ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

A Review on Energy Conservation Approach in Green Cloud Computing Using Software Architecture

Darpan Agarwal, Kunal Bidkar

TE Student, Dept. of Computer Engineering, Sinhgad Institute of Technology and Science, Narhe, Pune University, Pune, Maharashtra, India.

BE Student, Dept. of Computer Engineering, Sinhgad Institute of Technology and Science, Narhe, Pune University, Pune, Maharashtra, India.

ABSTRACT: Cloud Computing is one of the most popular emerging technology in today's world.The increase in demand of customer for computing services results into increase in Data Centres deployment.Data centres consume more energy and emits more CO_2 .Goal is not only to save energy resources for future use,but also to reduce CO_2 emission which causes global warming. This paper proposes a software architecture approaches in Green cloud computing to reduce energy consumption caused by data centres.Software architects must design Software's,Techniques and Algorithms like Energy-Aware-Scheduling,Green-Scheduling Algorithm,Smart-Traffic Routing Algorithm, and Virtualization Technique which are more aware of energy consumption.

KEYWORDS: Cloud computing, green computing, energy consumption, CO2emission, virtualization, software architecture, VM migration, DVFS, green scheduling algorithm.

I. INTRODUCTION

Cloud Computing is one of the most popular emerging technologies in today's world. It provides on-demand services, software, storage and computation on the pay-as-you-go basis [3].The customer only have to pay as they have used. Day to day usage of cloud computing in every field increases rapidly. The increase in demand of cloud computing services encouraging the cloud service providers e.g., Google, Microsoft, Yahoo!, etc. for more data centres deployment. People are doing a lot of surfing these days for single Google search engine query, Google uses large data centres that comprise thousands of servers as shown in Fig 1 that why query takes only 0.2 seconds to resolve[1].Huge amount of power is required for running these data centres and emits CO_2 .

According to Google's earnings reports, the company has spent US$1.9 billion on datacentres in 2006, and US$ 2.4 billion in 2007 [3] for the same purpose.

As mentioned in [3], the total power consumption of the data centres in 2012 was around 38 Giga Watt (GW) and this is around 63% more than the power consumption of 2011.IBM estimate, the power demanded worldwide by data centres currently stands at 100 billion kWh a year, and data centres are one of the fastest-growing users of power [4].Hence,there is a need to implement energy efficient computing i.e. "Green Cloud Computing". Green Computing is an overwhelming need for environment friendly computational framework development.

According to McKinsey report [3],"The total estimated energy
Bill for data centres in 2010 is 11.5 billion and energy costs in a typical data centre double every five years". The fact that electricity consumption is set to rise 76% from 2007 to 2030[7] and data centres are the main contributors of an important portion of this increase. Day by day increase in demand of cloud computing services makes it necessary to move towards Green computing so the power consumption and CO_2 emission

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

can be reduced. The main goal of green cloud computing is to develop energy efficient resources, computing techniques and software application with low cost. The research community has provided a range of software and hardware solutions. Software solutions such as virtualization in the clouds, VM migration etc[5].

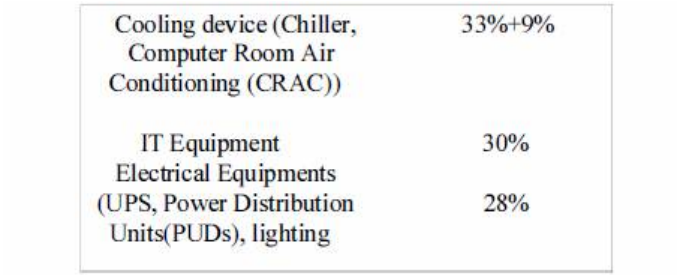

Fig.1. Energy consumption in one Google search [1]

Table 1.Comparison of significant cloud data centres [7]:

Cloud data centers	**Location**	**Estimated power usage effectiveness**	**Percentage of dirty energy generation**	**Percentage of renewable electricity used**
Google	Lenoir	1.21	50.5% coal,38.7% nuclear	3.8
Apple	Apple, NC	–	50.5% coal,38.7% nuclear	3.8
Microsoft	Chicago, IL	1.22	72.8% coal,22.3% nuclear	1.1
Yahoo	La Vista, NE	1.16	73.1% coal,14.6% nuclear	7

The above table illustrates the Cloud Data Centres with their Power Usage effectiveness and percentage of dirty energy generation and percentage of renewable electricity used. Google's Data Centre is located in Lenoir and 1.21 kW and has 50.5 % coal and 38.7% nuclear dirty energy generation and the percentage of renewable electricity used is 3.8%. Similarly, the mapping of other Data Centres is done with these parameters and shown in the tabular format.

