

IV. POWER AWARE CLOUD COMPUTING:

*"If the cloud were a country, it would have the fifth largest electricity demand in the world" [16].*According to Gary cook directed in his paper "How clean is your cloud? Nevertheless, in some cases more energy is consumed than doing same computation on a personal computer. For instance, according to Music Tank Report, streaming an album in the network several times can cost more energy than the manufacturing and production of its CD equivalent [17]. Energy consumed in watching a movie in a laptop using network is more than using a DVD.
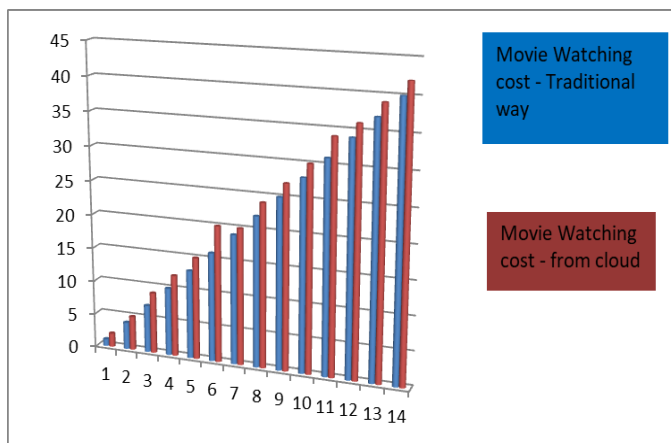

Figure 2. Energy Consumption for watching a movie

There are many ways of watching a movie with many ways. Streaming an video over the network uses more energy than the CD equivalent. Many research has been done to find out the energy consumption and still it is an unsolved question as it is difficult to find out the power consumption in cloud. Watching a movie once on the cloud will consume less energy than delivering it by DVD. Watching the same movie 6 times on the cloud will consume more power than watching it with the DVD.

V. SHUT DOWN UNUSED COMPONENTS

Powering off unused devices or machines is one of the techniques to reduce consumption of energy. This can be achieved with two methods with its own pros and cons. The primary is to switch off the devices which are not used which will allow a fast run back to state which will lead to reduced consumption of energy. The second method is to switch off the entire system and switch on when it is required.

Powering off few components	Powering off the system itself
Saving of energy is low	Better
Components which are on consumes energy	Entire system will be off
It will go back to run state faster	Slower

Power will be saved by many organizations by adopting above approaches to implement green cloud.

VI. SUMMARY AND CONCLUSION

An increased energy consumption from resources will lead to higher CO_2 emissions. More work is taken place in area research to reduce energy consumed by components of the cloud and to adopt green cloud, which is eco friendly. In this paper, many techniques discussed to save power in cloud and explaining the power aware compilers and so on. In [18],review of migration techniques is used for energy reduction in cloud.This paper discusses about the various approaches to implement green cloud. There are three methods to implement cloud: software approaches, network approaches are hardware approaches.

REFERENCES

[1] Jonathan Koomey, "Implications of historical trends in the electrical efficiency of computing", IEEE Annals of the History of Computing", vol-33, 2011.

[2] A. Elgelany, "Integrated framework for green ICT: Energy efficiency by using effective metric and efficient techniques for green data centres", Ph.D. dissertation, Comp. Sci., Sudan University of Science & Technology, 2015.

[3] Shaden M Alismail,"Review of Energy reduction Techniques for Green Cloud Computing", IJACSA, Vol 7,No.1,2016.

[4]   Altar Ur Rahman, "Energy efficiency techniques in cloud Computing", International Journal of CSIS, vol.14, No.6, June 2016.

[5]   H. Rong,H, H.Zhang, s.xiao, c.Li and c.Hu, "optimizing energy consumption for data centers",vole 58, pp. 674-691, 2016.

[6]   R.M. Calheiros, R. Ranjan, "CloudSim: A tool kit for modelling and simulation of cloud computing environment & evaluation of resource Provisioning nalgorithms", Journal – Software Practice & Experience, vole 41, no.1, pp. 23-50, Jan 2011.

[7]   N. Kord and H. Haghighi, "An energy-efficient approach for virtual machine placement in cloud based data centers," in Proc. 5th Information and Knowledge Technology Conf., 2013, pp. 44–49.

[8]   K.H Kim, A Beloglazov," Power aware Provisioning of virtual machines for real time cloud service",vol.23,pp. 1491-1505, 2011.

[9]   Vrunda J Patel, Hitesh Bheda," Reducing Energy Consumption with DVFS for Real time services in Cloud Computing",IOSR Journal of Computer Engineering, e-ISSN:2278-0661,p-ISSN:2278-8727.

[10] Liang-Teh Lee, Kang-Yuan Liu, Hui-Yang Huang and Chia-Ying Tseng "A Dynamic Resource Management with Energy Saving Mechanism for Supporting Cloud Computing" Department of Computer Science and Engineering, Tatung University, Taiwan.

[11] Florence AP, shanthi V," Energy Conservation using Dynamic voltage frequency scaling for computational cloud", Article, Scientific World Journal, 2016.

[12] Abdul Majeed, Munam Ali shah, "Energy Efficiency in big data Complex systems", Article, 2194-3206, 2015.

[13] R. Shinmonski, "Windows 2000 & win server 2003 clustering & load Balancing", CA, USA (2003), P2, 2003.

[14] Hesham Hassan,Ahmed Shawky Moussa," Power Aware Computing Survey", International Journal of Computer Applications,Vol -90, 2013.

[15] Dmitry Zhurikhin, Andrey Belevantsev, Arutyun Avetisyan, Kirill Batuzov, and Semun Lee, 2009, ―Evaluating power-aware optimizations within GCC compiler‖, GCC Research Opportunities workshop, GROW.

[16] Gary Cook, 2012, ―How Clean is Your Cloud? ‖ catalysing an energy revolution.

[17] Dagfinn Bach, 2012, ―MusicTank Report- Dark Side of the Tune - The Hidden Energy Cost of Digital Music.

[18] Navneet Singh, Dr Vijay Dhir, "A Literature Review: Efficient VM migration techniques for energy reduction in cloud computing", International Journal of Advanced Research in Computer Science, Volume 8, No. 9,2017

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