II. RELATED WORK

Reduction in Power consumption of cloud computing has become a challenging and innovative research topic in current scenario**.** Virtualization technology play an important role to improves power efficiency of data centers by enabling the assignments of multiple virtual machines (VMs) to single server. Another way for green computing is through service level agreement SLAs which is established between the consumer and the service provider before allocation of infrastructure.

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

Following below, illustrates the percent of power consumption by each Datacentre device:

Title of Paper	Identified Issues	Proposed Techniques	Tools/Algorithms Used	Virtualization (Yes/No)	Limitations
Energy Efficient Computing-Green Cloud Computing[1]	Power Consumption and CO_2 Emission.	Use of Energy Efficient Processors and Reduce CPU power dissipation.	Not Implemented	No	High Cost and tools implementation is complex
Green Cloud Computing[2]	High power consumption and high operational cost of data centers.	DVFS, MBFD and VM migration technique.	Green Scheduling Algorithm.	Yes	Large power dissipation by data centers and CO_2 emission.
Energy Saving Approaches for Green Cloud Computing: A Review[3]	Hungry Data Centers and large amount of CO_2 Emission.	Virtualization, Live Migration and VM Scheduling.	Associated analysis tool and empherical analysis approach.	Yes	Energy consumption during VM migrating.
The Green Cloud Effective Framework: An Environment Friendly Approach Reducing CO_2 Level[4]	High Energy Consumption and high carbon production.	Map Reduce and Distribution as per requirement.	Joule Sort and green data centers.	No	Lack of green data centers implementation techniques.
Green Cloud Computing :An Energy-Aware Layer in Software Architecture[5]	Energy Consumption and CO_2 Emission.	Virtualization, Self-Optimized Software applications.	Energy-Aware Scheduling and Smart traffic routing algorithm.	Yes	Self-optimized Softwares implementation is difficult.
An Energy-Saving Task Scheduling Strategy Based on Vacation Queuing Theory in Cloud Computing [6]	Turnoff the idle nodes consuming lot of powers.	Task scheduling and Analysis of energy consumption.	Vacation queuing model.	No	Complex Computation.

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

Green Cloud Computing and Environmental Sustainability.[7]	Reduce operational cost and energy consumption.	Resource Virtualization, Workload consolidation.	GMP, MP-MP, MCE-MP.	Yes.	Low Resource Utilization And Wastage of energy.
An Energy Aware Network Management Approach using Server Profiling in 'Green' Clouds[10]	Packet arrival rate, traffic volume and speed of server	Workload Allocation.	Opnet and NS-2	No	Costly.
A Review on Energy Efficient Techniques in Green Cloud Computing [8]	Improve Power Efficiency of data centers.	Virtualization and VM migration.	First fit, montecarlo and round robin.	Yes	Energy Consumption During VM migration.
Application of Green Cloud Computing for Efficient Resource Energy Management in Data Centers[9]	High energy cost and huge carbon footprints.	Power aware VM Scheduling, Resource provisioning and allocation algorithm.	Green Resource Allocator, VM manager and Green Negotiator.	Yes	Cooling Cost is High.

The above table shows the literature survey which is nothing but the work that has done before this paper. The table clearly illustrates the name/title of the paper, the issues identified by that paper, the techniques or the solutions that were proposed by the paper, whether implementation was done or not, whether virtualization technology was used and finally, the limitations of the papers. All these parameters are identified, analysed and plotted in the tabular format.

III. PROPOSED SOLUTION

Proposed a new model with a component called trigger engine which uses pre-processed data for automatic live migration of virtual machines. The whole architecture of the model can be clearly understood by the following fig 5.1.

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

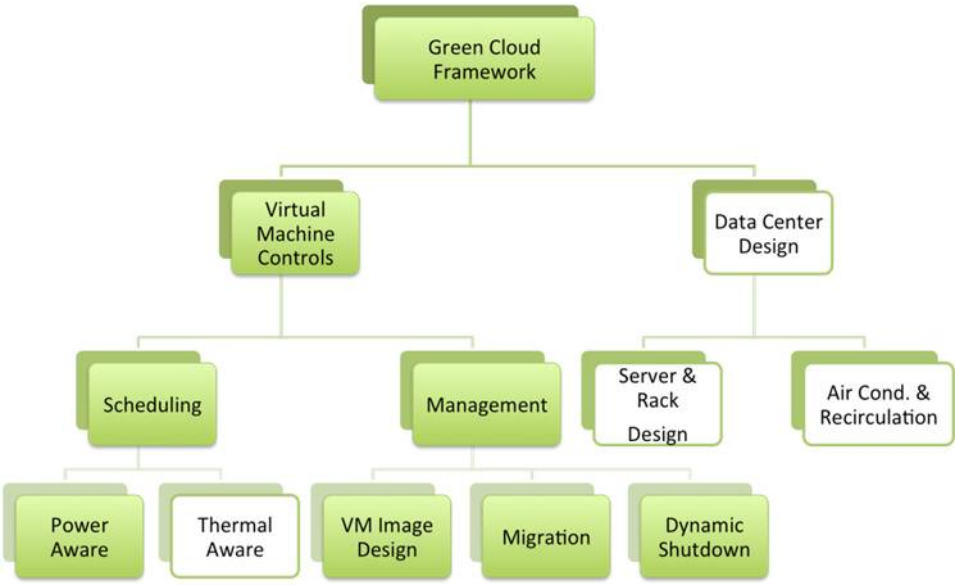

Fig 5.1 Green Cloud Frameworks

Fig 5.1 consists of Architecture diagram for Green Cloud Framework where in the framework is divided into two branches Virtual Machine Controls and Data Center Design. Scheduling and Management are the activities done under Virtual Machine Controls. The components such as Server and Rack Design and Air Cond. And recirculation come under the Data Center Design. Green Cloud Framework consists of Power Aware and Thermal aware components. And Management consists of modules such as VM Image Design, Migration and Dynamic Shutdown. Virtualization is a way to abstract the hardware and system resources from an operating system.
Dynamic Voltage and Frequency Scaling (DVFS) within Clusters and Supercomputers. By using DVFS one can lower the operating frequency and voltage, which results in decreased power consumption of a given computing resource considerably.

Fig 5.1.1.1 Virtualization Technique

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

Fig 5.1.1.1 shows Virtualization Technique. The diagram consists of a Virtualization Management System Center. And it has technologies such as Presentation Virtualization, Desktop Virtualization, Network Virtualization, Storage Virtualization, Server Virtualization and Application Virtualization.
Hence, these are the technologies and the products that are supported by Virtualization management System center.

VIRTUALIZATION AND LIVE M IGRATION

One of the techniques that are being widely used in cloud environment is virtualization. Virtualization helps in decreasing the hardware and operating cost by virtually running multiple operating systems parallel on a single system. Live migration refers to moving the virtual machines from one physical server to another transparently. The migration of virtual machines is found to be a useful technique for making the systems more energy efficient. The fundamental aspects of virtualization technologies employed in Cloud environments is resource consolidation and management.

Map Reduce

One stack of service provider to produce their service after completion of the users work. It is time saving process and also helps to low carbon producing. In this process, the processor pool when its goes to the ideal stage temporarily, it automatically power turns off with the help of power sensor machine and when it comes to active mode the power back again. In this process, power consumption is consistently maintained with check and thus ensuring revenue margin to some high extent. It has been observed that the process is also effective for ensuring low CO2 emissions.

VM Management

Idle physical machines in a Cloud can be dynamically shutdown and restarted to conserve energy during low load situations. This concept of shutting down unused machines will have no effect on power consumption during peak load as all machines will be running.

The use of live migration features within Cloud systems is a recent concept. Live migration is presently used for proactive fault tolerance by seamlessly moving VMs away from failing hardware to stable hardware without the user noticing a change in a virtualized environment. Live migration can be applied to Green computing in order to migrate away machines. VMs can be shifted from low load to medium load servers when needed. Low load servers are subsequently shutdown when all VMs have migrated away, Thus conserving the energy required to run the low load idle servers.

III. PSEUDO CODE

```
Algorithm - Power based scheduling of VMs
FOR i = 1 TO i _ jpoolj DO
pei = num cores in pooli
END FOR
WHILE (true)
FOR i = 1 TO i _ jqueuej DO
vm = queuei
FOR j = 1 TO j _ jpoolj DO
IF pej _ 1 THEN
IF check capacity vm on pej THEN
schedulevm on pej
pej 1
END IF
END IF
END FOR
END FOR
wait for interval t
END WHILE
```

ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

IV. CONCLUSION AND FUTURE WORK

Cloud Computing is dynamically scalable to provide on demand services which need more resources deployment more energy consumption and result into more CO2 emission. Architectural approach in softwares run on cloud is important method to reduce energy consumption caused by data centers. Software Architects must design softwares and algorithms like energy aware scheduling, green scheduling algorithms, smart traffic routing algorithms, virtualization techniques which are more aware of energy consumption.

REFERENCES

[1] Anubha Jain, ManojMishra,Sateesh Kumar Peddoj,NitinJain, "Energy Efficient Computing- Green Cloud Computing", IEEE, 978-1-4673-6150-7/13/$31.00 2013

[2] Gayathri, "Green Cloud Computing",Chennai and Vivekanandha College of Technology for women, Third International Conference on Sustainable Energy and Intelligent System Volume: 02 , Issue: 08 , pp.1650-1654, Nov-2015

[3] BhartiWadhwa, AmandeepVerma. "Energy Saving Approaches for Green Cloud Computing: A Review" Proceedings of 2014 RAECS UIET Panjab University Chandigarh, pp. 1-6, 06 - 08 March, 2014.

[4] Samiran Roy, SomsubhraGupta,"The Green Cloud Effective Framework: An Environment Friendly Approach Reducing CO2 Level", Proceedings of 2014 1st International Conference on Non-Conventional Energy (ICONCE 2014).

[5] RasoulBeik,"Green Cloud Computing: An Energy-Aware Layer in Software Architecture", IEEE,978-1-4577-1964-6/12/$31.00 ©2012.

[6] ChunlingCheng,JunLi,and Ying Wang,"An Energy-Saving Task Scheduling Strategy Based on Vacation Queuing Theory in Cloud Computing", TSINGHUA SCIENCE AND TECHNOLOGY ISSN 1007-0214 04/11 Volume 20,pp. 28-39,February 2015.

[7] Pragya,ManjeetGupta,"A Review on Energy Efficient Techniques in Green Cloud Computing",Pragya et al., International Journal of Advanced Research in Computer Science and Software Engineering, pp.550-554, March – 2015.

[8] YuvapriyaPonnusamy, S Sasikumar,"Application of Green Cloud Computing for Efficient Resource Energy Management in Data Centres",YuvapriyaPonnusamy et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 3 (5) ,pp.5101 – 5107, 2012

BIOGRAPHY

Darpan Agarwalis a third year engineering student in the Computer Engineering Department, Sinhgad Institute of Technology and Science. He got 27th rank in Pune in Indian Engineering Olympiad (Computer Science). He had qualified till semi-finals in IT Olympiad. His research interests are Cloud Computing, Green Cloud and Networking.

Kunal Bidkar is a final year engineering student in the Computer Engineering Department, Sinhgad Institute of Technology and Science. He was 11th in Pune in Indian Engineering Olympiad (Computer Science).
He got his first paper published in IJARCSMS journal which was related to Information Security. Currently, he is doing his BE project on Cloud Virtualization. And the project title is "Remote Triggered Software Defined Radio". His research interests are Cloud Computing, Databases, Information Security and Web Applications.